

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

STARA S.A.-INDÚSTRIA DE IMPLEMENTOS AGRÍCOLAS,
Petitioner,

v.

AGCO CORPORATION,

Patent Owner.

Case IPR2024-_____
Patent No. 11,665,989 B1

Declaration of Dr. Paul R. Weckler

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DECLARATION OF PAUL R. WECKLER, PH.D.

I, Paul Weckler, declare as follows:

I. QUALIFICATIONS

1. My name is Paul R. Weckler. I am currently a Professor Emeritus in the Department of Biosystems & Agricultural Engineering at Oklahoma State University, Stillwater, Oklahoma.

2. I have been asked to provide my opinions in this matter regarding U.S. Patent No. 11,665,989 (the “’989 patent”) and certain prior art to the ’989 patent. I have been asked to give my opinions regarding the teachings and scope of the prior art to the ’989 patent and whether those documents disclose the features of the ’989 patent.

3. In 1982, I received a Bachelors in Science degree in Agricultural Engineering from California Polytechnic State University, San Luis Obispo, Calif. Afterwards, I attended Utah State University in Logan, Utah. In 1984, I received a Masters in Science degree in Agricultural & Irrigation Engineering from Utah State University. I then worked on my Doctorate at Oklahoma State University Stillwater, Oklahoma. In 1989, I received my Ph.D. in Agricultural Engineering from Oklahoma State University. I was a USDA National Needs Graduate Fellow.

4. I am a registered, professional engineer with over thirty years of experience in electromechanical, sensor and instrumentation engineering. I have over 34 years of post-doctoral experience in both academia and industry relevant to this matter. Attached hereto Exhibit 1003 is my curriculum vitae that describes further details on my education, experience, publications, relevant cases experience and other qualifications to render an expert opinion in this matter.

5. As a result of my experience, I have gained a detailed understanding of the technology that is the subject of this declaration. For example, my experience with agriculture implements and sensors is highly relevant to the subject matter of the '989 patent. I have studied product designs for agriculture implements including all the features of the '989 patent. Through my education, training, and experience in agricultural engineering, I am fully qualified to provide opinions regarding the state of the art at the period of time of the invention, which I understand to be around the year 2016-2017 timeframe, how one of ordinary skill in the art at that time would have interpreted and understood the '989 patent, and how one of ordinary skill in the art at that time would have interpreted and understood the disclosure of prior art to the '989 patent.

6. I provide expert consulting services through ForensisGroup, Inc. ForensisGroup, Inc. charges between \$315 and \$365 an hour for my services depending on the type of service.

7. My compensation is not contingent upon the content of my testimony, or upon any outcomes or court proceedings. I have no interest, either current or anticipated, in the parties to the suit upon which the report, analysis and testimony may be based.

II. SCOPE OF WORK

8. I understand that a petition is being filed with the United States Patent and Trademark Office for Inter Partes Review (IPR) of U.S. Patent 11,665,989 (the “’989 Patent”) attached as EX1001, entitled “Implement Contouring Toolbar.”

9. I have been retained by Petitioner, Stara S.A.-Indústria De Implementos Agrícolas (“Stara”) to offer an expert opinion on the ’989 patent related to my experience and expertise. I have never worked with Stara before.

10. For purposes of this declaration, I have been specifically asked to provide my opinions on claims 1-4, 6-8, 10-13 and 15-18 of the ’989 patent. In connection with this analysis, I have reviewed the ’989 patent and relevant portions of the file history. I have also reviewed and considered various other documents in

arriving at my opinions, and I cite to them in this declaration. For convenience, the information relied upon in arriving at my opinions is listed in Appendix A.

III. LEGAL STANDARDS

11. I have been advised that the U.S. Patent Trial and Appeal Board (PTAB) will interpret the claims of the challenged patent using the same claim construction standard that would be used to construe the claims in a civil action under 35 U.S.C. 282(b), including construing the claims in accordance with the ordinary and customary meaning of such claims as understood by one of ordinary skill in the art and the prosecution history pertaining to the patent. 37 C.F.R. § 42.100(b) (2020). “In determining the meaning of [a] disputed claim limitation, we look principally to the intrinsic evidence of record, examining the claim language itself, the written description, and the prosecution history, if in evidence.” *DePuy Spine, Inc. v. Medtronic Sofamor Danek, Inc.*, 469 F.3d 1005, 1014 (Fed. Cir. 2006).

12. I have been advised that claim terms are given their plain and ordinary meaning as would be understood by a person of ordinary skill in the art at the time of the invention and in the context of the entire patent disclosure. *Phillips v. AWH Corp.*, 415 F.3d 1303, 1313 (Fed. Cir. 2005) (*en banc*). “There are only two exceptions to this general rule: 1) when a patentee sets out a definition and acts as

his own lexicographer, or 2) when the patentee disavows the full scope of a claim term either in the specification or during prosecution.” *Thorner v. Sony Comput. Entm’t Am. LLC*, 669 F.3d 1362, 1365 (Fed. Cir. 2012).

13. I have been advised that to prevail in a challenge to the patentability, a Petitioner must demonstrate by a preponderance of the evidence that the claims are unpatentable. 35 U.S.C. § 316(e). I have been advised that in an IPR, the Petitioner has the burden from the onset to show with particularity why the patent it challenges is unpatentable. *Harmonic Inc. v. Avid Tech., Inc.*, 815 F.3d 1356, 1363 (Fed. Cir. 2016).

14. I have been advised that a claim is unpatentable for obviousness if, to one of ordinary skill in the pertinent art, “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.” *KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 406 (December 2016) (quoting 35 U.S.C. § 103(a) (2006)).

15. I have been advised that the question of obviousness is resolved on the basis of underlying factual determinations, including “the scope and content of the prior art”; “differences between the prior art and the claims at issue”; and “the level of ordinary skill in the pertinent art.” *Graham v. John Deere Co.*, 383 U.S. 1, 17–

18 (1966). When conducting an obviousness analysis, the PTAB will consider a prior art reference “not only for what it expressly teaches, but also for what it fairly suggests.” *Bradium Techs. LLC v. Iancu*, 923 F.3d 1032, 1049 (Fed. Cir. 2019) (citation omitted).

16. I have been advised that a patent claim “is not proved obvious merely by demonstrating that each of its elements was, independently, known in the prior art.” *KSR*, 550 U.S. at 418. An obviousness determination requires finding “both ‘that a skilled artisan would have been motivated to combine the teachings of the prior art references to achieve the claimed invention, and that the skilled artisan would have had a reasonable expectation of success in doing so.’” *Intelligent Bio-Sys., Inc. v. Illumina Cambridge Ltd.*, 821 F.3d 1359, 1367–68 (Fed. Cir. 2016) (citation omitted); *see KSR*, 550 U.S. at 418 (for an obviousness analysis, “it can be important to identify a reason that would have prompted a person of ordinary skill in the relevant field to combine the elements in the way the claimed new invention does”). Also, “in appropriate circumstances, a patent can be obvious in light of a single prior art reference if it would have been obvious to modify that reference to arrive at the patented invention.” *Arendi S.A.R.L. v. Apple Inc.*, 832 F.3d 1355, 1361 (Fed. Cir. 2016).

17. I have been advised that “[a]lthough the *KSR* test is flexible, the Board ‘must still be careful not to allow hindsight reconstruction of references . . . without any explanation as to how or why the references would be combined to produce the claimed invention.’” *TriVascular, Inc. v. Samuels*, 812 F.3d 1056, 1066 (Fed. Cir. 2016) (citation omitted). Further, an assertion of obviousness “cannot be sustained by mere conclusory statements; instead, there must be some articulated reasoning with some rational underpinning to support the legal conclusion of obviousness.” *KSR*, 550 U.S. at 418 (quoting *In re Kahn*, 441 F.3d 977, 988 (Fed. Cir. 2006)).

18. I have been advised that in order to rely on a document as a basis for challenging claims, the document must qualify as prior art under 35 U.S.C. §§ 102(a) or (b).

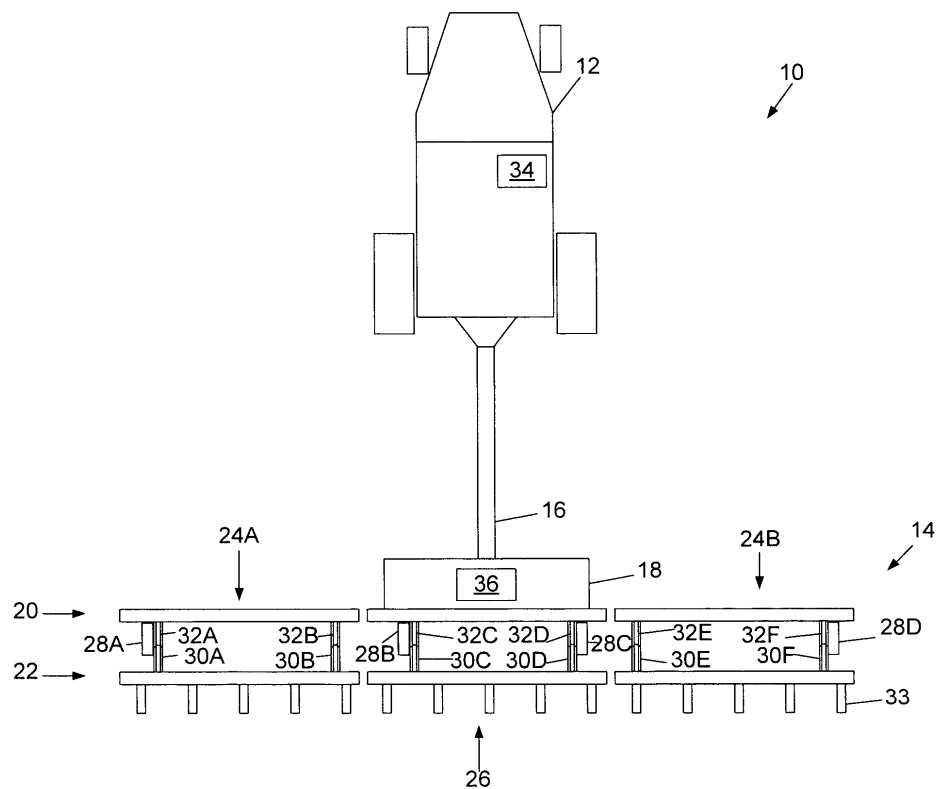
19. Accordingly, I have applied the foregoing concepts to the best of my ability in rendering my opinions and other testimony in this declaration.

IV. OVERVIEW OF THE '989 PATENT

20. I will first describe the Background of the '989 patent. The '989 patent is titled, IMPLEMENT CONTOURING TOOLBAR, and directed to an agricultural or farm implement.

A. The '989 Patent Disclosure

21. The '989 patent describes a farm implement that has a toolbar coupled to a frame member with a hinged joint, and an actuator configured to move the toolbar based on the sensed position of the toolbar. EX1001, Abstract. The farm implement 14 is shown below in Fig. 1 of the '989 patent.



22. **FIG. 1**

The implement could be a cultivator or planter.

23. As I stated above, the purpose of the invention '989 patent was to improve handling of the implement on uneven, undulating or contoured fields -- a

field may comprise gullies and/or terraces. Id., Col. 1: 10-18. The implement includes an actuator configured to maintain the tools (e.g., coupled row units 33) properly engaged with the soil (e.g., seeding) despite the contoured surfaces of the field. Id., Col. 2:2-15. The toolbar system uses the sensed position of the toolbar to enable in-field adjustment by the actuator.

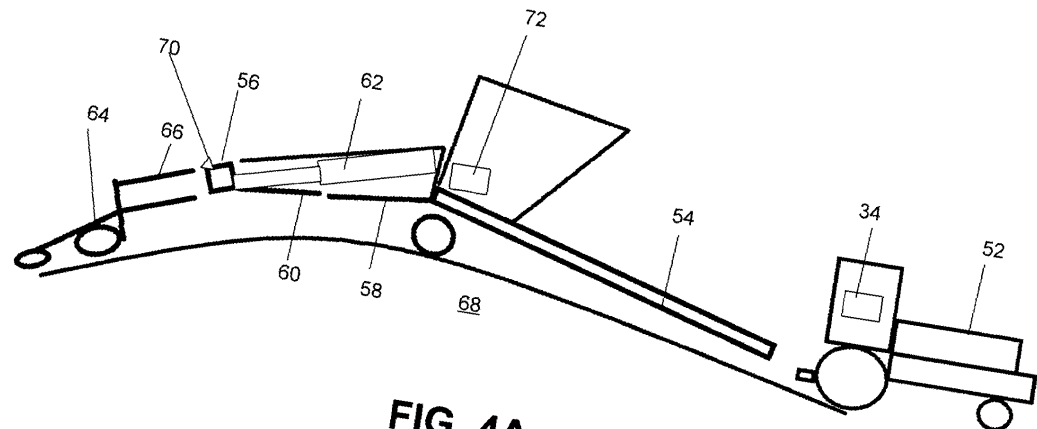


FIG. 4A

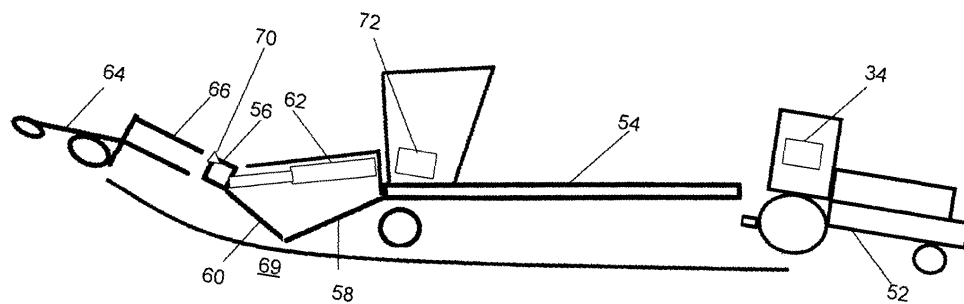


FIG. 4B

24.

25. Figs. 4A-4B illustrate a planter being towed. As shown above, the actuator 62 can extend (Fig. 4A) to rotate the toolbar 56 relative to the planter

26. I note that the '989 patent discloses little detail regarding the claims hinged coupling and the sensors. Fig. 3 is the only figure showing any detail of the hinged coupling.



-15-

coupled to the toolbar 38A (e.g., via a hinged connection at the bracket arm 30 (FIG. 2) and the bracket arm 42). The actuator 32A-1 provides for retracting and extending movements that cause the toolbar 38A to rotate relative to the frame member 20A.” I note that in Fig. 2, there is no reference 30, but rather, 30A refers to a bracket arm. Col. 3, line 43. No hinged joint is actually shown. I mention this because the '989 patent is not limited to any particular kind of hinged joint and the hinged joint was well-known and itself, is not an invention.

28. The patent discloses that the system is always focused on controlling the measurement of the distance X, shown in Fig. 3. X is shown as the distance from the toolbar to the ground, and the distance that the tools are penetrating into the ground, and a 25 degree angle measured from a tangent to a wheel 28A-1. The angle of the tool is not discussed other than to say that the toolbar should follow the contour of the ground

29. The patent discloses using sensors to detect the position of the toolbar, and by extension, the position of the tools, using one or more sensors. EX1001 6:1-7:40. In one embodiment, the sensors 48 and 50 may each provide an angle value for every programmed amount of sensed rotation. As shown above, sensor 48 is positioned at the joint between the toolbar 38A and the frame 20 while sensor 50 is positioned on the toolbar. The control of the actuation is based on the sensed

position of the toolbar. *Id.* 6:22-24. “In general, to enable the toolbar 38A (and hence toolbar 38A) to follow the contour of the field, sensor information is received about the (relative) position of the toolbar 38A (and by extension, the relative position of the 30 row unit 33B) relative to the ground. A row unit sensor, such as sensor 50, is used for the contouring operation. In one embodiment, at least one row unit sensor 50 is used, though in some embodiments, there may be a row unit sensor 50 per every row unit 33B.” *Id.* 6:26-34. “The sensor 48 senses the angular position and/or change in angular position between the toolbar 38A and the frame member 20. The sensor 50 may be located at the pivot 60 point between the linkage 44 and the toolbar 38A, and used to sense the position of the toolbar 38A (and hence the position of the row unit 33B) relative to the ground.” *Id.* 6:57-63. Thus, the sensors of the '989 patent can sense the position relative to the ground by sensing a position of the toolbar relative to the frame. In other embodiments, non-contact type, electromagnetic sensors, including ultrasonic, radar, or lidar type sensors, or as a combination of angular position and non-contact types. For instance, the electromagnetic sensors may detect the position of the ground (e.g., via transmittal to and reflection from the ground). *Id.* 7:26-32. In another embodiment, an angle sensor 70 positioned on or near the toolbar 56 and row unit 64 senses a change in position of the toolbar 56 (and hence row unit 64) relative to

the ground. Thus, the measurement of the position of the toolbar relative to the ground can be accomplished directly or indirectly.

30. As I explain below, hinged joints coupling a tool bar to an implement frame were well known and it would have been an obvious design choice to the skilled person in the art to use a hinged joint in a farm implement. Also, as explained herein, the arrangement disclosed by the '989 patent was known prior to the date of the invention.

B. Claims of the '989 Patent

31. The '989 patent claims are merely directed to obvious combinations of known components. Claim 1 of the '989 patent is representative and recites the following:

1. A system, comprising:
 - an elongate frame member;
 - an elongate toolbar coupled to the frame member via a hinged joint, the toolbar oriented parallel to the frame member;
 - a plurality of row units coupled to the toolbar;
 - a first sensor configured to sense a position of the toolbar relative to ground;
 - a second sensor configured to sense an angle of the toolbar relative to the frame member; and

an actuator coupled between the frame member and the toolbar, the actuator configured to rotate the toolbar relative to the frame member based on a sensed position of the toolbar, wherein the toolbar remains parallel to the frame member throughout the rotation of the toolbar.

32. To provide an implement that keeps tools engaged with the ground, the claims recite an arrangement for controlling the tool bar position relative to the ground. The arrangement includes a hinged joint coupling the frame to the tool bar, and an actuator that is adapted to move the tool bar relative to the frame based on a sensed position of the tool bar. The position is sensed by two different sensors. The first sensor senses the position of the toolbar relative to ground. The second sensor senses an angle of the toolbar relative to the frame member. The claim does not say which position it uses or what the adjustment taken is. The claim merely states that the toolbar is “rotated” relative to the frame based on its position. Since there is a hinged joint connecting the toolbar to the frame, the hinge causes the toolbar to rotate about an axis (i.e., the frame).

33. This configuration was well-known prior to the '989 patent.

34. Claims 2-4, 6-8, 10-13, and 15-18 are also challenged. These claims do not add anything that appears to be novel. Claims 2-4, 6-8, 10-13, 15-16 and 18

depend directly or indirectly from claim 1. Claim 17 is an independent claims that has the same limitations of claims 1 and 2.

35. Claim 2 adds a controller configured to receive first and second signals from the first and second sensors and cause actuation of the actuator based on the first and second signals. The addition of such a controller would have been standard by the time of the invention.

36. Claim 3 adds a control component that actuates the actuator, wherein the controller is configured to cause actuation by sending a signal to the control component. This also would have been quite obvious because, at the time of the invention, varied controllers were available for controlling actuators, many of which would send a signal to the actuator to cause it to be controlled.

37. Claim 4 modifies claims 3 by adding that the control component comprises a control valve, an air valve, an electronic control component, a magnetic control component, *or* an electromagnetic control component. This also would have been quite obvious because, at the time of the invention, because control valves, air valves, electrical, magnetic and electromagnetic control components were well-known. For example, if the actuator was pneumatic, an air valve would be the natural control component to be used. Likewise, if the actuator were a linear motor, an electrical controller would naturally be used.

38. Claim 6 adds that the sensed position of the ground from the first sensor is used. This would have been obvious based on the prior art.

39. Claim 7 is the same as claim 3, except based on claim 6. Claim 8 is the same as claim 4, except based on claim 7. Therefore, Claims 7-8 would have been obvious for the same reasons.

40. Claim 10 adds additional sensors are electromagnetic sensors coupled to the frame member and/or the tool bar for sensing a position relative to a field surface (i.e., the ground surface). The sensors sense absolute elevation or change in elevation between the field surface and the toolbar or a combination the frame and the toolbar. As describe below, this was done prior to the invention.

41. Claim 11 adds that the additional sensors are used for actuating the actuator. As describe below, this was done prior to the invention.

42. Claim 12 is the same as claim 3, except based on claim 11. Claim 13 is the same as claim 4, except based on claim 12. Therefore, Claims 12-13 would have been obvious for the same reasons.

43. Claim 15 adds to claim 10 that the electromagnetic sensors are ultrasonic, lidar, or radar sensors. These sensors existed prior to the invention and would have been obvious design choices at the time.

44. Claim 16 merely adds that the angle of rotation of the tool bar be obtuse. Prior to the invention, there were many common ways for moving the toolbar to a safe position for transit (turning or going on to a road, for example), and one known way was to rotate the toolbar up over the frame, which necessarily would make the angle of rotation of the tool bar be obtuse.

45. Claim 18 adds only a support wheel to the frame. This was standard before 2016.

46. Claim 17 are also challenged. Claim 17 is an independent claim which mirrors claim 1 except the structural limitations of the farm implement are recited in the preamble instead of the body of the claim. Claim 17 also adds limitations that are covered by claim 2. Claim 17 would have been obvious for the same reasons that claims 1 and 2 would have been obvious.

C. Prosecution History of the '989 Patent

47. I have been advised that the examination process, or prosecution history, of the application that led to the '989 patent may be relevant to my analysis of the patentability of the claims.

48. I have been advised that the Application that became the '989 patent was filed as a PCT application on October 26, 2017, and claims priority to a

provisional application number 62/435,118, filed December 16, 2016. Therefore, I have been advised to use December 16, 2016 as the date of the invention.

49. The following is my understanding of certain relevant highlights of the prosecution history of the '989 patent.

50. The applicant filed two preliminary amendments prior to examination. Claim 1 as originally examined was listed as follows:

1. A system, comprising:

An elongate frame member;

An elongate toolbar coupled to the frame member via a hinged joint, the toolbar oriented parallel to the frame member;

a plurality of row units coupled to the toolbar;

a first sensor configured to sense a position of the toolbar relative to ground; and

an actuator coupled between the frame member and the toolbar, the actuator configured to rotate the toolbar relative to the frame member based on a sensed position of the toolbar.

Notably, claim 3 as examined recited:

3. The system of claim 1, further comprising a second sensor configured to sense an angle of the toolbar relative to the frame member.

EX1004 at 113.

51. All the claims were rejected as being either anticipated by or obvious in view of Casper et al. (US 8,573,319)[Deere I]. See Office Action dated June 24, 2021 (EX1004 at 106-110). In a July 29, 2021 response, the Applicant argued that Deere I was deficient because it did not disclose the same linkage as claims in claim 1. The Applicant argued:

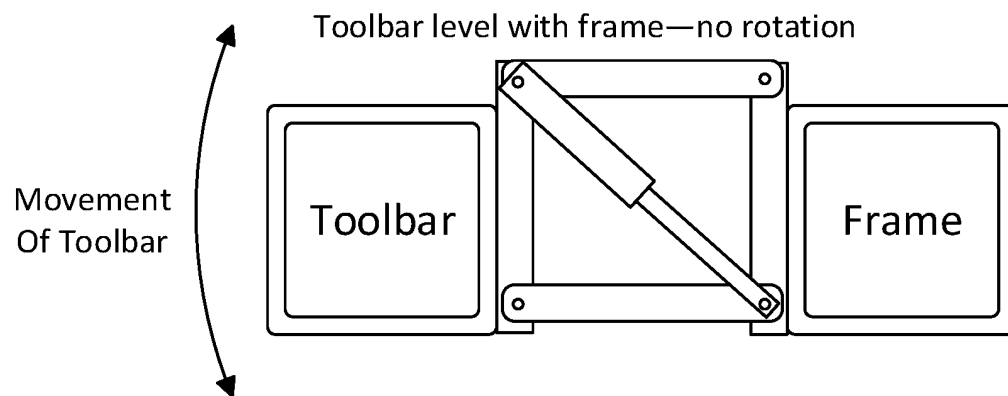
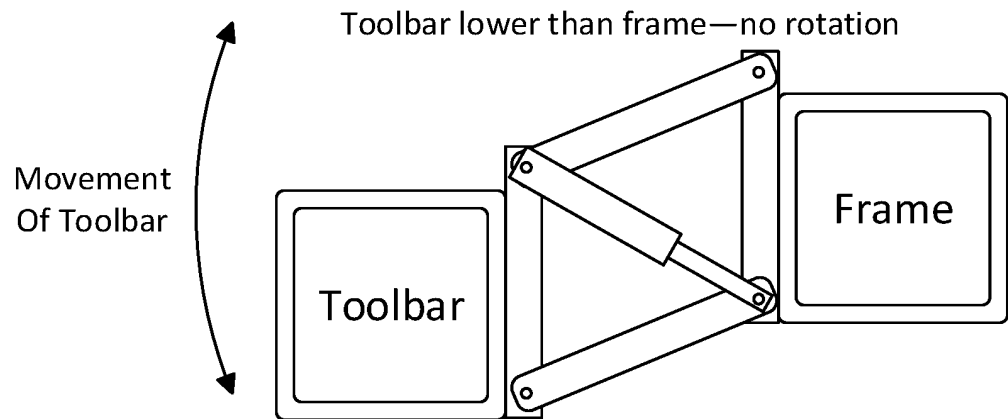
The Office relies on the actuator 300 as being configured to rotate the toolbar 85. However, because the toolbar 85 is connected by a parallel linkage, the toolbar 85 does not rotate relative to the second frame section 65. The toolbar 85 instead may be raised and lowered relative to the second frame section 65.

Therefore, Deere [I] does not disclose "an actuator ... configured to rotate the toolbar relative to the frame member." Furthermore, an actuator as claimed is not inherent in the structure disclosed in Deere [I].

Response at page 7 (EX1004 at 100).

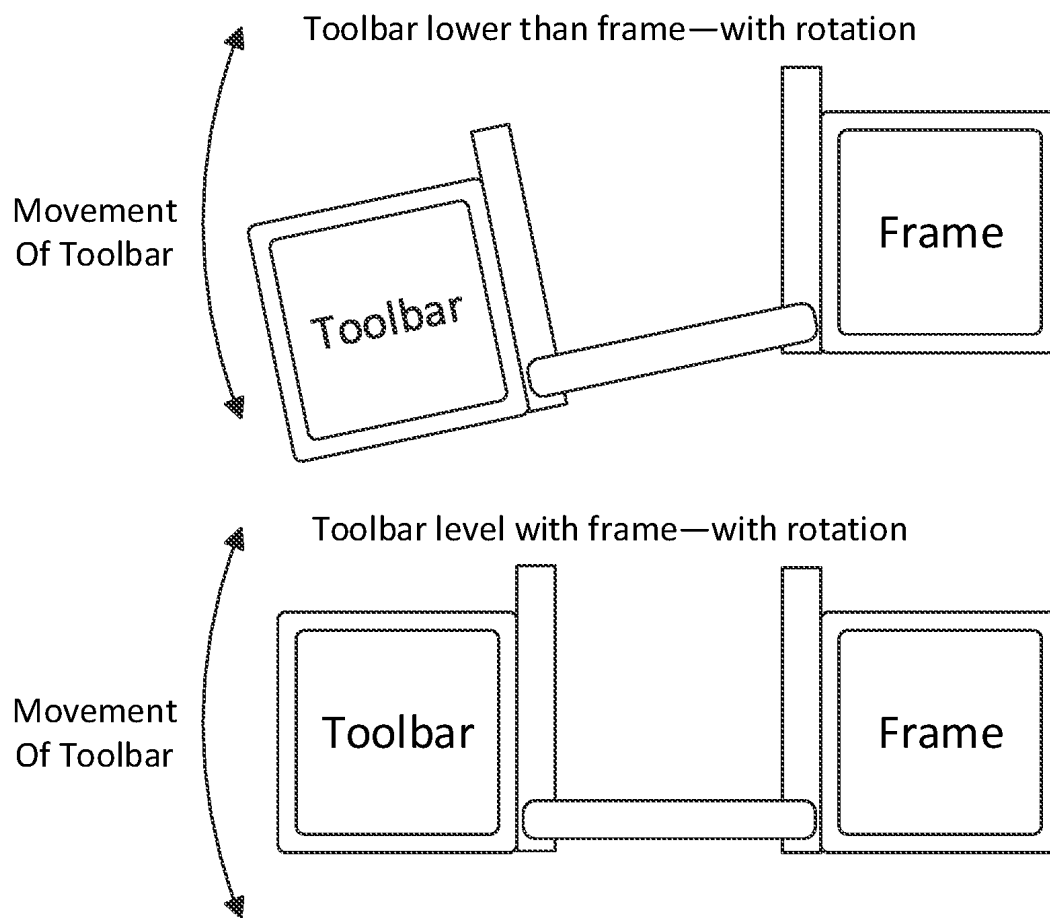
52. In response, the Examiner issued a Final Office Action rejecting the claims over the same references on October 28, 2021 (EX1004 84-93). The Applicant eventually appealed these rejections and made arguments to the Board differentiating Deere I because of its parallel type linkages that “revolved” the toolbar, instead of a hinged linkage that allowed rotation of the tool bar relative to the frame.

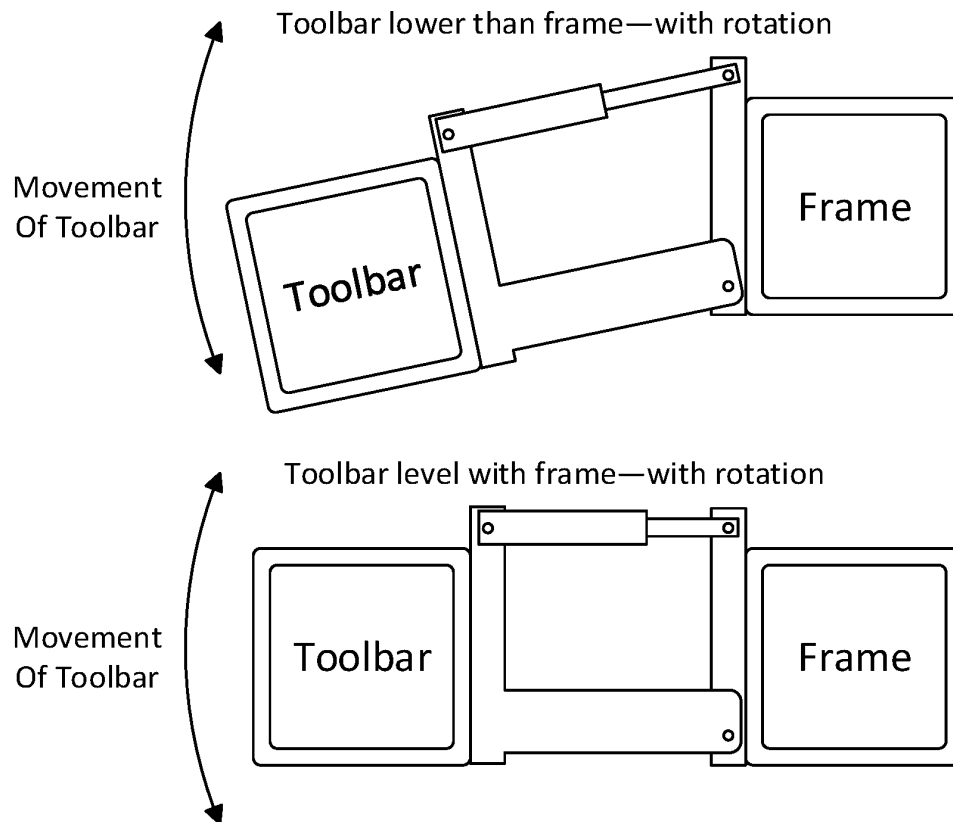
53. In the Appeal (EX1004 41-64), the Applicant submitted the following figures:



54.

PRIOR ART





EX1004 50-51.

55. In response to the Appeal, the Examiner issued a new Office Action on July 28, 2022, reopening prosecution. The claims were rejected over new art. The main claims were rejected as being anticipated by Gilstring (US 9,301,439). EX1004 at 34.

56. In response, the Applicant amended the independent claims to include:

“an actuator coupled between the frame member and the toolbar, the actuator configured to rotate the toolbar relative to the frame member based on a sensed position of the toolbar, wherein the toolbar remains parallel to the frame member throughout the rotation of the toolbar

EX1004 at 24.

57. The Applicant then argued that Gilstring discloses an implement for working soil having a frame 10 with a front section and a rear section connected at a pivot and by a hydraulic cylinder 15a, as seen in FIGS. 3a-3d. The two sections are approximately collinear in the positions shown in FIGS. 3a and 3c, and angled relative to one another in the positions shown in FIGS. 3b and 3d. The sections do not "remain[] parallel" to one another "throughout the rotation of the toolbar."

October 13, 2022, Response at page 5 (EX1004 at 27).

58. The Examiner issued a new Final Office Action rejecting the claims over new art. This time, the claims were rejected over Hubalek et al. (US 9,031,759) and Houck (US 2015/0230391). EX1004 at 14-18. Notably, the Examiner found that Houck anticipated the second sensor of claim 3. *Id.* at 17. In the Office Action, the Examiner made the finding that Houck disclosed a second sensor configured to sense an angle of the tool bar relative to the frame member (112), and a controller configured to receive first and second signals from the first

and second sensors and cause actuation of the actuator based on the first and second signals [0036-0037]. *Id.*

59. The Applicant had a pilot program after final interview and filed a response, which appears to have resulted in an agreement to allow the case. Not much is said about the interview, but in response, the Applicant added the features of claim 3 to claim 1 and argued that the Final Office Action did not reject claim 3 based on Hubalek, and therefore, Claim 1, as proposed to be amended, is not anticipated by Hubalek.

60. As for Houck, the Applicant argued that it had only parallel linkages and that it did not have a plurality of row units coupled with the tool bar. See February 17, 2023, Response at page 8-9 (EX1004 8-9).

The system has two different row units for each row: a tillage row unit 52, and a seeding row unit 62. Houck¶¶ [0028]-[0029]. Each is coupled to the implement frame 34 by a parallel linkage 54, 64. The parallel linkages 54, 64, maintain the row units 52, 62 at the same orientation relative to the frame 34 (i.e., they revolve relative to the frame 34). The Final Office Action refers to the part indicated below as corresponding to the elongate toolbar recited in claim 1, i.e., the part to which the parallel linkage 64 is attached. This part appears to be rigidly connected to the row unit frame 70.

The parallel linkage 64 maintains the orientation of that part (and hence, the row unit frame 70) relative to the implement frame 34.

Thus, claim 1, as proposed to be amended, is not anticipated by Houck. Claims 4-11 are not anticipated at least because they depend from claim 1

Id. at 8-9.

61. Thus, Houck was distinguished based on differences in the physical limitations and not because of the amendment to claim 1 adding the second sensor.

62. **It appears that the Applicant was able to eliminate Hubalek and the Examiner does not appear to ever have considered combining Houck with Hubalek.**

63. It is my understanding that none of the combinations of prior art that I consider in this Declaration were considered during prosecution history of the '989 patent.

V. LEVEL OF ORDINARY SKILL AND RELEVANT TIME

64. I have been advised that "a person of ordinary skill" is a hypothetical person who is presumed to have known the relevant art at the relevant time.

Factors that may be considered in determining the level of ordinary skill in the art may include: (A) "type of problems encountered in the art;" (B) "prior art solutions

to those problems;" (C) "rapidity with which innovations are made;" (D) "sophistication of the technology; and" (E) "educational level of active workers in the field. In a given case, every factor may not be present, and one or more factors may predominate." *In re GPAC*, 57 F.3d 1573, 1579, 35 USPQ2d 1116, 1121 (Fed. Cir. 1995); *Custom Accessories, Inc. v. Jeffrey-Allan Indus., Inc.*, 807 F.2d 955, 962, 1 USPQ2d 1196, 1201 (Fed. Cir. 1986); *Environmental Designs, Ltd. V. Union Oil Co.*, 713 F.2d 693, 696, 218 USPQ 865, 868 (Fed. Cir. 1983). "[I]n many cases a person of ordinary skill will be able to fit the teachings of multiple patents together like pieces of a puzzle." *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 42 (December 2016).

65. I have been advised that, for the purposes of my analysis, I should assume that the relevant time is December 2016

66. By virtue of my education, experience, and training, I am familiar with the ordinary level of skill in the art of the '989 patent. In my opinion, the person of ordinary skill would include someone who had, through education or practical experience, obtained a working knowledge of agricultural implements. This would include someone who had, through education or practical experience, the equivalent of a bachelor's degree in agricultural or mechanical engineering, or a related field, and at least two years of work experience designing, building,

maintaining or otherwise working with farm implements. This would also include a person who had, through education or practical experience, the equivalent of a bachelor's degree in a related field, and who had obtained knowledge of farm implements equivalent to that described above.

VI. THE STATE OF THE ART

67. I reviewed the patent claims and compared them to the prior art. In doing so, I applied the plain and ordinary meaning of the words of the claims as would be understood by the skilled person, except I also considered the arguments made in the prosecution of the '989 patent.

68. In my opinion, and as explained in further detail below, the challenged claims of the '989 patent, viewed as a whole, do not identify anything new or significantly different from what was already known to individuals of ordinary skill in the field prior to the priority date of the '989 patent, December 16, 2016.

69. In the following sections, I provide a brief overview of the state of art in the field of the '989 patent. The overview is based on my knowledge and experience and on the references considered, which are listed in Appendix A, which confirmed my understanding of the farm implement field before December 16, 2016. I may cite to certain documents that published after December 16, 2016, but describe the state of the art prior to December 16, 2016. These documents also

confirm my understanding, based on my experience in the field, of the state of the art prior to December 16, 2016.

A. Background of Farm Implements

70. A farm implement is a tool or piece of machinery used in agricultural production for various tasks such as planting, cultivating, harvesting, and processing crops. These implements can range from simple hand tools like shovels and hoes to complex machinery like tractors, combines, plows, seeders, and sprayers. The purpose of farm implements is to make agricultural tasks more efficient, reducing the labor required and increasing productivity on the farm.

71. Humans have been farming since the last Ice Age. Humans have created myriad tools to assist with farming. Farm implements have been used for thousands of years, dating back to ancient civilizations where rudimentary tools were used for cultivating crops. Implements were pulled by yaks, oxen, and other draft animals, and one of the earliest examples is likely the plow. The plow has a long history, with evidence of its use dating back to around 4000 BCE in Mesopotamia and other regions. These early plows were typically made of wood and pulled by animals such as oxen, horses, or donkeys. They were used to turn over the soil in preparation for planting crops.

72. Over time, various improvements and innovations were made to farm implements, leading to the development of more sophisticated tools and machinery that greatly increased agricultural efficiency and productivity.

73. By the time of the invention, late 2016, farm implements had evolved significantly from their early origins. Farm machinery had become highly mechanized and technologically advanced, with a wide range of implements available to farmers to assist in various agricultural tasks. Some common types of farm implements and machinery in 2016 included tractors, plows, planters, seeders, harvesters, sprayers for applying fertilizer, and various types of tillage equipment. Tillage equipment are used to prepare the soil for planting, and may include disc harrows, cultivators, and rotary tillers. These implements are designed to break up soil clods, incorporate crop residues, and create a suitable seedbed for planting.

74. Modern farm equipment has become very large in size. The '989 patent states a problem with the prior art:

Implements, such as agricultural implements, are used to enable the engagement of tool attachments, including row units, with the soil for seeding, fertilizing, soil agitation, etc. As implements continue to get wider, they tend to have longer, rigid sections that do not handle uneven fields well. (Col. 1, lines 10-15.)

75. Fields are not always flat. In fact, most fields have undulating topography, gullies and contours. As the '989 patent explains:

For instance, the field may comprise gullies and/or terraces that compromise the ability of the row units to properly operate in the field. As an example, when a planter encounters a terrace, frame wheels of the implement lift the row units up and out of the ground. Conversely, as the wheels go down the back of the terrace, the entire weight of the frame rests on the row units. In either case, possible detrimental results include insufficient crop yield due to seeds being planted too shallow or too deep. (col. 1, lines 15-25.)

76. The '989 patent offers a system for maintaining the proper depth of the tools on an instrument. The problem addressed by the '989 patent has been around for ages, and, as explained in further detail below, existed prior to the December 16, 2016.

B. Prior Art References

77. Next I provide a brief summary of prior art references relevant to the claims of the '989 patent. As part of this analysis, I evaluate each piece of prior art both as a whole, and for its individual teachings, and explain what specific disclosures would have taught those of ordinary skill in the art. My descriptions of

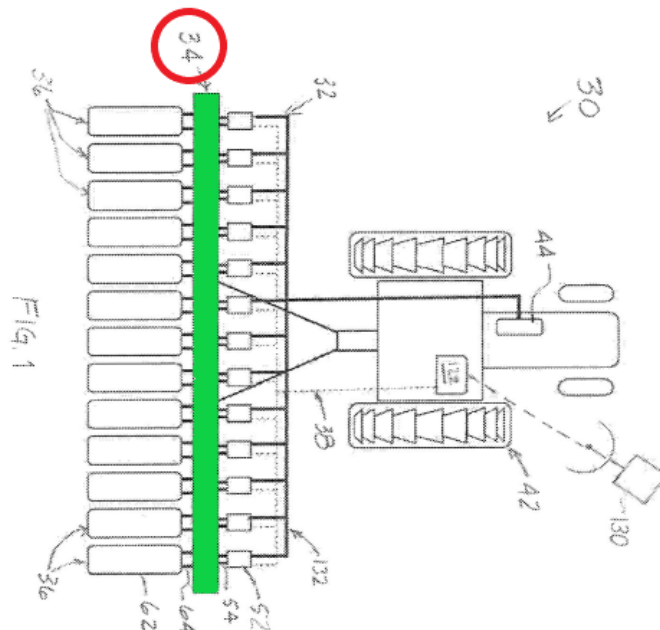
the disclosures of the prior art are from the perspective of how one skilled in the art would have read the references and viewed their teachings.

1. U.S. Patent Application Publication 2015/0230391 to Houck, EX1005

78. Houck was published on August 20, 2015, and is prior art to the ‘989 patent under 35 U.S.C. § 102(b). Houck’s title is Depth Control for a Seed Planting System.

79. Houck discloses a planting system. (See the summary and figures).

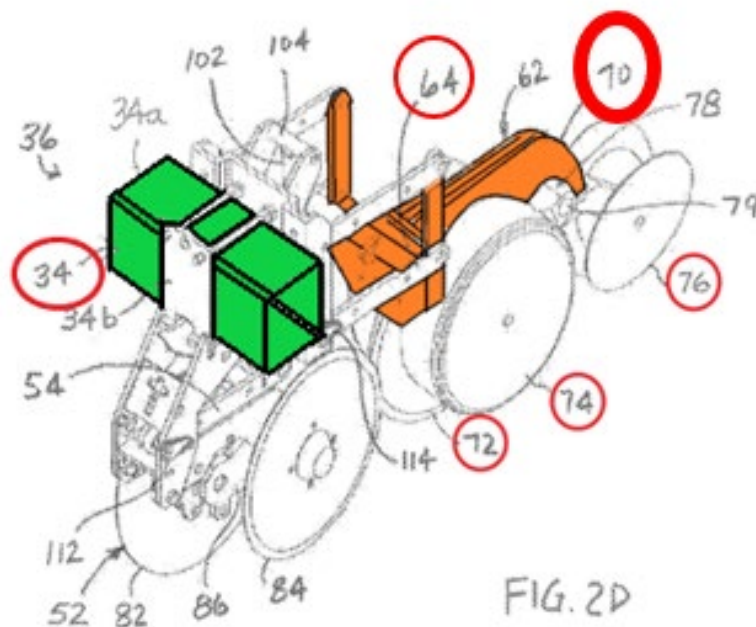
80. The planting system of Houck also comprises an elongated frame element 34. (See figure 1 and para. 0027).



81.

82. “Referring to FIGS. 1, 2, and 2A through 2D, a seed planting system 30 is depicted in an embodiment of the disclosure. The seed planting system 30 includes a seeding implement 32 including an implement frame 34, a plurality of seeding row assemblies 36 operatively coupled with the implement frame 34, and a control system 38 operatively coupled with each of the seeding row assemblies 36.” Para. 0027.

83. Houck does not disclose a toolbar identical to the toolbar 38, 56 of the ’989 patent, but Houck discloses a structure 70 is equivalent to the toolbar 38 of ’989 patent and performs the same function, which is, to provide support to the assembly of tools on the agricultural implement. The toolbar element or toolbar of an agricultural implement is nothing but a structure, to which the operating tools are mounted. Therefore, the part highlighted below in Fig. 2C of Houck corresponds to the toolbar 38, 56 because its function is the same, which is, provide a structure 70 on which the toolbar 72, 74 and 76 is mounted.



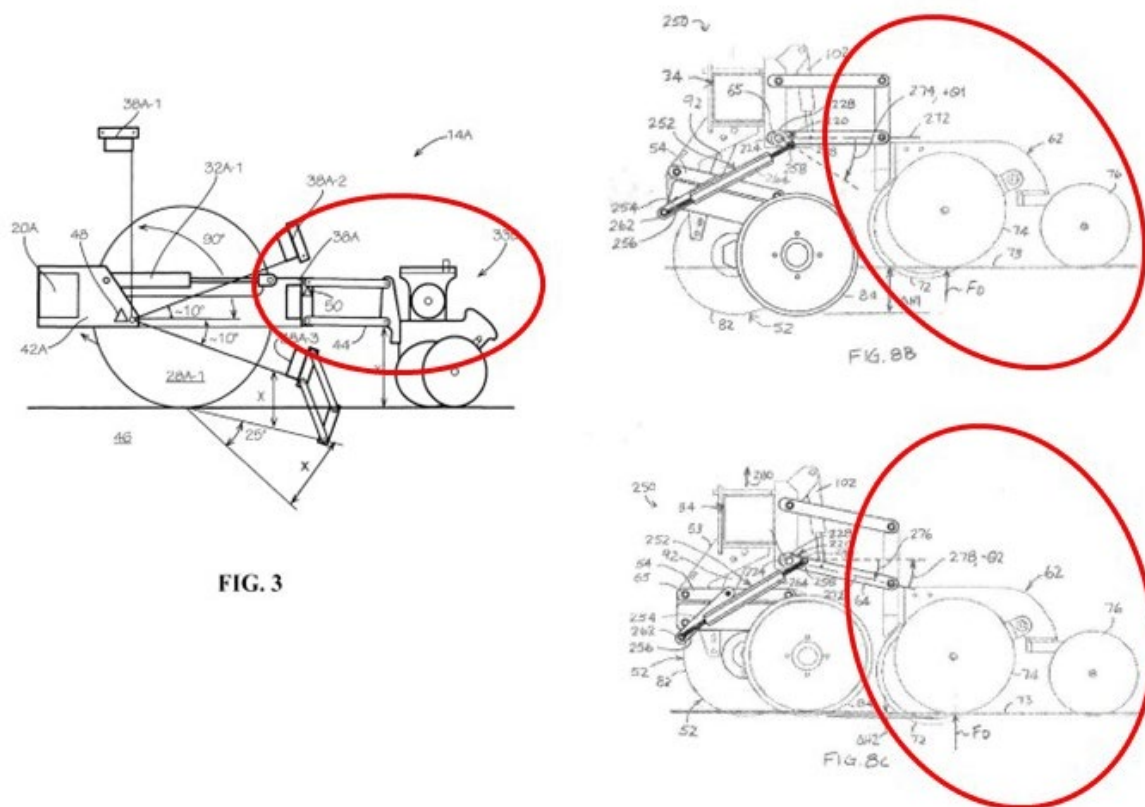
84.

85. As a result, the structure 70 of Houck corresponds to a toolbar is coupled to the frame element 34 by means of an articulation link 64 which rotates around a pivot 65. (See para. 0028 of Houck).

86. “Each seed row assembly further includes a seeding row unit 62 including a second linkage 64 operatively coupled with the implement frame 34 and rotatable about a pivot 65 for accommodation of an elevation 66 of the seeding row unit 62 relative to the implement frame 34.”

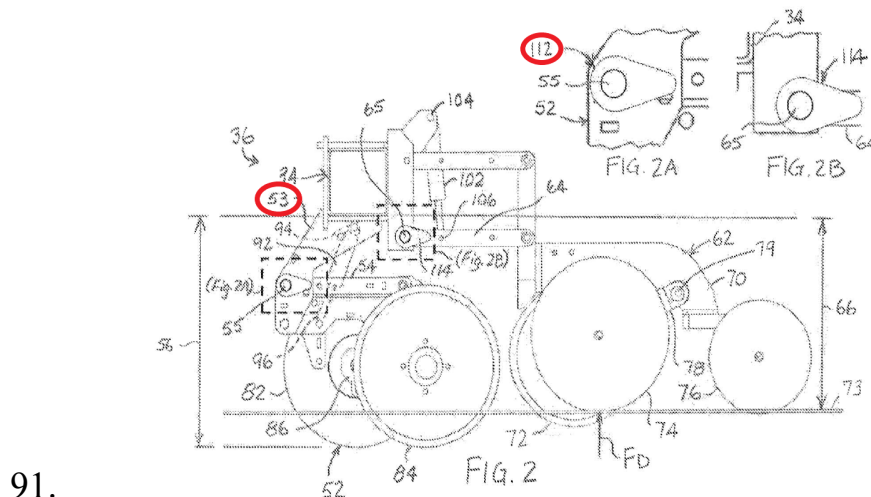
87. As seen in the figure above, the structure 70 corresponds to a toolbar and also oriented in parallel and at the back of the frame element 34.

88. Even if the structure 70 is not considered, it is equivalent to the toolbar 38, 56 of claim 1 of the '989 patent, it would be obvious for a technician in the subject matter to use in the place of the structure 70 highlighted, the toolbar 85 disclosed in Houck. This is shown in the figure below.



89. Houck teaches sensors 112 and 114 (see para. 0033 and Fig. 2).

90. “Each of the seeding row assemblies 36 can further comprise a position sensing module 110. In certain embodiments, the position sensing module 110 includes position sensors 112 and 114 operatively coupled to the first linkage 54 and the second linkage 64, respectively, that output signals 116 and 118, respectively, corresponding to the sensed position. The position sensors 112 and 114 are arranged to detect an angular rotation of the respective linkages 54 and 64 about their respective pivots 55 and 65, as depicted herein, for example by a rotating potentiometer. In other embodiments, position sensing can be provided by magnetostrictive sensors or linear sliding devices, such as sliding potentiometers or linear variable differential transformers (LVDT). One embodiment of the position sensors 112, 114 is discussed below attendant to FIG. 7.”



92. Para. 0028 discloses that the unit of cultivation row 52 is connected in a pivoting way to a structure 53, which is connected to the frame element 34.

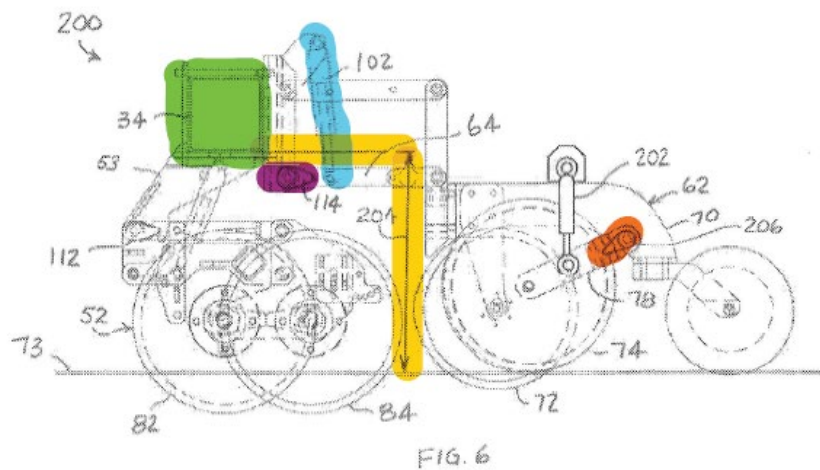
93. “Each of the seed row assemblies 36 includes a ground engaging attachment or tillage row unit 52 coupled to a rigid frame 53 by a first linkage 54 operatively about a pivot 55, the rigid frame 53 depending from the implement frame 34. The first linkage 54 is for adjusting an elevation 56 of the tillage row unit 52 relative to the implement frame 34. Each seed row assembly further includes a seeding row unit 62 including a second linkage 64 operatively coupled with the implement frame 34 and rotatable about a pivot 65 for accommodation of an elevation 66 of the seeding row unit 62 relative to the implement frame 34. In various embodiments, the seeding row unit 62 is in substantial forward/aft alignment with the tillage row unit 52.” Para. 0028

94. Therefore, the structure 53 of Houck also acts as a toolbar, which row unit 52 is connected in an articulated way.

95. The structure 53 of Houck being a structure equivalent to a toolbar, in which the sensor 112 of Houck is equivalent to the second sensor 48 of the '989 patent application.

96. The sensor 112 of Houck is also configured to detect the structure position 53 (equivalent to the toolbar of the 989 patent) in relation to the frame. (See para. 0033 highlighted above).

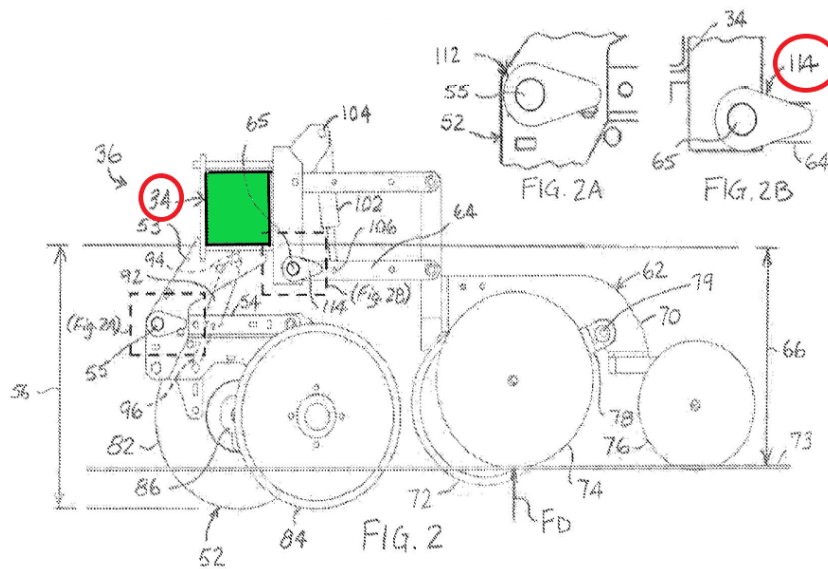
97. In the embodiment of Fig. 6, an additional position sensor 206 is added. Position sensor 206 measures the elevation 204 of the tool bar. Para. 0047.



98.

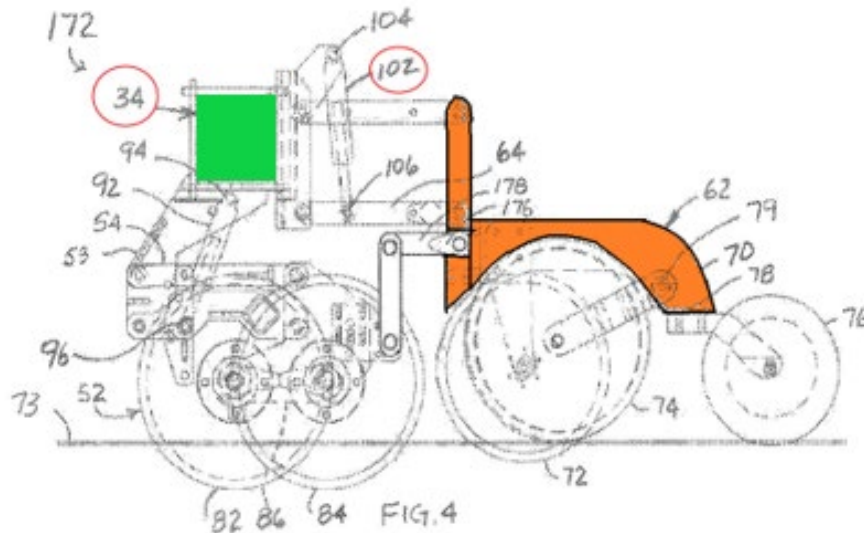
99. The toolbar is shown in green. The actuator is shown in blue. The elevation to the ground 204 is shown in gold. The first sensor is shown in orange and the second sensor is shown in purple.

100. Houck teaches a second sensor 114 coupled to the frame element 34 (see paras. 0028 and 0033 above and Fig. 2). Thus, the claimed first sensor is disclosed by sensor 206 while the claimed second sensor is disclosed by sensors 112 and 114.



101.

102. Houck teaches sensor 114 (see above in circle) coupled to the frame element 34 (see paras. 0028 and 0033 above and Fig. 2). Houck also comprises an actuator 102 coupled between the frame element 34 and the structure 70 equivalent to the toolbar of claim 1 of the '989 patent. (See figure 4 of Houck).



103.

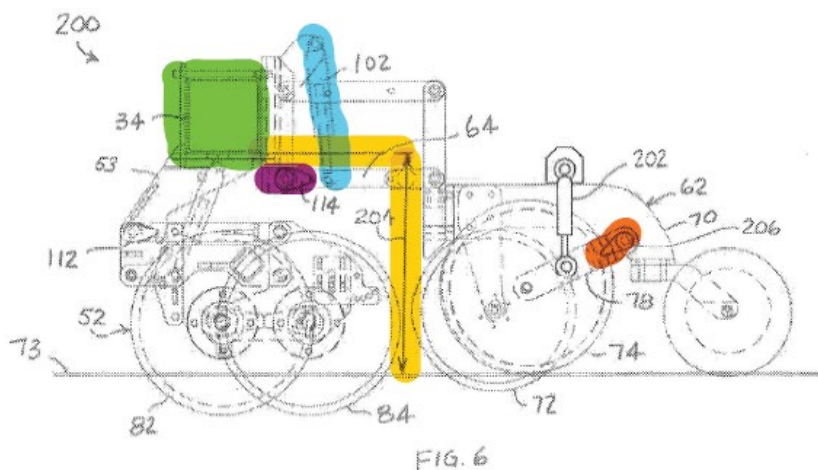
104. The actuator 102 is a down-force cylinder. (See para. 0031)

105. “In some embodiments, each of the seed row assemblies 36 further includes a seeding row actuator 102 operatively coupled between the implement frame 34 and the seeding row unit 62, the seeding row actuator 102 including a base portion 104 and a free portion 106, the free portion 106 being translatable relative to the base portion 104, and the free portion 106 being operatively coupled with the seeding row unit 62 for adjustment of the down force FD of the seeding row unit 62.”

Para. [0031].

106. As mentioned above, Houck teaches position sensors to detect the position of the toolbar relative to the frame and to the ground, and articulate it according to the position detected.

107. Fig. 6 shows another embodiment disclosing this feature.



108.

109. Although Houck doesn't specifically mention that the structure 70 (equivalent to the toolbar of the 989 patent) remains in parallel to the frame element 34 under any rotation motion, the figures of Houck verify that, obviously, the referenced elements are kept in parallel between each other.

110. From examining the figure below, the implement frame 34 has the vertical member of a four-bar parallel linkage attached to it. This is shown in the red circle. The corresponding linkage member is shown the blue oval. The linear actuator 102 will rotate the mechanism in a very gradual arc around the frame 34 to accomplish vertical control of the tool while maintaining orientation with the frame. For small amounts of movement, the tool for all intents and purposes is moving vertically.

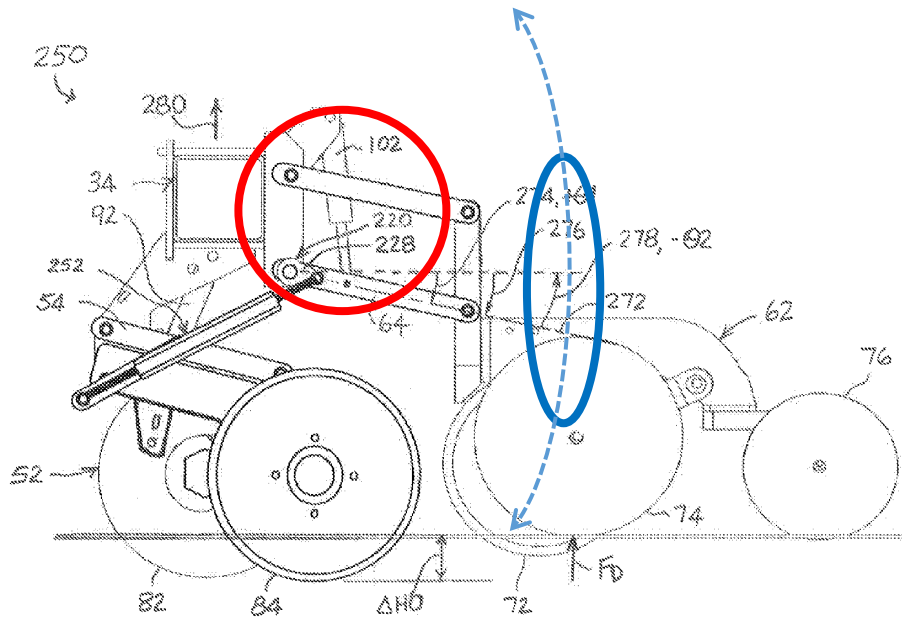


FIG. 8D

111.

112. Thus, in my opinion, Houck does rotate the toolbar relative to the implement frame.

113. I note, as discussed below in Section VII, to the extent any claim limitation from the challenged claims is missing from Houck, it is found in other references.

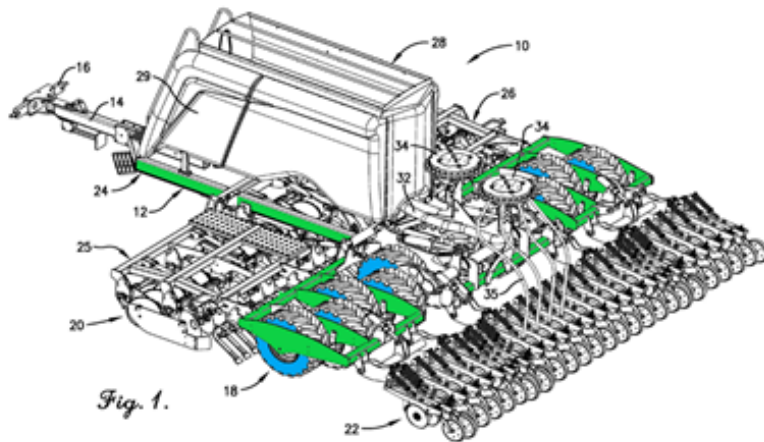
2. U.S. Patent No. 9,031,749 to Hubalek et al. ("Hubalek"), EX1006

114. Hubalek is titled "Cultivation Air Seeder Having Sequentially Operated Tools."

115. Hubalek discloses a planting system -- a cultivation air seeder having operating tools that operate in sequence to carry out the planting. (See the summary and figures).

116. “When the operator of a cultivation air seeder shifts the tractor valve to raise the cultivators and openers from the ground as the seeder prepares to turn around at the end of a field, the operating and control system of the seeder causes the cultivators to be raised first, followed in sequence by the trailing openers. The seed meter turns off as soon as the cultivators leave their lowered position, but the blower stays on so that seeds in the conduits downstream from the meter continue to be delivered to and deposited into the ground by the openers until the cultivators reach their raised position, where upon the openers are raised. Depending upon the particular seeding mode selected by the operator, the cultivators and openers either lower simultaneously as the operator shifts the tractor valve to the lowering position when starting down the next pass, or the cultivators are lowered first, followed in sequence by the openers. Regardless of the selected seeding mode, the seed meter turns on as soon as the cultivators reach their lowered positions.”

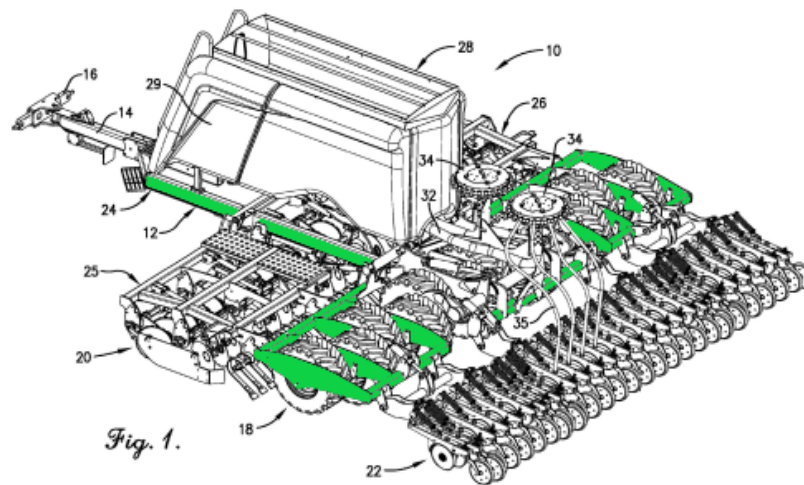
117. The planting system of Hubalek comprises an elongated frame element
12. EX1006 2:59, Fig. 1.



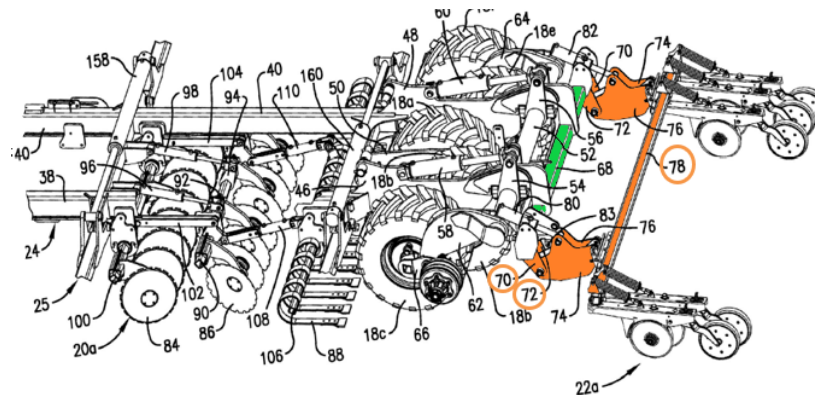
118.

119. “With initial reference to FIGS. 1 and 2, an exemplary cultivation air seeder in accordance with the present invention is broadly denoted by the numeral 10 and is provided with a mobile chassis or frame 12 having a tongue 14 and hitch structure 16 for connecting seeder 10 to a suitable towing tractor or other vehicle (not shown). A number of ground engaging support and compaction wheels 18 are disposed across the rear of frame 12 to support the frame for over-the ground travel and for compacting the soil after it has been cultivated by cultivation tools 20 (cultivators) on frame 12 ahead of wheels 18.”

120. Hubalek teaches an elongate toolbar 78 coupled to the frame element 12 by means of an articulation link 70, 72 (see figures 1 and 11, column 4, lines 29 to 38).



121.

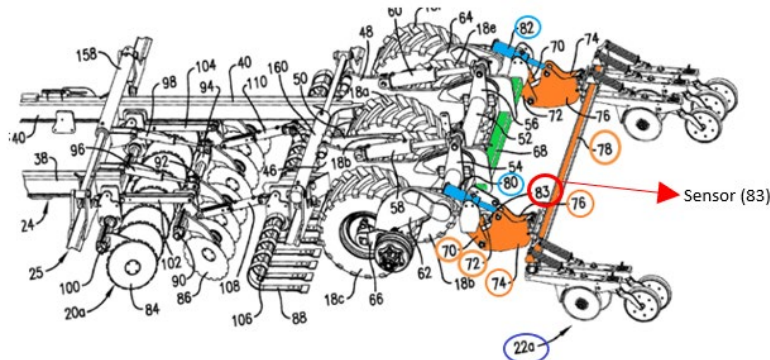


122.

123. “The center frame section 24 further includes a rear transverse beam 68 spaced below and slightly rearwardly of torque tube 52. Beam 68 is fixed to the lower rear ends of upright support plates 46, 48 and to the rearmost end of intermediate support plate 50. Two sets of lugs 70, 72 are fixed to beam 68 adjacent opposite ends thereof and project downwardly and slightly rearwardly therefrom to pivotally support a corresponding pair of rearwardly projecting links 74, 76. Links

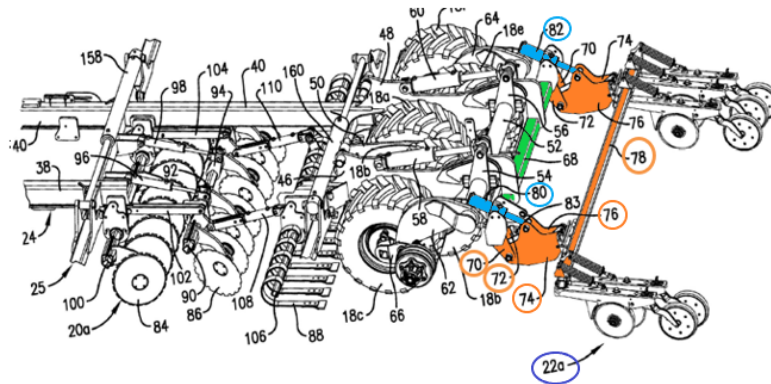
74, 76 are fixed joined at their rearmost ends to a transverse toolbar 78 that supports a center gang 22a of the openers 22.”

125. Hubalek does not disclose the use of two sensors. However, it would be obvious for a technician in the subject matter to use two sensors to improve the implement performance.



128. “An opener down position sensor 83 (FIG. 11) in the nature of a proximity switch is mounted between one pair of the links 74, 76 and is covered and uncovered thereby for detecting when openers 22a are in their lowered position.”

130. Hubalek also comprises an actuator 80, 82, known as hydraulic cylinders connected to the links 74, 76 and coupled between the frame element (12) and toolbar 78 (see figure 11 and column 4, lines 39 to 42).



132. “A pair of hydraulic cylinders 80, 82 have their rod ends connected to links 74, 76 respectively and their base ends supported on upstanding structure fixed to transverse beam 68 for raising and lowering links 74, 76.”

133. Similarly, the actuator 80, 82 of Hubalek is configured to lift or lower the toolbar 78 in relation to the frame element 12 (provided in column 4, lines 42 a 51).

134. Even if it isn't clear in Hubalek that the actuator 80, 82 is configured to rotate the toolbar 78, it is easy to understand that the toolbar 78 rotates too, as requested in the '989 patent. From figure 11 on, when the cylinder 80, 82 is activated, the link 74, 76 rotates around the link 70, 72, and as a consequence, executes the rotation motion of the toolbar 78 around its own axis, as provided in presentation below, which shows the full cylinder stroke 80, 82 when activated.

135. "Thus, when cylinders 80, 82 are actuated, they raise or lower the center gang of openers 22a relative to center frame section 24. For convenience, cylinders 80, 82 are hereinafter referred to as the "opener cylinders." As will be seen, opener cylinders 80, 82 are also utilized to apply down pressure to openers 22a. An opener down position sensor 83 (FIG. 11) in the nature of a proximity switch is mounted between one pair of the links 74, 76 and is covered and uncovered thereby for detecting when openers 22a are in their lowered position."

136. As mentioned above, Hubalek already teaches a position sensor 83 to detect the toolbar position and actuate it according to the detected position, once the

toolbar is connected to the frame element by means of an articulation link, such as in the '989 patent.

137. Likewise, in the Hubalek document, the toolbar 78 remains in parallel to the frame element 12. Although it is not clear, it is easily seen that by means of the figures of Hubalek, that the toolbar 78 keeps itself in parallel under any rotation motion.

138. Hubalek discloses all the principal features of the claims of the '989 patent in my opinion, except the first sensor, detecting the position of the ground relative to the frame.

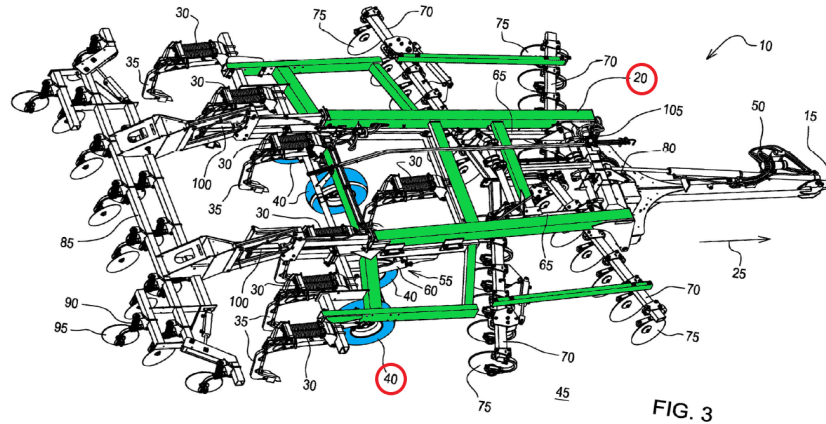
3. U.S. Patent No. 8,573,319 to Casper et al. ("Deere I"), EX1007

139. Deere I issued on November 5, 2013, and is prior art to the '989 patent under 35 U.S.C. § 102(b).

140. Deere I refers to a planting system since it is intended to an agricultural implement that comprises ground-engaging tools used for planting operations. (See the summary and figures).

141. "A control system for an agricultural implement is disclosed. The control system includes a position sensor configured to measure a depth indication of an actual operating depth of a ground-engaging tool and configured to generate a corresponding position signal." EX1007, 1:52-59.

142. As clearly seen in Figs. 1-3, the planting system of Deere I also comprises an elongated frame element 20 with wheels 40 coupled to it. EX1007, Figs. 1-3, and column 3, lines 27-29.



143.

144. “A plurality of wheel assemblies 40 are coupled to the first frame section 20 to support the first frame section 20 above ground 45.”

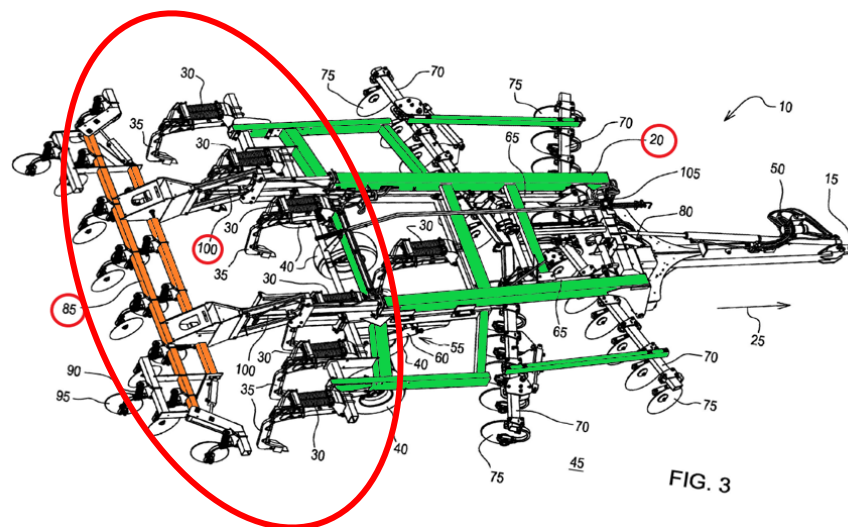
145. On the other hand, Deere I teaches an elongated toolbar 85, 285 coupled to the frame element 20, 220 by means of an articulation link. (See column 4, lines 7-16, Fig. 3 and column 6, lines 46-49, Fig. 10). A plurality of tools or row units are attached thereto.

146. “With reference to FIG. 3, illustratively, a third frame section 85 is pivotally coupled to the first frame section 20, rearward of the first ground engaging tool 30. A third ground-engaging tool 90 is coupled to the third frame section 85. The

illustrated third ground-engaging tool 90 is a closing disk assembly 95. Other ground-engaging tools (e.g., ripper, disk gang assembly) are contemplated by this disclosure.

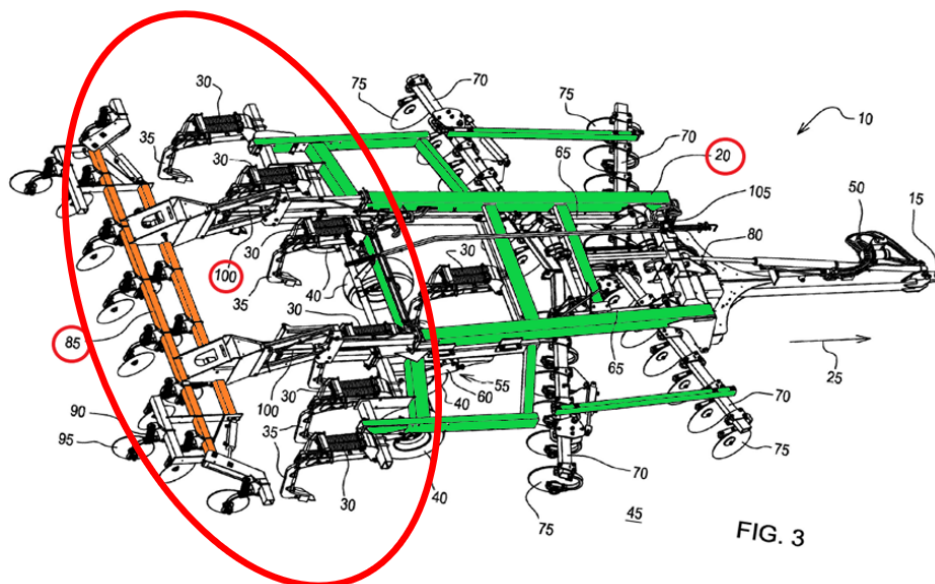
147. A third adjustment device 100 (e.g., extendable and retractable hydraulic cylinder) is coupled to the first frame section 20 and the third frame section 85.”

148. “With continued reference to FIG. 10, a third adjustment device 300 (e.g., electronic linear actuator, electronic rotational actuator) is coupled to the first frame section 220 and a third frame section 285.”



149.

150. As seen in the figure above, Deere I also corresponds to a toolbar 85, 285 and oriented in parallel and at the back of the frame element 20, 220.



151.

152. It is highlighted that the implement frame 20, 220 is not only constructed by longitudinal beams, but also from rail plates that connect the longitudinal beams, which are in parallel to the toolbar 85, 285.

153. Deere I teaches a control system 105 comprising position sensors for each one of the toolbars of the row unit of the agricultural implement, which is, a first sensor position 110 for the first ground-engaging tool 30, a second position sensor 120 for the second ground-engaging tool 70, and a third position sensor 130 for the third ground-engaging tool 90 (see column 4, lines 27-38, lines 47-55 and column 4, line 64a, column 5, line 4).

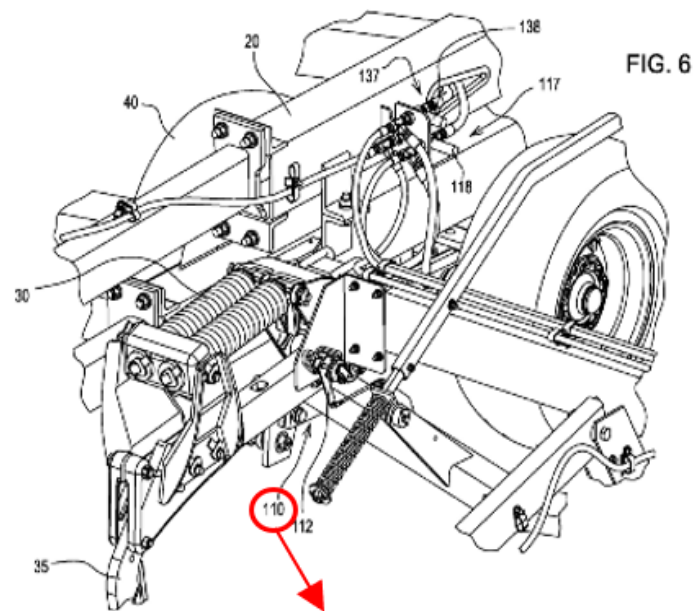
154. “With continued reference to FIG. 3, a control system 105 is coupled to the agricultural implement 10. Illustratively, the control system 105 is coupled to the first frame section 20. Referring to FIGS. 5 and 6, the control system 105 includes a first position sensor 110 (e.g., hall effect rotational sensor, potentiometer) configured to measure a first depth indication (e.g., relative position) of an actual operating depth of the first ground-engaging tool 30 and configured to generate a corresponding first position signal 115. The illustrated first position sensor 110 is a first Hall Effect rotational sensor 112. Other types of the first position sensor 110 are contemplated by this disclosure.”

155. “With reference to FIGS. 4 and 5, a second position sensor 120 (e.g., hall effect rotational sensor, potentiometer) is configured to measure a second depth indication (e.g., relative position) of an actual operating depth of the second ground-engaging tool 70 and configured to generate a corresponding second position signal 125. The illustrated second position sensor 120 is a second Hall Effect rotational sensor 122. Other types of the second position sensor 120 are contemplated by 55 of this disclosure.

156. “With reference to FIGS. 5-7, a third position sensor 130 (e.g., hall effect rotational sensor, potentiometer) is configured to measure a third depth indication (e.g., relative position) of an actual operating depth of the third ground-

engaging tool 90 and configured to generate a corresponding third position signal 135. The illustrated third position sensor 130 is a third Hall Effect rotational sensor 132. Other types of the third position sensor 130 are contemplated by this disclosure.

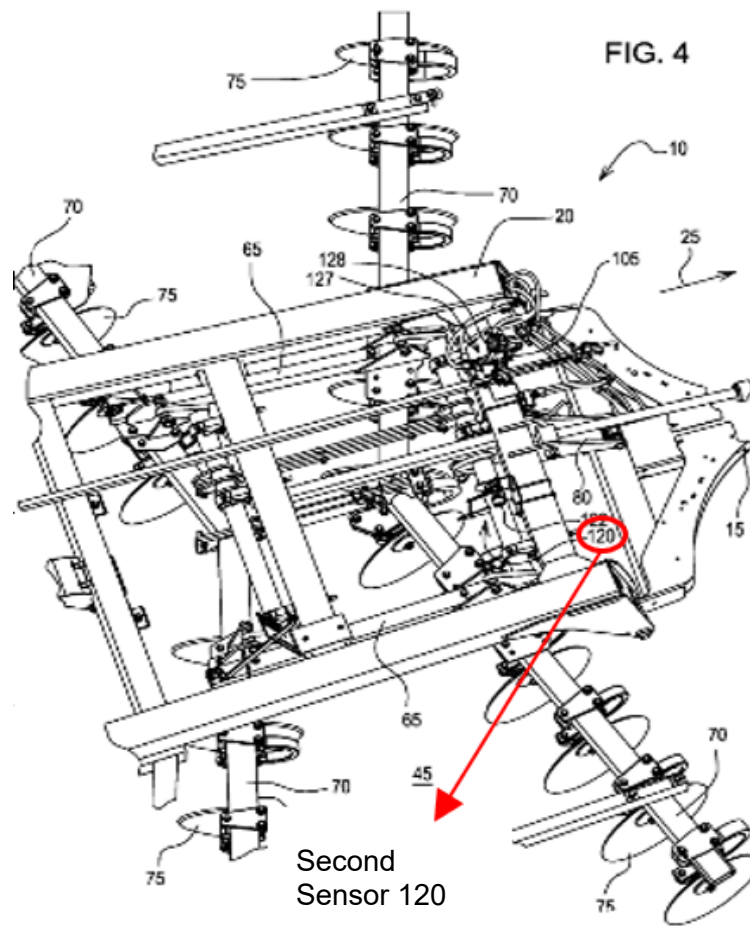
157. Therefore, Deere I teaches the usage of multiple position sensors to measure the position of the tools 90 on toolbar 85, as given in the figures below.

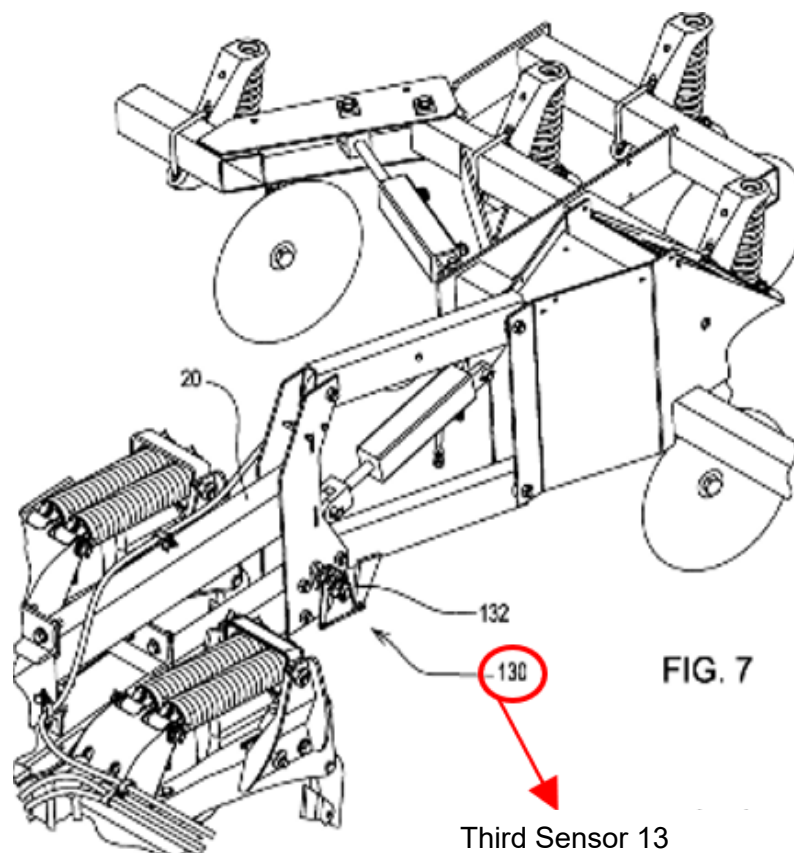


158.

First Sensor 110

159.





160.

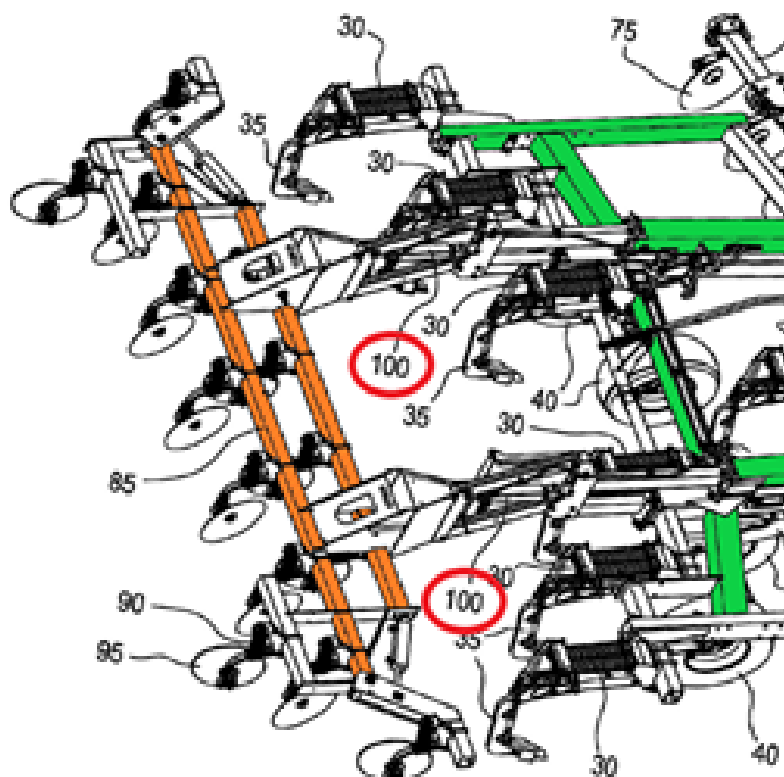
161. Deere I also teaches a control system 105 comprising position sensors to measure the position in relation to the ground depth (see column 4, lines 27-38, highlighted above).

162. “With continued reference to FIG. 3, a control system 105 is coupled to the agricultural implement 10. Illustratively, the control system 105 is coupled to the first frame section 20. Referring to FIGS. 5 and 6, the control system 105 includes a first position sensor 110 (e.g., hall effect rotational sensor, potentiometer) configured to measure a first depth indication (e.g., relative position) of an actual

operating depth of the first ground-engaging tool 30 and configured to generate a corresponding first position signal 115. The illustrated first position sensor 110 is a first Hall Effect rotational sensor 112. Other types of the first position sensor 110 are contemplated by this disclosure.”

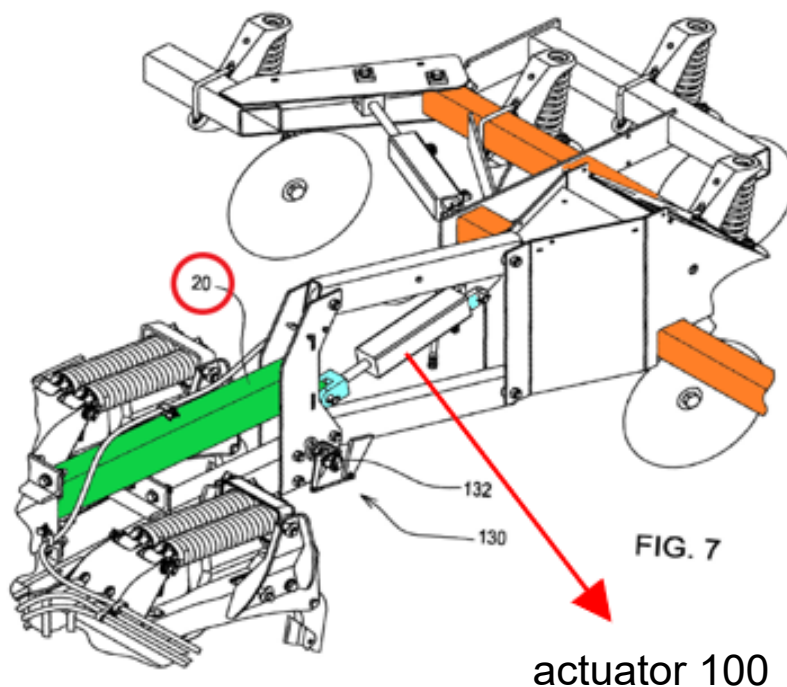
163. With reference to FIGS. 5-7, a third position sensor 130 (e.g., hall effect rotational sensor, potentiometer) is configured to measure a third depth indication (e.g., relative position) of an actual operating depth of the third ground-engaging tool 90 and configured to generate a corresponding third position signal 135. The illustrated third position sensor 130 is a third Hall Effect rotational sensor 132. Other types of the third position sensor 130 are contemplated by this disclosure.

164. In Figure 5, Deere I discloses a control unit 140 (e.g., PID controller), using open loop, closed loop, or preferably proportional-integral-derivative “PID control methodology, is configured to receive the first, second, and third position signals 115, 125, 135 and the first, second, and third pressure signals 119, 129, 139, and generate a control signal 145, which is received by the controller 50. Deere I also comprises an actuator 100, 300 coupled between the frame element 20, 220 and the toolbar 85, 285, as observed in the figure below.



165.

166. Deere I teaches an actuator 100 between the frame element 20 and the toolbar 85. The actuator 100 of Deere I can be better seen in Fig. 7 below, which connects to the frame element 20 to the toolbar 85 by means of articulation links arranged at its ends (highlighted in light blue).



167.

168. Although the hydraulic cylinder 100 of the agricultural implement of Deere I is coupled to the frame element 20 and toolbar 85 by means of an articulation link as seen above, such articulation may not be enough to rotate the toolbar 85 in relation to the frame element 20 of the implement of Deere I because of the parallel link.

169. The toolbars 85 of Deere I, which are connected to the ground-engaging tools 90, are also configured to be articulated based on the position detected by the position sensor 130. EX1007 4:64-5:4 (highlighted above).

170. Although Deere I doesn't specifically mention that the toolbar 85 remains in parallel to the frame element 20 under any rotation motion, by just seeing

the figures of Deere I to verify that, obviously, the referenced elements are kept in parallel between each other. Although Houck does not disclose the same exact elongated tool bar of shown in the '989 patent, it would have been obvious to the POSITA to use an elongated toolbar such as the one disclosed by Deere I, in the device of Houck to improve that system. For example, the elongated toolbar of Deere I can hold more tools and simplify the implement.

171. In addition, Deere I teaches that to identify and use a rotational sensor to determine angular position around a pivot point would have been obvious to the skilled person to apply the teachings of Deere I to the systems of Houck or Hubalek.

4. EP2335465 to Amazonen-Werke H. Dreyer GmbH & Co. KG (“Amazonen”), EX1008

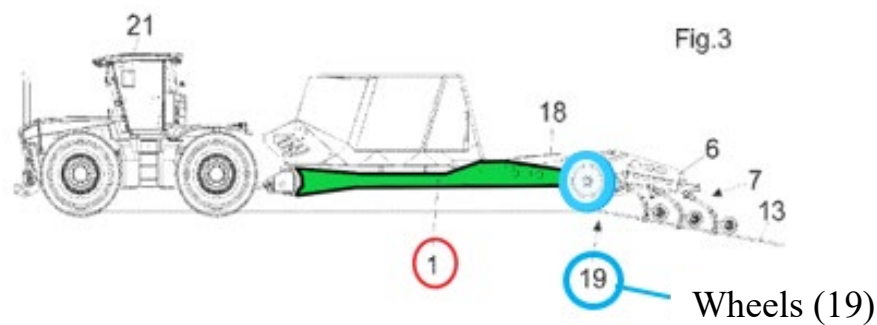
172. Amazonen is titled, “Agricultural machine” and was published on May 23, 2012. Amazonen is prior art to the '989 patent under 35 U.S.C. § 102(b). I reviewed a certified English translation of the same.

173. Amazonen also refers to a planting system. EX1008 at 1.

174. “Such agricultural machine is known, for example, by means of DE 10 2006 034 798 A1. This machine was engineered as seeder. The machine structure can be adjusted around a rotary shaft that runs cross-sectionally to the travelling direction by means of an adjustment device with motor to adapt the sowing cutting

pieces to copy the terrain, since it ensures that the operation depth or placement depth for the seed to be sowed is possible to be more uniform. The assembly position and the design of the machine structure to adapt the ground-engaging elements formed as cutting pieces are relatively expensive. *Id.* at 2.

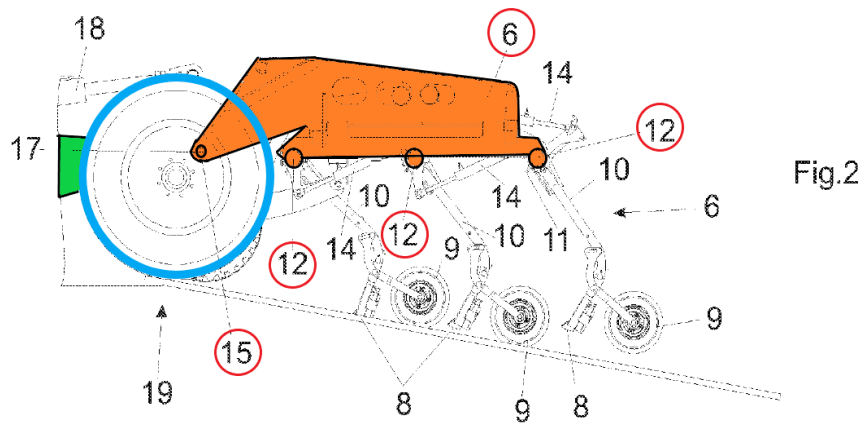
175. The planting system of Amazonen also comprises a frame element 1 with wheels 19. *Id.* at 3.



176. EX1016 at 6.

177. “The agricultural machine is designed as a semi-mounted seed drill. The seed drill has a machine frame 1 supported on the ground by a running gear 2. The machine frame 1 has a pulling device 3 on its front side, which is coupled to the coupling devices 4 of the tractor 5 pulling the agricultural machine.” EX1008 at 3.

178. Amazonen teaches a toolbar 12 coupled to the frame element 1 by means of an articulation link 15 formed by the structure 6. *Id.* A plurality of row elements are coupled with the toolbar 12.



179.

EX1016 at 5.

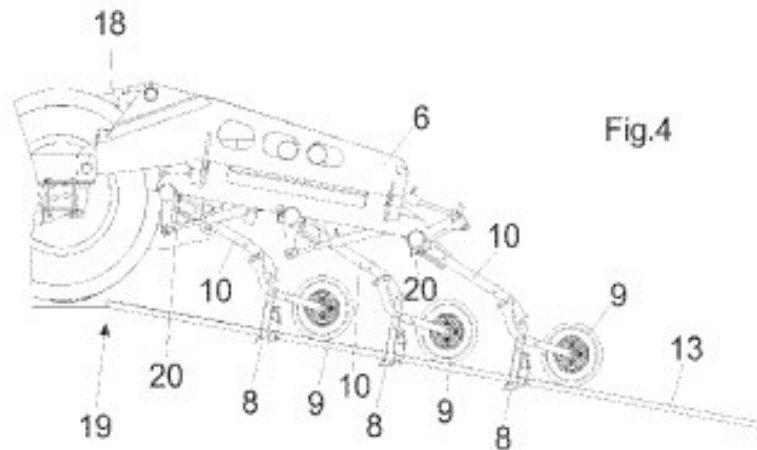
180. “A supporting frame 6 is arranged on the rear of the machine frame 1. A work unit 7 is arranged on this supporting frame 6. The work unit 7 comprises soil cultivating elements designed as seed coulters 8 with associated depth control rollers and/or pressure rollers 9. In the embodiment example, the soil cultivating elements designed as seed coulters 8 are arranged in three cross- rows at a distance from one another one behind the other. The soil cultivating elements 8 with the associated depth control rollers 9 are each arranged on the spaced-apart cross beams 12 of the support frame 6 so that they can be moved in the vertical direction by means of a retaining arm 10 with an articulated connection 11. The soil cultivating elements 8 are pressed against the ground 13 by spring elements, not shown, arranged between the retaining arms 10 of the soil cultivating elements 8 and the cross beams 12. These spring elements can, for example, be designed as known rubber suspensions. In this

case, the spring force is applied by turning the cross beams 12, which are arranged rotatably on the supporting frame 6, by means of the actuating means in the form of hydraulic cylinders 14 through the rubber elements.” EX1008 at 3-4.

181. “The supporting frame 6 is attached to the machine frame 1 by means of an articulated coupling 15. This articulated coupling 15 has a pivot axle 17 running transversely to the direction of travel 16. Furthermore, at least one motor-driven actuating device in the form of a hydraulic cylinder 18 is arranged between the supporting frame 6 and the machine frame 1. By means of this hydraulic cylinder 18, the supporting frame 6 with the soil cultivating elements 8 and associated rollers 9 arranged thereon can be pivoted about the pivot axle 18 running transversely to the direction of travel 16.” *Id* at 4.

182. From the figures it is possible to see that the toolbar 12 is arranged in parallel and at the back of the frame element 1

183. Amazonen teaches a first sensor 20 to detect the position of the ground-engaging tools 8. *Id*.



184.

EX1016 at 6.

185. “To achieve this automatically, a sensor element 20 for detecting the deflection of the retaining arm 10 of the soil cultivating element 8 relative to the supporting frame 6 is as-signed to each soil cultivating element 8 of the front cross-row and the rear cross-row. This sensor 20 sends signals and data to an on-board computer 21 arranged on the tractor 5. An evaluation program is stored in the memory of the on-board computer 21, by means of which the control elements of the motor-driven actuating device 18 are controlled by the on-board computer 21 in such a way that, by pivoting the supporting frame 6 by the actuating device 18, the deflection of the soil cultivating elements 8 of the first cross-row is at least approximately equal to the deflection of the soil cultivating elements 8 of the rear

cross-row relative to the supporting frame 6, as shown in Figs. 3 and 4. ...” EX1008 at 4-5.

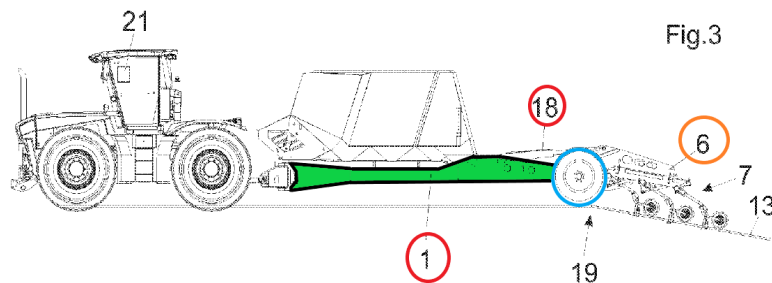
186. Although the Amazonen doesn’t define where the position sensor 20 is arranged, Figure 4 makes it clear that the sensor 20 is found on the toolbar 12. Therefore, Amazonen already teaches arranging a position sensor on the toolbar.

187. The sensor 20 of Amazonen is also configured to detect the position of the toolbar 12 in relation to the ground, as mentioned above. “By means of this evaluation program of the on-board computer 21 and the detection of the position of the retaining arms 10 of the soil cultivating elements 8 in relation to the supporting frame 6, the position of the supporting frame 6 in relation to the soil cultivating elements 8 and thus to the contour of the ground surface 13 can be adjusted during the entire cultivation process and the deflection of the soil cultivating elements 8 of the rear cross-row in relation to the supporting frame 6 and the deflection of the soil cultivating elements 8 in relation to the first outer row can be adjusted and maintained at least approximately the same. In this way, a uniform penetration depth of the soil cultivating elements 8 or the seed coulters into the ground 13 is achieved. By simply comparing the angle values between the soil cultivating elements 8 of the first cross-row and the soil cultivating elements 8 of the rear cross-row relative to the supporting

frame 6, an adaptation to the ground level or contour can be achieved in a simple manner by adjusting the supporting frame 6.” *Id.* at 5.

188. Amazonen is unclear as for the presence of a second position sensor. However, it would be obvious for a technician in the subject matter to use a second position sensor to improve the implement performance.

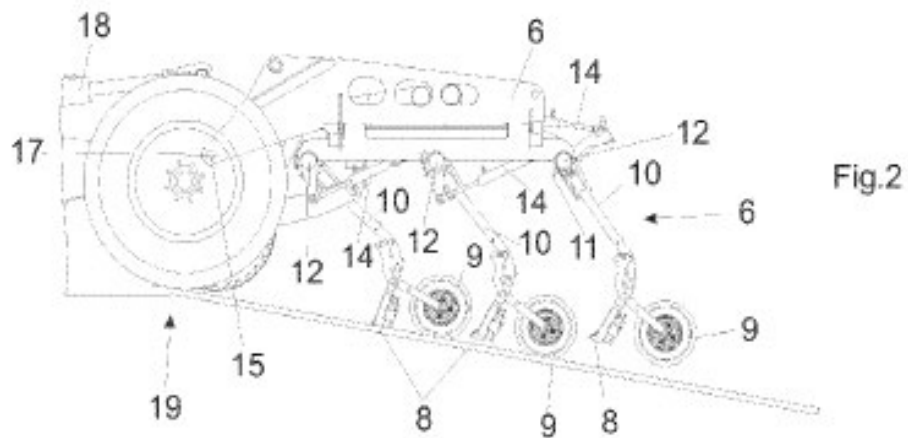
189. Amazonen also comprises an actuator 18, known as a hydraulic cylinder, between the frame element 1 and the articulation link 15 formed by the structure 6 that comprises the toolbar 12. *Id.*



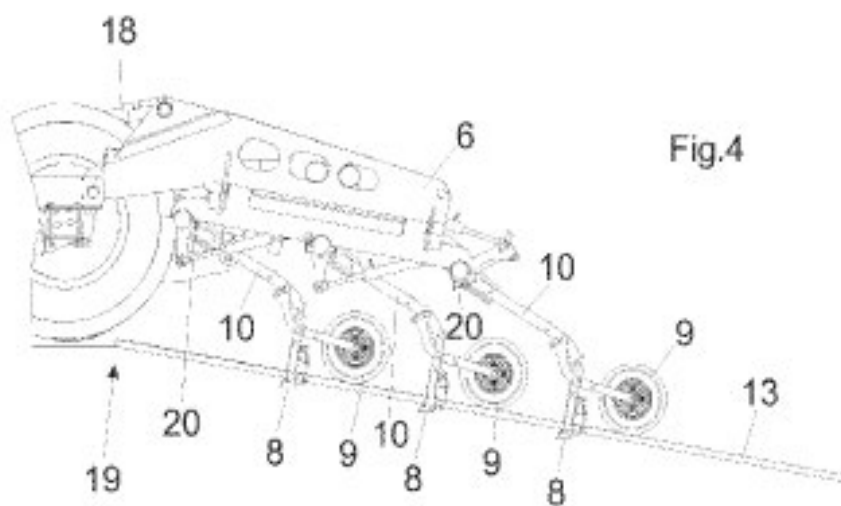
190.

191. The actuator 18 of Amazonen is also configured to rotate the toolbar 12 in relation to the frame element 1.

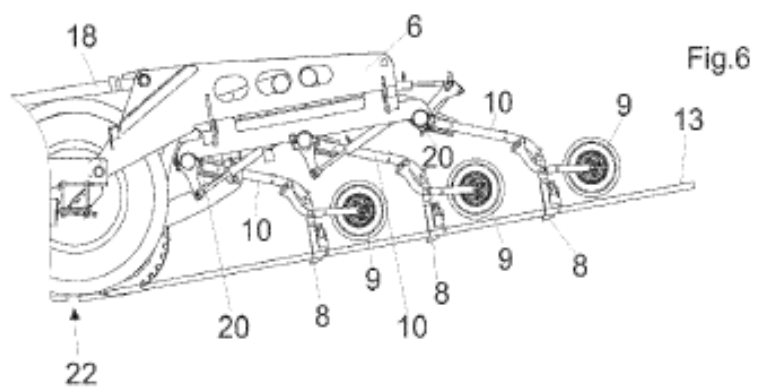
192. As provided in Figures 2, 4 and 6 of Amazonen, the actuator 18, arranged between the frame element 1 and the articulation link 15 formed by the structure 6 rotates the toolbar 12 in relation to the frame element 1, as in the ‘989 patent.



193.



194.



195.

196. As mentioned above, Amazonen already teaches a position sensor 20 to detect the toolbar position and rotate it according to the detected position, once the toolbar is connected to the frame element by means of an articulation link, such as in the ‘989 patent.

197. Also, in the Amazonen document, the toolbar 12 remains in parallel to the frame element 1 under any rotation motion, by just seeing the figures of Amazonen verify that, obviously, the referenced elements are kept in parallel between each other.

5. DE102006034798 to POETTINGER LANDTECHNIK GMBH (“Poettinger”), EX1009

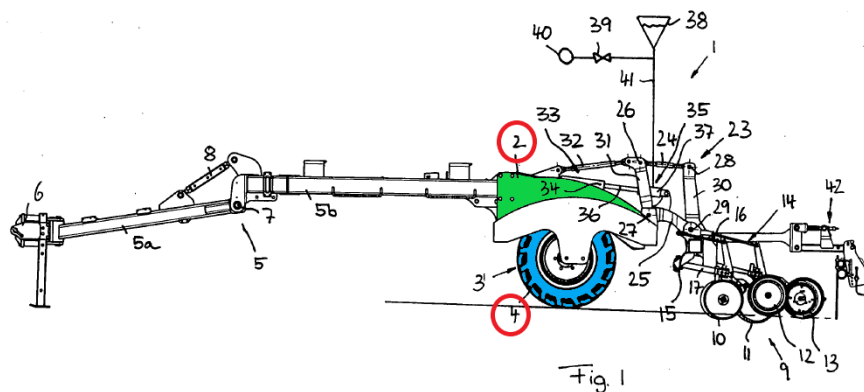
198. Poettinger is titled “Agricultural machine” and published on February 13, 2008. EX1009 at 1. Poettinger is prior art to the ‘989 patent under 35 U.S.C. § 102(b). I reviewed a certified English translation of Poettinger.

199. Poettinger also refers to a planting system since it is intended to an agricultural implement that comprises ground-engaging tools used for planting operations. *Id.* at 2.

200. “The present invention relates to an agricultural machine, in particular a semi-mounted seed drill, with a machine frame supported on the ground by a running gear, and at least one work unit, in particular a sowing unit comprising at

least one seed coulter and a depth control roller or pressure roller, which is mounted on the machine frame in a vertically adjustable manner, wherein the work unit is mounted in a vertically adjustable manner by a first four-bar linkage on a cross-member, which in turn is mounted in a vertically adjustable manner by a second four-bar linkage on the machine frame.” *Id.*

201. The planting system of Poettinger also comprises a frame element 2 with wheels 4 coupled to it. *Id.* 5-6.



202.

EX1018 at 8 (annotated).

203. “The seed drill 1 shown in the Figures comprises a machine frame 2 supported on the ground by a running gear 3, which in the illustrated version is single-axle and has wheels 4. The machine frame 2 can be attached to an undrawn tractor by a drawbar 5 by means of a coupling piece 6 at the front end of the drawbar, which allows the drawbar 5 to pivot about an upright pivoting axle. In the illustrated

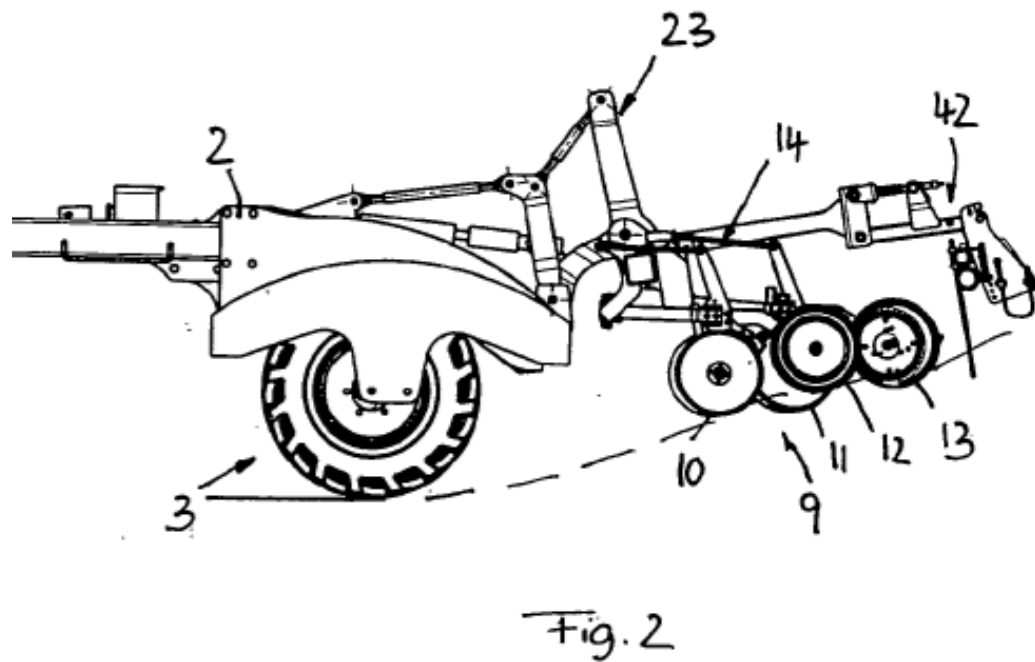
204. Poettinger also teaches an elongate toolbar 15 coupled to the frame element 2 by means of an articulation link with a plurality of row units 9 attached thereto. *Id.*

-75-

207. “The cross-member 15, to which the first four-bar linkage 14 is attached, is, as shown in Fig. 1, articulated to the machine frame 2 by a second four-bar linkage 23. This second four-bar linkage 23 has a geometry that differs from a parallelogram. In the embodiment shown, the two links 24 and 25 of the second four-bar linkage 23 are arranged in a slightly diverging manner toward the sowing unit 9. The two articulated points 26 and 27 on the machine frame-side, to which one of the links 24 and 25 is articulated, are slightly closer to one another than the two articulated points 28 and 29 on the cross-member-side, which are provided on a cross-member arm 30 that is connected in a rotationally fixed manner to the cross-member 15. The two links 24 and 25 have a comparable, i.e. approximately equal, length, but one of the two links - in the illustrated version, the upper link 24 - is formed to be length-adjustable in order to enable the geometry of the second four-bar linkage to be adjusted. The two links 24 and 25 are - roughly speaking - arranged in a horizontal position, with them sloping slightly backwards in the undeflected working position, wherein the lower link 25 is in turn arranged so as to slope more down.” *Id.* 9-10.

208. From the figures Poettinger on, it is possible to see that the toolbar 15 is arranged in parallel and at the back of the frame element 2.

209. Poettinger teaches the presence of a sensor in the row unit 9 to control the pressure that keeps the ground-engaging tools in the desired position *Id.* at 9.



210.
EX1018 at 9.

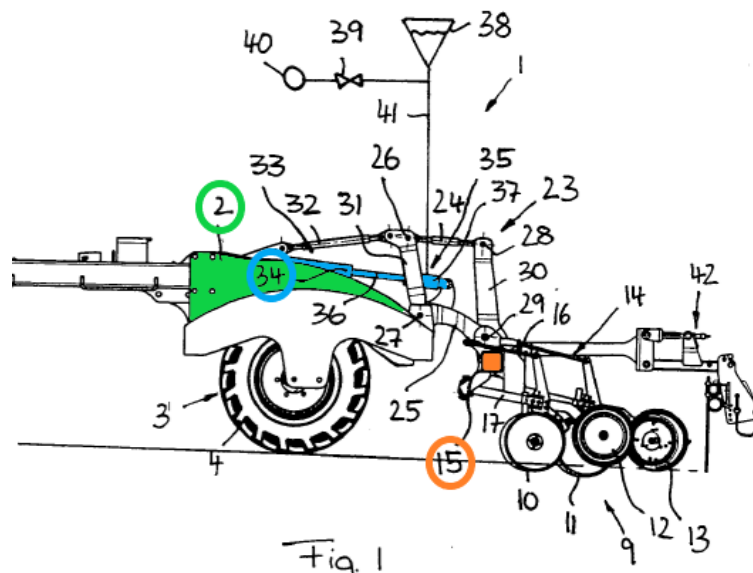
211. "Agricultural machine according to claim 12, wherein the pressure cylinder (37) can be connected to a controllable pressure supply for affecting the ground contact pressure, a sensor device for detecting an actual value of the ground contact pressure of the work unit (9) is provided and the pressure supply can be

controlled by an electronic control device as a function of a signal from the sensor device.” EX1009 at 14.

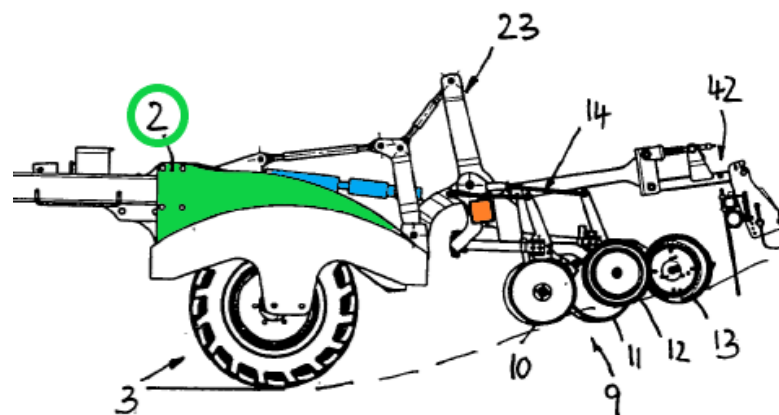
212. Poettinger also teaches a sensor to detect the relative position of the toolbar in relation to the ground. *Id.*

213. Poettinger discloses an agricultural machine according wherein the impression cylinder can be connected to a controllable pressure supply for influencing the ground contact pressure, a sensor device for detecting an actual value of the ground contact pressure of the working unit is provided and by an electronic control device, the pressure supply in response to a signal of the sensor device is controlled. *Id.* Naturally, such a controller communicates using signals. Poettinger is unclear as for the presence of a second sensor.

214. Poettinger also comprises an actuator 34 coupled between a frame element 2 and the toolbar 15. *Id.* at 10.



215.

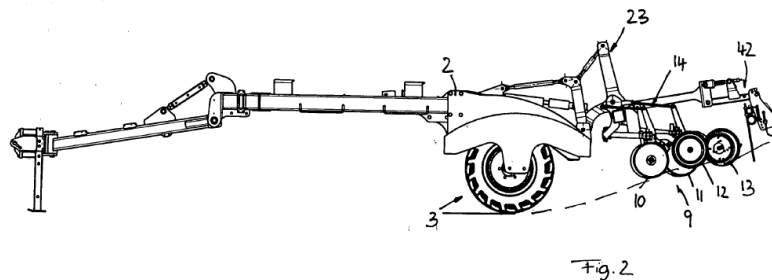


216.

217. “To excavate the sowing unit 19, an excavation device 33 is provided which comprises a pressure cylinder 34 which acts on the machine frame 2 on the one hand and on one of the links 25 of the second four-bar linkage 23 on the other

hand in order to pivot the four-bar linkage upwards and thus lift the sowing unit 9 from the ground.” Id. at 10.

218. Moreover, a ground pressure adjusting device 35 is integrated into the lift-out device 33, which comprises a pressure cylinder 37 that advantageously is seated on the same piston rod 36 on which the pressure cylinder 34 of the lift-out device 33 is also seated. The two pressure cylinders 34 and 37 are seated on opposing ends of the shared piston rod 36 and can each be designed as single-acting cylinders.”
Id.



219.

220. Poettinger also teaches an actuator 34 between the frame element (2) and the toolbar 15 configured to rotate the toolbar 15 in relation to the frame element 2, acting on the articulation link 23, as already mentioned above in Figures 2 and 3.

221. I note that the behavior of the implement of Poettinger is the same as that shown in the ‘989 patent. See below a side by side comparison.

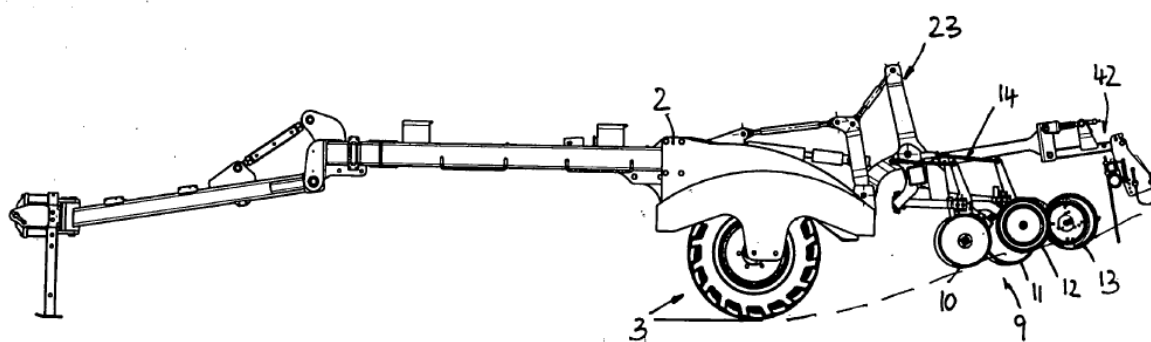


Fig. 2

Poettinger Downhill

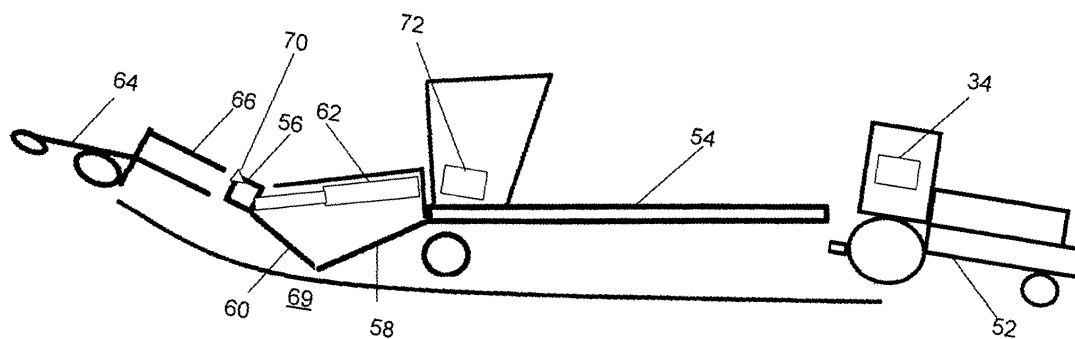
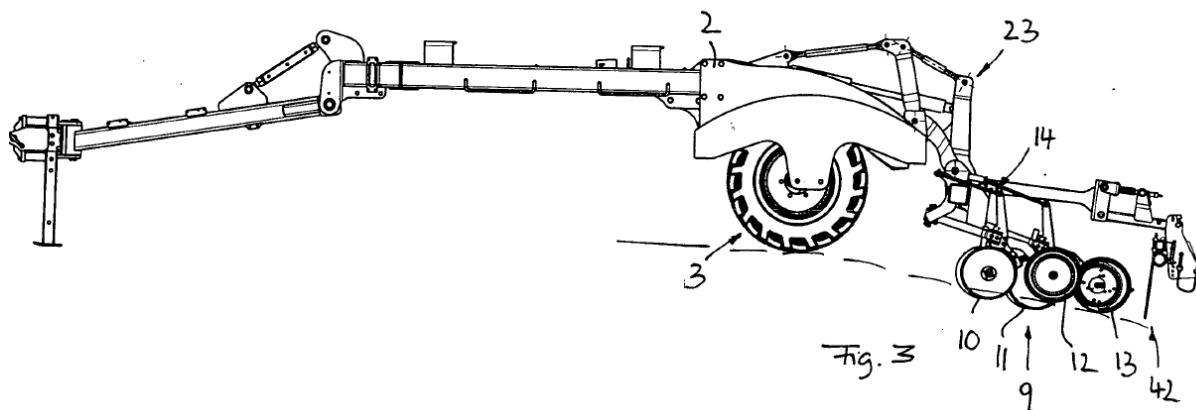
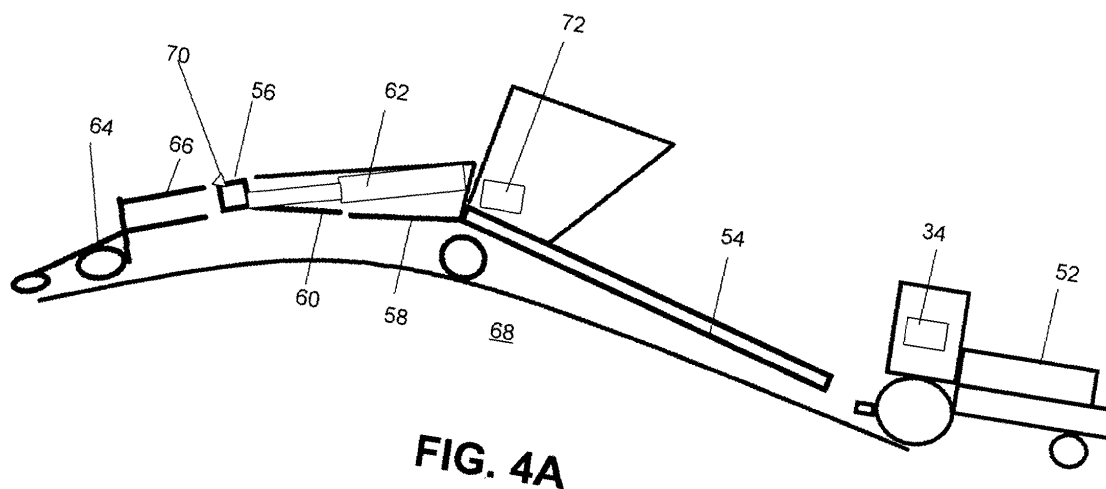


FIG. 4B

'989 Patent Downhill



Poettinger Uphill



'989 Patent Uphill

222. As shown above, in both cases – uphill and downhill -- the tool bar in Poettinger rotates relative to the implement frame in the same fashion as the '989 patent.

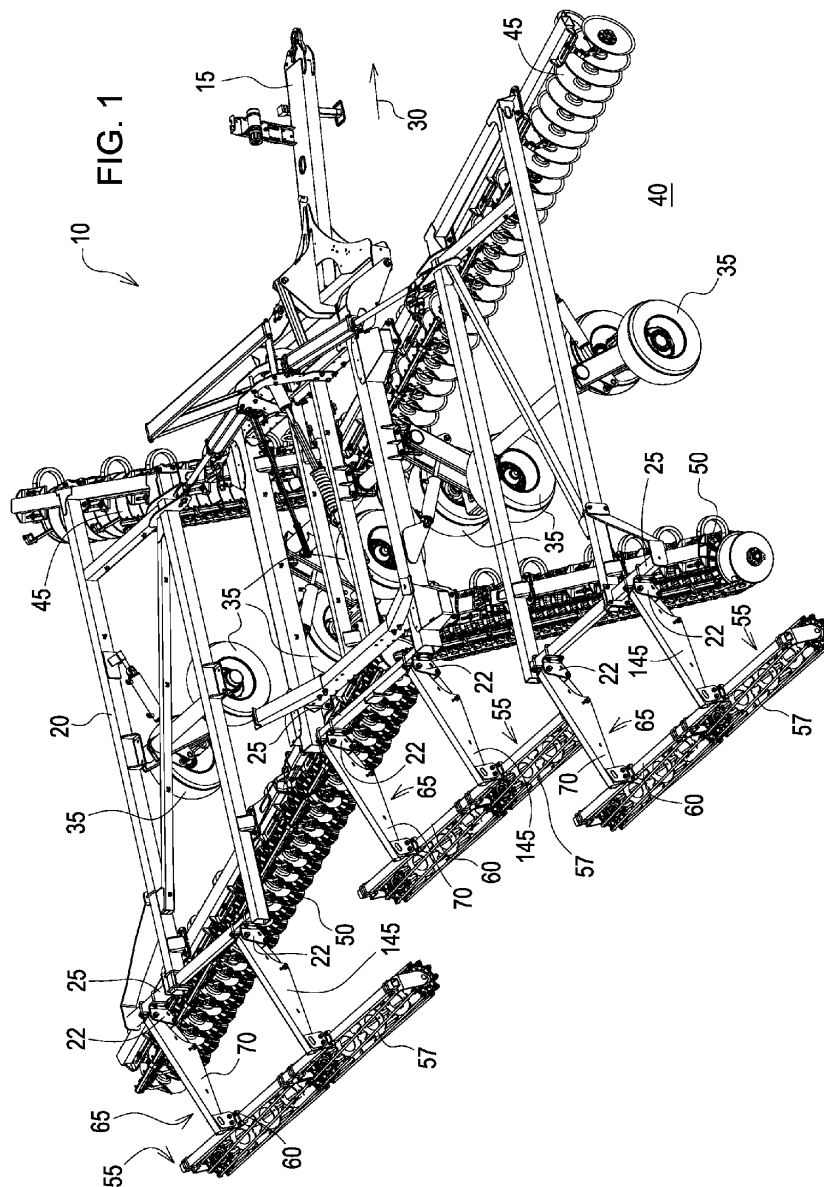
223. Poettinger discloses that the toolbar 15 remains in parallel to the frame element 2 under any rotation motion, by just seeing the figures of Poettinger to verify that, obviously, the referenced elements are kept in parallel between each other.

224. Thus, Poettinger discloses all the features of claim 1 of the '989 patent except the presence of two sensors

6. U.S. Patent Application Publication 2014/0209335 to Casper et al. (“Deere II”), EX1010

225. Deere II published on July 31, 2014, and is titled “Drawbar Apparatus of an Agricultural Implement.” Deere II is prior art to the '989 patent under 35 U.S.C. § 102(b).

226. Deere II teaches a hinged drawbar that couples earth-working tools to a farm implement frame similar to the implements of Houck and Deere I.



227.

228. In operation, the coupling mechanism 15 of the agricultural implement 10 is coupled to the vehicle and pulled in the direction of travel 30. As the agricultural implement 10 encounters terrain changes, the drawbar apparatus 65

230. Thus, Deere II teaches a hinged, actuated joint for coupling a tool bar to a farm implement frame that provides goods range of rotation and helps the tools to follow the contour of the ground surface. It can be seen that the joint of Deere II, when the actuator 220 is extended or contracted, will cause the toolbar 60 to rotate relative to the implement frame. Replacing the parallel linkages in Houck with a hinged joint, like the one in Deere II, would have been obvious to the POSITA as a way to improve the ability of the soil tools to follow a contoured surface.

**7. EP3192343 to POETTINGER LANDTECHNIK GMBH
 (“POETTINGER II”), EX1011**

231. Poettinger II was filed on October 25, 2016, before the priority date of the '989 patent, but published on July 19, 2017, before the filing date of the PCT application that because the '989 patent. I am informed that Poettinger II may be prior art to the '989 patent under 35 U.S.C. § 102(e) if the priority document does not support a challenged claim.

232. Although Poettinger II is not likely prior art to the '989 patent, it does inform the state of the art was prior to December 2016. In its background section, Poettinger II teaches “[i]t It is, of course, known in the prior art to monitor the working height of the working units by detecting the height position of the working units with various sensors and then displaying it on a display device on the tractor,

cf., for example, EP 13 00 061 A1, EP 21 58 799 A1, US 2012/186503 A1, US 6076611 A, US 2012/227992 A1, US 6085846 A, WO 2012/167258 A1, US 2013/081830 A1 and US 5339906 A.” EX1011 at 2.

233. This confirms my belief that it was well known in the industry prior to the '989 patent to use sensors on farm implements to detect the position of the implement, the frame or the tools, from the ground.

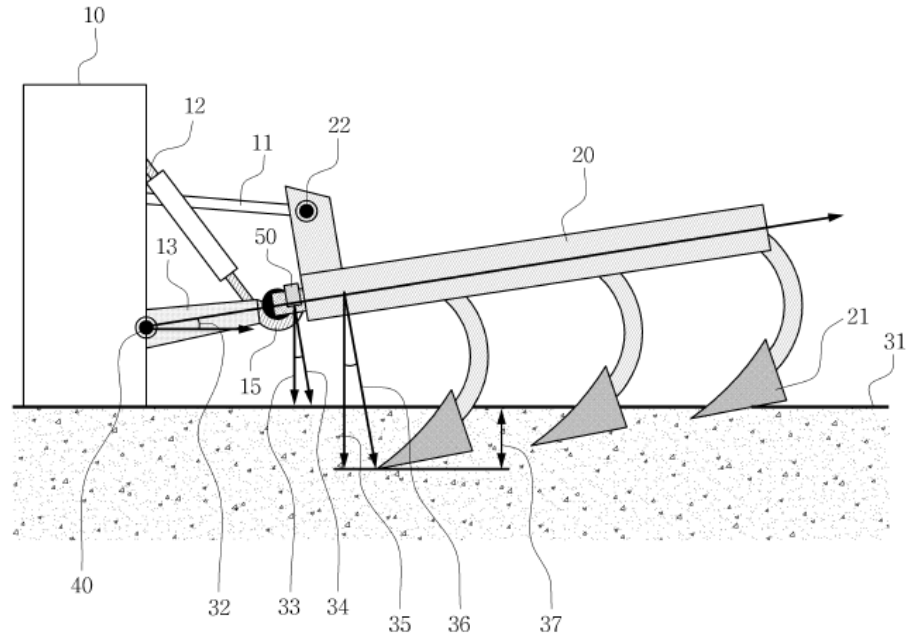
8. KR101877062 B1 to LS MTRON (“KR’062”), EX1012

234. KR’062 is a Korean patent publication titled “Apparatus and Method for Controlling Plowing Depth in Tractor,” that was published on May 15, 2014, and is therefore prior art to the ‘989 patent under 35 U.S.C. § 102(a). I reviewed a certified English translation of the same, EX1012.

235. KR’062 discloses a device and a method for controlling a plowing depth in a tractor. “The tractor plow depth control apparatus according to the present invention comprises: a distance sensor, installed on a plow frame connection part connected to a lower connection part provided at the front end of a lower link, that measures under the control of a control unit and transmits to the control unit the ground surface distance corresponding to the distance from the ground surface; an angle sensor that measures under the control of the control unit and transmits to the control unit the lower link angle corresponding to the driving angle of the lower link;

the control unit that, according to a plow depth control program during plowing work, performs plow depth control to maintain a constant plow depth, receives input of the ground surface distance from the distance sensor and the lower link angle from the angle sensor, calculates the current plow depth, and controls a flow control valve to maintain a constant plow depth; a storage unit that stores and provides to the control unit the plow depth control program and that stores various data for plow depth control processing under control of the control unit; a display unit that displays various driving state information according to the plow depth control under the control of the control unit; a flow control valve under the control of the control unit that applies hydraulic pressure to an actuator for driving the lift rod, drives the lift rod up and down, and adjusts the depth of the plow by raising and lowering the plow frame using the lift rod; and an operation unit that applies commands and data input through manual operation to the control unit.” EX1012 at 1-2.

236. FIG. 2 is duplicated below.



237.

EX1019 at 9.

238. KR'062 discloses a “plow frame (20) equipped with a plow blade (21) is connected to the lower link (13) through the lower connection part (15) and to the upper link (11) through the upper connection part (22), being mounted on the tractor (10). And, the lift rod (12), driven up and down by an actuator provided on the tractor, is coupled to the lower link (13), driving the lower link (13) up and down to raise and lower the plow frame (20) connected to the lower connection part (15). Also, the distance sensor (50) is installed on the connection part of the plow frame (20) connected to the lower connection part (15), measuring the distance from the ground surface (31) by emitting laser light to the ground surface (31) under the

control of the control unit (70) and measuring the distance from the ground surface based on the laser light reflected from the ground surface, and transmitting the measured distance to the control unit (70). The angle sensor (40) is installed on the tractor coupling part for coupling the lower link (13) to the tractor (10), measuring the angle of the lower link (13) and transmitting the measured angle to the control unit (70). In addition, although Fig. 2 shows the angle sensor (40) installed on the tractor coupling part for coupling the lower link (13) to the tractor (10), it is not limited thereto and may also be installed on the driving mechanism for driving the lift rod.” EX1012 at 6. KR’062 contemplates other configurations.

239. “In Fig. 2, the ground surface vertical distance (33) is the vertical distance between the distance sensor (50) and the ground surface (31), the ground surface distance (34) is the distance between the distance sensor (50) and the ground surface (31) measured by the distance sensor (50), the plow blade vertical distance (35) is the vertical distance from the plow frame (20) to the plow blade (21), the plow blade depth (36) is the distance from the plow frame (20) to the front end of the plow blade (21), and the plow depth (37) is the vertical distance from the ground surface (31) to the plow blade (21), and the lower link angle (32) is the angle between the lower link (13) and the ground surface (31).” *Id.*

240. The control unit may calculate the plowing blade vertical distance by multiplying the plowing blade depth corresponding to the distance from the plowing frame to the plowing blade tip and the coincidence value of the lower linking angle. The current vertical distance is calculated by multiplying the surface distance by the cosine value of the lower link angle and then the difference between the vertical distance of the plow blade and the vertical distance of the ground surface is calculated to calculate the current pivot angle.

241. That is, the control unit 70 calculates the pivot angle 37 based on the difference between the plow knife blade vertical distance 35 and the ground surface vertical distance 33 as shown in Equation 1, and the plow blade vertical distance 35 is calculated as shown in Equation 2, and the surface vertical distance 33 is calculated as shown in Equation (3).

[Formula 1]

plow depth = plow blade vertical distance – ground surface vertical distance

[Formula 2]

plow blade vertical distance = plow blade depth $\times$ cos(lower link angle)

[Formula 3]

ground surface vertical distance = ground surface distance $\times$ cos(lower link angle)

Id.

242. The control unit 70 performs a pneumatic control process to maintain a constant pneumatic work in accordance with a command input through the operation unit 90. *Id* at 7.

243. It is obvious from the above descriptions, this mechanism pivots or rotates about point 40 as shown in Fig. 2 above.

244. Thus, KR'062 discloses the sensor, actuator and controller arrangement in the challenged claims. It would have been obvious to the skilled person by December 2016, to use two sensors, a first sensor for measuring the distance to the ground, and a second sensor for measuring the angle of the coupling for the tool bar, and providing the sensor measurements to a control unit to calculate and control an actuator to maintain the proper ground depth for the ground working tools, as taught by KR'062.

9. U.S. Pat. Pub. No. 2016/0302350 to Kinzenbaw (Kinze Manufacturing Inc.)(“the '350 application”). EX1013

245. Thus, the '350 application was filed on Apr. 20, 2016, and therefore, is prior art to the '989 patent under 35 U.S.C. § 102(e).

246. The '350 application is directed to a lift and rotate farm implement that has a toolbar that extends transverse to a tongue when in a field use configuration.

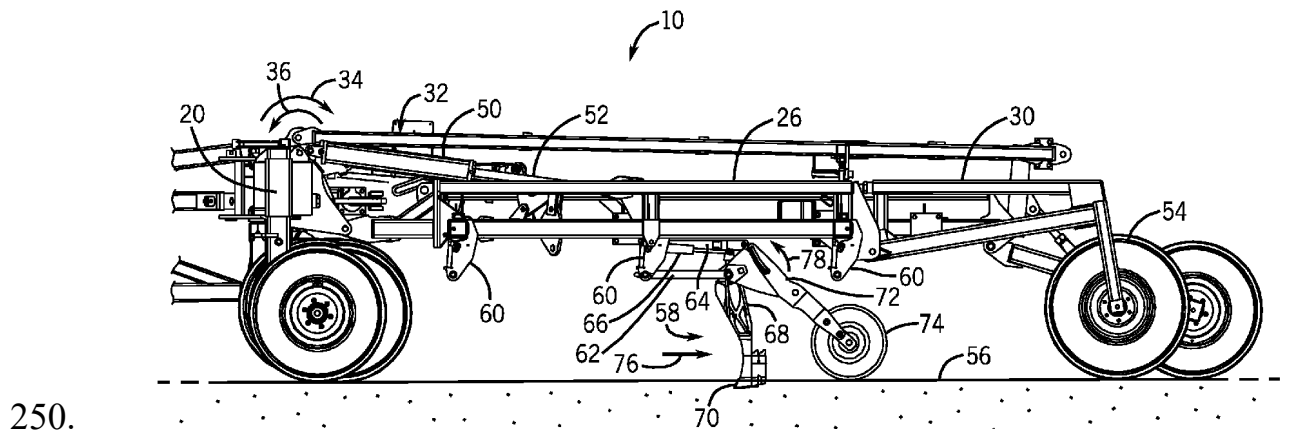
The toolbar can be lifted and/or rotated relative to the tongue to transition between a field use and a transport use.

247. A lifting assembly includes one or more actuators and linkage systems to lift the toolbar attached thereto in an arced manner in moving from a field use configuration to a transport configuration. A rotating mechanism can also include one or more actuators to rotate the toolbar about a pivot member. *See* Abstract, para. 0017.

10. U.S. Patent 8,567,517 to Friggstad (CNH Canada, Ltd.) (“the ’517 patent”). EX1014

248. The ’517 patent issued on October 29, 2013, and therefore is prior art to the ’989 patent under 35 U.S.C. § 102(b).

249. The ’517 patent is directed to a system for actuating a tool frame on an agricultural implement, and more specifically, to a frame actuator configured to transfer weight from a tool bar to the tool frame while the tool frame is in a lowered position, and to raise the tool frame into a transport position. Col. 1:5-10. The ’517 patent is attempting to solve a problem with ground penetration of a planter. Col. 1:29-32.



250.

251. The agricultural implement also includes multiple row units coupled to the tool frame, and a frame actuator extending between the tool bar and the tool frame. The frame actuator is configured to rotate the tool frame between a lowered position that places each row unit in contact with soil and a transport position that raises each row unit above the soil. The frame actuator is also configured to transfer weight from the tool bar to the tool frame while the tool frame is in the lowered position. Each row unit includes a ground engaging tool configured to selectively engage and disengage the soil while the tool frame is in the lowered position. Transferring weight from the toolbar to the tool frame urges the row units against the soil despite variations in soil elevation and/or torque induced by a draft force acting on the ground engaging tools. Consequently, the ground engaging tools may maintain a desired penetration depth into the soil during seeding and/or planting operations. Col. 1:41-58.

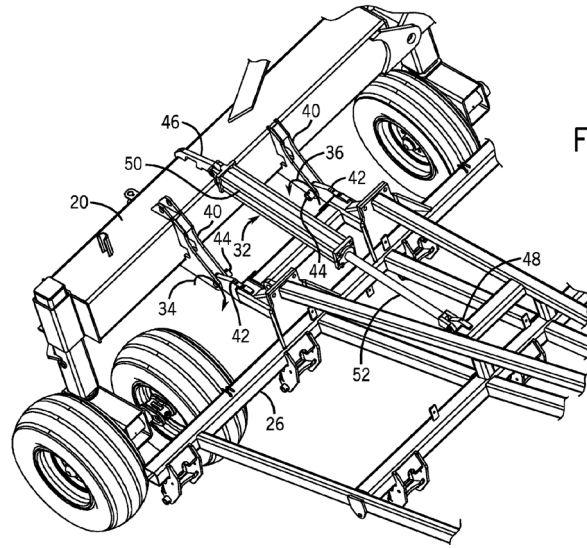


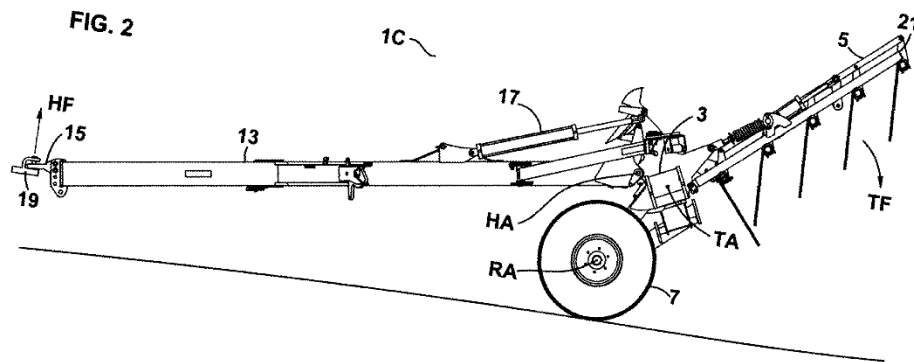
FIG. 2

252.

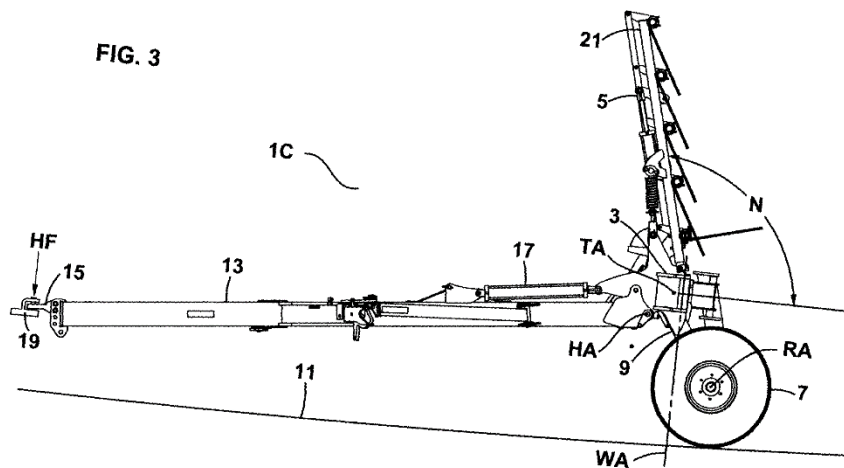
253. As shown above, the tool frame 26 is rotatably coupled to the tool bar 20 such that the tool frame 26 may adjust to the contours of the terrain, and transition to the transport position. Col. 3:45-49. An actuator 32 rotates the tool bar about a pin 44 in the hinged coupling (40, 42, 44) connecting the tool bar to the frame. Col. 3:48-60.

254. Thus, the use of a hinged coupling between the tool bar and the frame of a farm implement, such as a planter, was well known and it would have been obvious to use this arrangement with the implement of Houck or Deere I to provide for better range of movement of the tool bar.

10. U.S. Patent Application Publication 2014/0069670 to Friesen et al. (“Friesen”). EX1015



259.



260.

261. See, EX1015 ¶¶0012-0014. Comparing the above figures with Fig. 3 of the '989 patent, it is clear that the rotation of the toolbar is the same in Friesen as in the '989 patent.

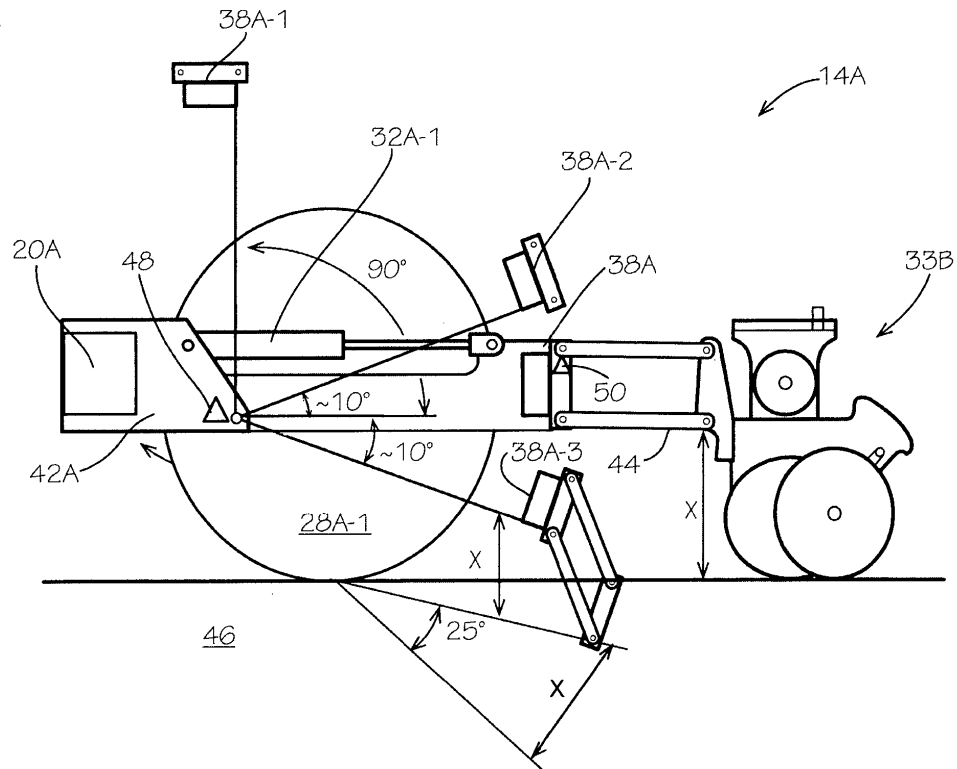


FIG. 3

262.

263. “Comparing the position of FIG. 1 and FIG. 3 it can be seen that the center tool bar 3 pivots about the hitch pivot axis HA through an angle N greater than ninety degrees when moving from the field operating position of FIG. 1 to the transport position of FIG. 3.” EX1015 ¶0026.

264. Compare positions 38A-3 of Friesen with Fig. 1, 38A-2 with Fig. 2 of Friesen, and 38A-1 with Fig. 3 of Friesen. The movement is the same as in the ‘989 patent as in the prior art.

265. During the prosecution of the '989 patent, Friesen was never considered in combination with Hubalek, Deere I, Amazonen, or Poettinger.

VII. DISCUSSION OF CLAIMS

266. In the following sections, I analyze the challenged claims of the '989 patent. As part of this analysis, I evaluate each claim as a whole while also explaining why each limitation reflects a process or feature that was routine and conventional to those of ordinary skill in the art in light of the disclosures of the prior art. I will also explain how the skilled person would have found the features of the claims obvious based on the prior art. I will explain why the skilled person would have been motivated to implement certain teachings of the prior art and/or to combine such teachings from different references. In my analysis, I have applied the legal framework discussed above, and considered the words of the claims, the teaching of the Specification, and the prosecution history of the '989 patent.

267. As described herein, it is my opinion that each and every element of claims 1-4, 8, 10-13 and 15-18 of the '989 patent can be found in prior art, as set forth above in Section VI, which is hereby incorporated into this Section by reference, and as further set forth below.

268. It is my opinion that the claims of the '989 patent merely recite routine features of a farm implement. These features include an actuator, a controller, two

sensors and a hinged coupling. It was well-known by December 2016 to couple tools on a tool bar to an implement frame via a hinged coupling, and to measure the distance to the ground and the angle of the coupling in order to calculate the depth of the tools in the ground. It was obvious to use a controller and an actuator to adjust the angle of the tool bar in order to ensure the tools are maintaining proper depth.

A. Independent Claim 1 of the '989 Patent

269. In my opinion, each and every element of claim 1 was already disclosed by the prior art and the skilled person would have had no problem combining the teaching of the prior art to arrive at each and every element of claim 1 as arranged. Below I set forth non-limiting examples where each element may be found in selected prior art references. I note, however, that the subject matter of claim 1 was generally well-known as shown by the disclosures of many other references described above in Section V. Therefore, to the extent an element may differ from the prior art, it would have been generally known to the skilled person by December 2016 given the extent and depth of the prior art on this subject matter.

1. A system, comprising:

270. The first line is the preamble. The word “system” can cover nearly anything. I know that the '989 patent is directed to a farm implement, such as a

planter. Each of the references described in Section V above are directed to the same type of systems as the '989 patent.

i. an elongate frame member;

271. Element *i* is an elongate frame member. In order to work the ground, a farm implement will include numerous spaced tools, forming rows, which cultivate the soil for planting. It was well known by December 2016 to provide a frame member perpendicular to the rows for attaching the tools. In the '989 patent, three frame members (24A, 24B, 26) are provided for holding the tools 33 mounted on tool bars 22:

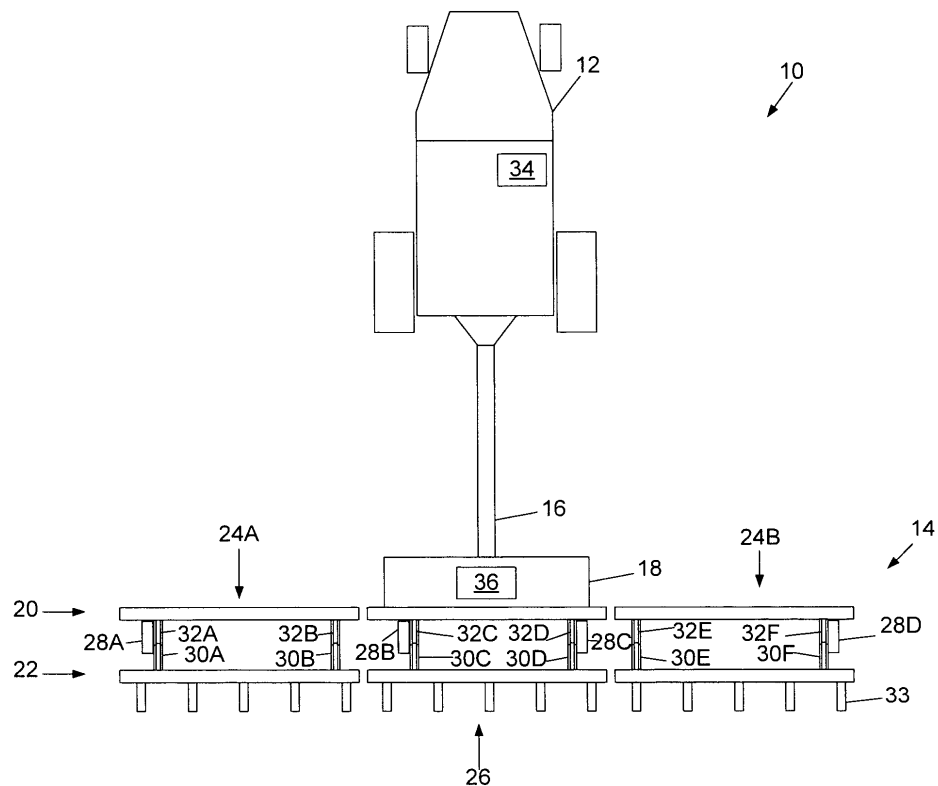
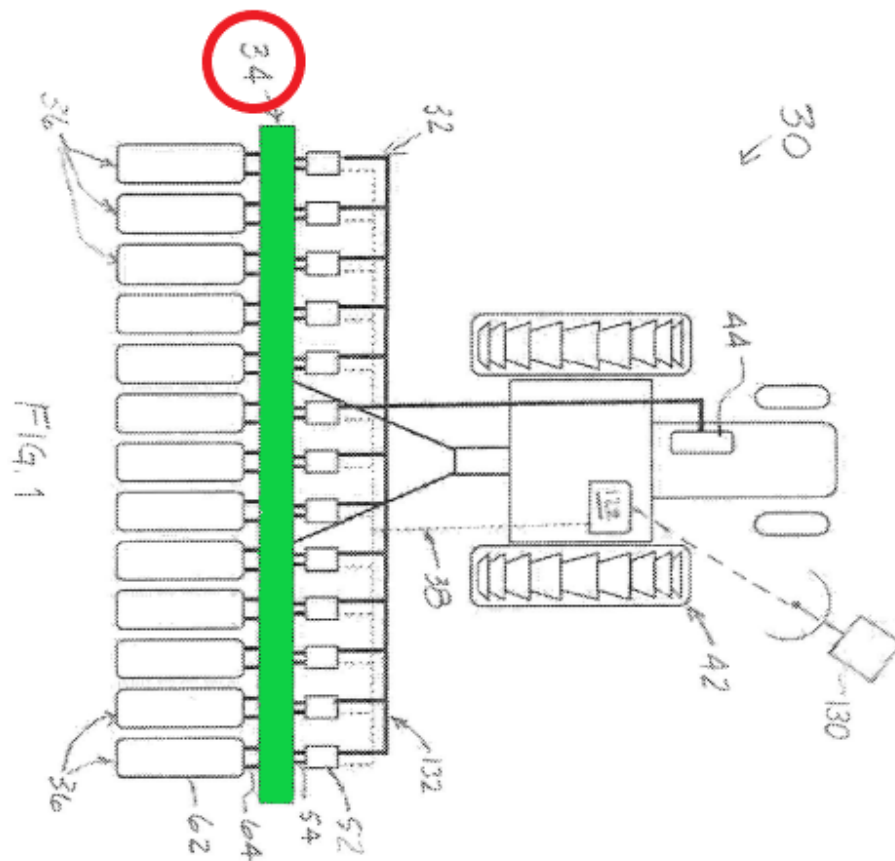


FIG. 1

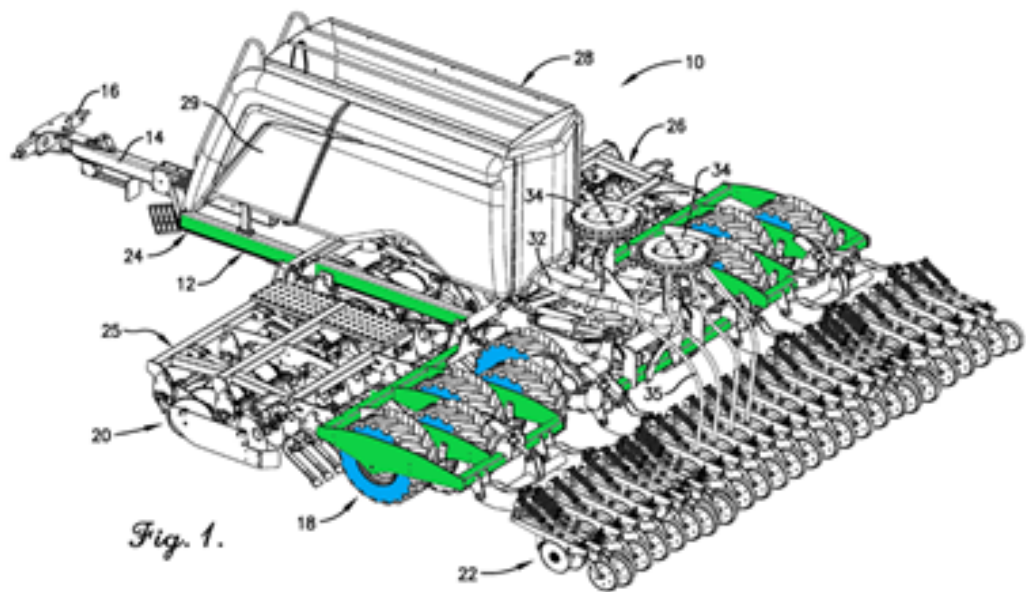
272.

273. The planting system of Houck also comprises an elongated frame element 34. (See figure 1 and para. [0027]).



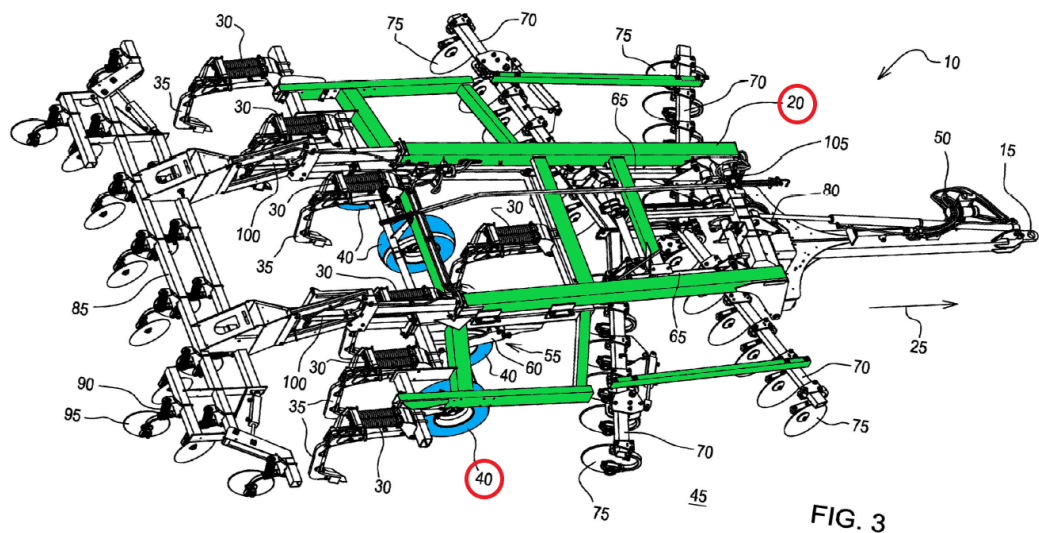
274.

275. The planting system of Hubalek also includes an elongated frame element (12). (see column 2, line 59 and figure 1) This also shows elements of the frame connected to the support wheels (18) that are longitudinal or parallel with the crop rows. That demonstrates that frame components are both transverse (perpendicular) and longitudinal (parallel) to the direction of travel.



276.

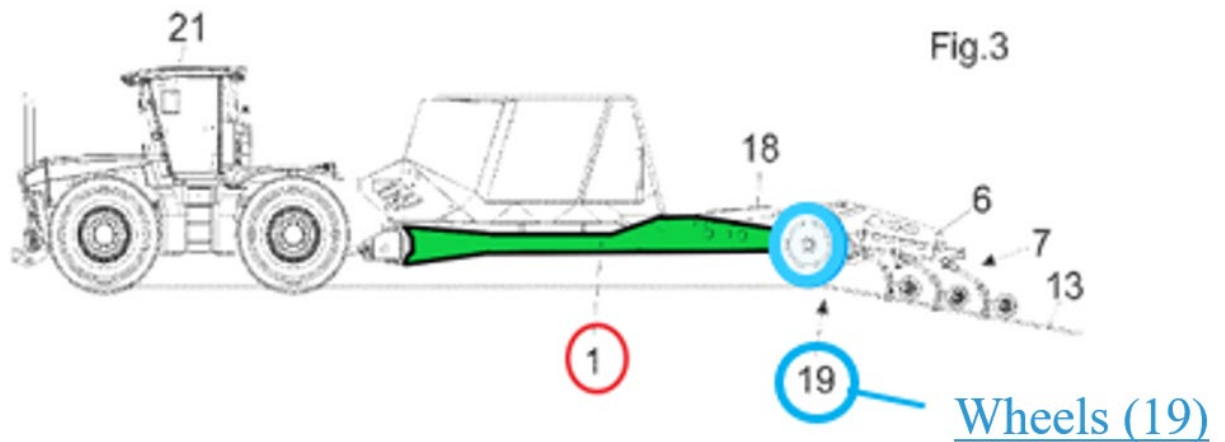
277. The planting system of Deere I also comprises an elongated frame element 20 with wheels 40 coupled to it. EX1007, Figs. 1-3 and col. 3, lines 27-29.



278.

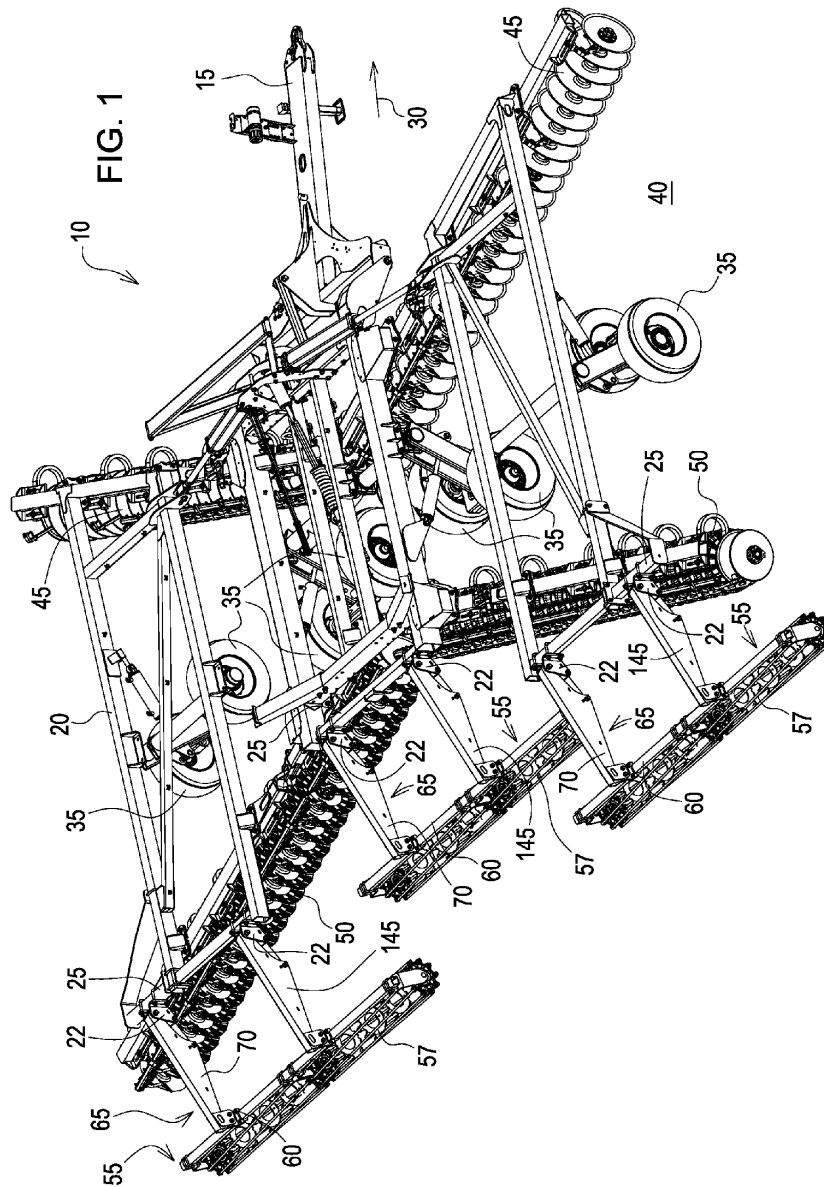
279. The planting system of Amazonen also comprises a frame element 1 with wheels 19. EX1008 at 3.

280.



281.

282. Deere II teaches a hinged drawbar that couples earth-working tools to a farm implement frame. The implement frame has three elongated members 25 for mounting tool bars thereto.



283.

- ii. *an elongate toolbar coupled to the frame member via a hinged joint, the toolbar oriented parallel to the frame member;*

284. Element *ii* is a toolbar coupled to the frame member. As shown above, the '989 patent discloses three tool bars, two wing members 24A, 24B and the center section 26. Each of the toolbars is elongated similar to the frame member that it is coupled with, and the toolbars are coupled to the frame member with a hinge.

285. Houck does not disclose a toolbar identical to the toolbar 38, 56 of the '989 patent, but Houck discloses a structure 70 is equivalent to the toolbar 38 of '989 patent and performs the same function, which is, to provide support to the assembly of tools on the agricultural implement. The toolbar element or toolbar of an agricultural implement is nothing but a structure, to which the operating tools are mounted. Therefore, the part highlighted above (Section VI.B.1) in Fig. 2C of Houck corresponds to the toolbar 38, 56 because its function is the same, which is, provide a structure 70 on which the toolbar 72, 74 and 76 is mounted. As a result, the structure 70 of Houck corresponds to a toolbar is coupled to the frame element 34 by means of an articulation link 64 which rotates around a pivot 65. (See para. 0028 of Houck). The articulation link is hinged.

286. Hubalek teaches an elongate toolbar 78 coupled to the frame element 12 by means of an articulation link 70, 72 (see figures 1 and 11, column 4, lines 29

to 38). The articulation link is hinged and therefore pivots (i.e., allows rotation). See Figs. 1, 11.

287. Deere I teaches a toolbar 85, 285 coupled to the frame element 20, 220 by means of an articulation link. (See column 4, lines 7-16, Fig. 3 and column 6, lines 46-49, Fig. 10).

288. Amazonen also teaches a toolbar 12 coupled to the frame element 1 by means of an articulation link 15) formed by the structure 6. EX1008 at 3.

289. Poettinger also teaches a toolbar (15) coupled to the frame element (2) by means of an articulation link. EX1009 at 10.

290. Deere II likewise discloses elongated toolbars coupled to the frame via a hinged joint.

iii. a plurality of row units coupled to the tool bar;

291. In general, the type of farm implements that the '989 patent is direct to utilize a plurality of row units, such as openers, seeders, etc.

292. Hubalek discloses an elongate toolbar 78 is coupled to the frame element 12 by means of a pivoting articulation link 70, 72. EX1006 4:29-38, Figs. 1, 11. A plurality of row units 22 are coupled to the toolbar. *Id.*

293. Houck discloses that its planting system 30 includes a seeding implement 32 including an implement frame 34, a plurality of seeding row

assemblies 36 operatively coupled with the implement frame 34, and a control system 38 operatively coupled with each of the seeding row assemblies 36. EX1005 ¶0027.

294. Poettinger also has a number row units 9 coupled with the toolbar 15. EX1009 at 10, Fig. 1.

295. Deere I discloses toolbar 85 is coupled with row units 90. EX1007 4:7-16, Fig. 3 and 6:46-49, Fig. 10.

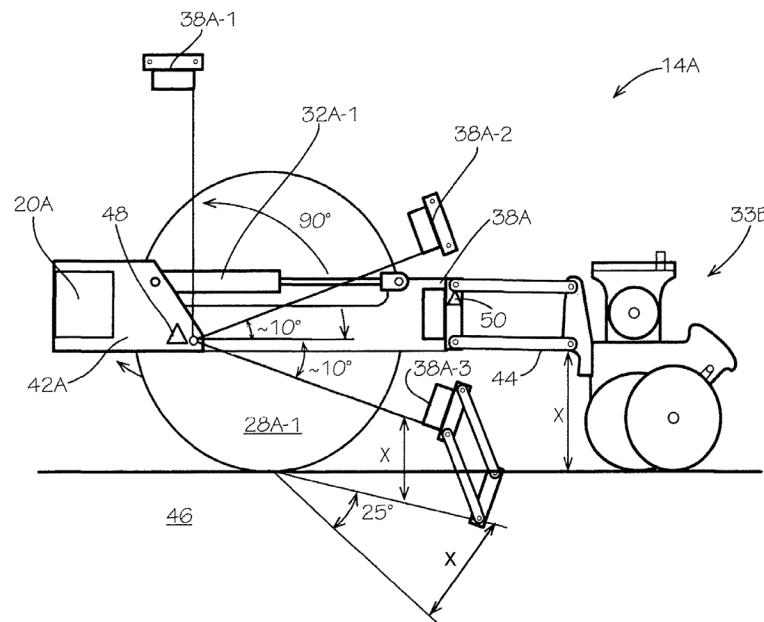
296. Amazonen discloses a plurality of row units 7 are coupled with the toolbar 12. EX1008 Fig. 2 and 3.

iv. a first sensor configured to sense a position of the toolbar relative to ground;

297. Element *iv* is a sensor for determining a position of the toolbar relative to the ground. The '989 patent states that sensors may be disposed for each row unit 33B of a planter, or one or more sensors may be used for all of the row units 33B. In general, to enable the toolbar 38A (and hence toolbar 38A) to follow the contour of the field, sensor information is received about the (relative) position of the toolbar 38A (and by extension, the relative position of the 30 row unit 33B) relative to the ground. A row unit sensor, such as sensor 50, is used for the contouring operation.

In one embodiment, at least one row unit sensor 50 is used, though in some embodiments, there may be a row unit sensor 50 per every row unit 33B.

298. The patent further discloses that sensor 50 may be located at the pivot 60 point between the linkage 44 and the toolbar 38A, and used to sense the position of the toolbar 38A (and hence the position of the row unit 33B) relative to the ground. See below.



299.

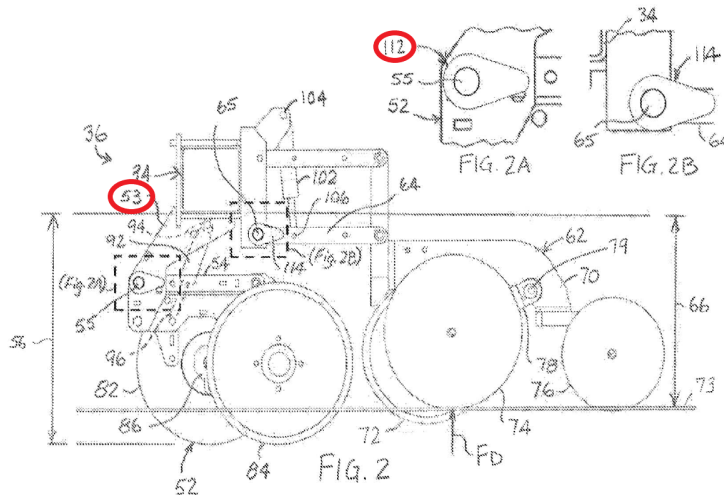
300. As described above in Section VI.B, it was well known to use sensors in devices like that of the 989 patent before the filing of the 989 patent. For instance, the background section of Poettinger II states that it was known in the prior art to monitor the working height of the working units by detecting the height position of

the working units with various sensors. Thus, this element was already well-known in the field.

301. Houck discloses a farm implement with multiple sensors. Position sensors 112 and 114 can be used to measure angle and to measure elevation. See Paras. 0033, 0037-0038. That is, by measuring the angle of the toolbar with respect to the frame, both the angle is determined (claimed second sensor) and a distance from the ground is determined via calculation (claimed first sensor). Houck also discloses an embodiment where seeding row assembly can utilize a second position sensor for control of elevation of the row units. See para. 0046. Measurement of the elevation 66 of the frame member and the relative depth 56 of the row units is shown in Fig. 2.

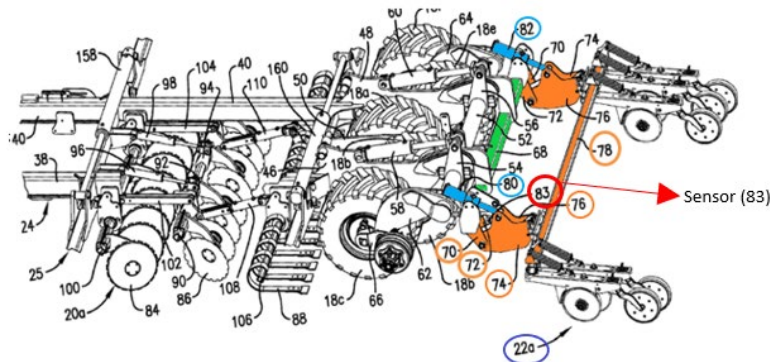
302. Houck teaches the first sensor 112 is a first sensor configured to sense a position of the toolbar relative to ground. The first sensor 112 is also configured to detect the structure position 53 (equivalent to the toolbar of the 989 patent) in relation to the ground. See para. 0033.

303. In the embodiment of Fig. 6, an additional position sensor 206 is added. Position sensor 206 measures the elevation 204 of the tool bar (i.e., distance to the ground). Para. 0047. Thus Houck has several sensors that correspond to the claimed first sensor.



304.

305. Hubalek teaches a sensor 83 coupled to the frame element (see figure 11 and column 4, lines 47 to 51).



306.

307. “An opener down position sensor 83 (FIG. 11) in the nature of a proximity switch is mounted between one pair of the links 74, 76 and is covered and uncovered thereby for detecting when openers 22a are in their lowered position.”

308. The sensor 83 of Hubalek is configured to detect the position of the units of row 22. Thus, in an analogic way to the second sensor 48 of the ‘989 patent,

the sensor 83 detects the position of the toolbar 78 in relation to the frame element (see figure 11 and column 4, lines 47 to 51). The sensor 83 also detects whether the tool bar is in a transport position or in a ground engaging position, which is analogous to detecting the position of the toolbar relative to the ground. Thus, sensor 83 can also correspond to the claimed first sensor.

309. Deere I teaches a control system 105 comprising position sensors for each one of the toolbars of the row unit of the agricultural implement, which is, a first sensor position 110 for the first ground-engaging tool 30, a second position sensor 120 for the second ground-engaging tool 70, and a third position sensor 130 for the third ground-engaging tool 90 (see column 4, lines 27-38, lines 47-55 and column 4, line 64a, column 5, line 4).

310. “With continued reference to FIG. 3, a control system 105 is coupled to the agricultural implement 10. Illustratively, the control system 105 is coupled to the first frame section 20. Referring to FIGS. 5 and 6, the control system 105 includes a first position sensor 110 (e.g., hall effect rotational sensor, potentiometer) configured to measure a first depth indication (e.g., relative position) of an actual operating depth of the first ground-engaging tool 30 and configured to generate a corresponding first position signal 115. The illustrated first position sensor 110 is a first Hall Effect

rotational sensor 112. Other types of the first position sensor 110 are contemplated by this disclosure.”

311. “With reference to FIGS. 4 and 5, a second position sensor 120 (e.g., hall effect rotational sensor, potentiometer) is configured to measure a second depth indication (e.g., relative position) of an actual operating depth of the second ground-engaging tool 70 and configured to generate a corresponding second position signal 125. The illustrated second position sensor 120 is a second Hall Effect rotational sensor 122. Other types of the second position sensor 120 are contemplated by 55 of this disclosure.

312. “With reference to FIGS. 5-7, a third position sensor 130 (e.g., hall effect rotational sensor, potentiometer) is configured to measure a third depth indication (e.g., relative position) of an actual operating depth of the third ground-engaging tool 90 and configured to generate a corresponding third position signal 135. The illustrated third position sensor 130 is a third Hall Effect rotational sensor 132. Other types of the third position sensor 130 are contemplated by this disclosure.

313. Therefore, Deere I already teaches the usage of the position sensors.

314. Amazonen teaches a first sensor 20 to detect the position of the ground-engaging tools 8. EX1008 at 3. The sensor is mounted on the tool bar. By measuring the deflection of the tools, Amazonen measures the distance to the ground and

therefore, sensor 20 corresponds to the claimed first sensor. It would have been obvious to the skilled person add the sensor of Amazonen to Hubalek.

315. KR'062 discloses a device and a method for controlling a plowing depth. The device for controlling a plowing depth includes a distance sensor measuring the earth surface distance and transmitting the earth surface distance to a control unit; an angle sensor measuring the angle of a lower link and transmitting the angle of the lower link to the control unit; the control unit controlling a flow control valve; a storage unit storing data for controlling the plowing depth according to the control of the control unit; a display unit displaying driving state information; the flow control valve controlling the depth of a plow by lifting a plow frame with a lift rod; and an operation unit applying a command and the data inputted according to manual control to the control unit. EX1012 at 1.

316. Thus, KR'062 discloses the claims first sensor.

v. a second sensor configured to sense an angle of the toolbar relative to the frame member; and

317. Element *v* is a second sensor for detecting the angle of the toolbar relative to the frame. The '989 patent discloses that an angle sensor 48 may be positioned at the hinged joint coupling the toolbar to the frame to detect the relative angle of the tool bar. This feature also was well-known by December 2016.

318. As described above, several references disclose a second sensor for detecting the relative angle of the toolbar relative to the frame member that it is attached to.

319. As mentioned above, Houck teaches position sensors to detect the position of the toolbar and articulate it according to the position detected. For instance, Houck discloses The position sensors 112 and 114 are arranged to detect an angular rotation of the respective linkages 54 and 64 about their respective pivots 55 and 65, as depicted herein, for example by a rotating potentiometer. Houck teaches a second sensor 114 coupled to the frame element 34 (see clauses 0028 and 0033 above and Fig. 2), is a second sensor configured to sense an angle of the toolbar relative to the frame member.

320. Hubalek includes a sensor 83 that determines whether the toolbar is in a travel position or in a ground engaging position. Hubalek therefore also measures the position of the toolbar relative to the frame of the implement.

321. Each of the sensors taught by Deere I are rotational sensors. Sensor 130 is a Hall Effect rotational sensor 132 and is positioned on a hinge coupling the frame to the toolbar to measure the angle thereof. Col. 4, lines 64 – col. 5, line 4; Fig. 7.

322. KR'062 disclose an angle sensor 40 provided in the tractor coupling unit for coupling the lower link 13 to the tractor 10, which measures the angle of the lower link 13 and transmits the measured angle to the control unit 70.

vi. *an actuator coupled between the frame member and the toolbar, the actuator configured to rotate the toolbar relative to the frame member based on a sensed position of the toolbar;*

323. The '989 patent disclose that actuators 32 may be configured as single rod hydraulic actuators (e.g., a linear-acting, piston and rod assembly, though in some embodiments, rotary actuation may be used). In some embodiments, the actuators 32 may be configured as either pneumatic, electric, magnetic, or electromagnetic actuators. Col. 3, lines 58-60. Such actuators were well-known for rotating a tool bar from a working position to a travelling position, thereby controlling the angle of rotation of the toolbar relative to the implement frame.

324. Houck discloses an actuator 102 coupled between the frame element 34 and the structure 70. (See figure 4). Houck teaches position sensors to detect the position of the toolbar and articulate it via the actuator, according to the position detected. "Each of the seed row assemblies 36 includes a ground engaging attachment or tillage row unit 52 coupled to a rigid frame 53 by a first linkage 54

327. “A pair of hydraulic cylinders 80, 82 have their rod ends connected to links 74, 76 respectively and their base ends supported on upstanding structure fixed to transverse beam 68 for raising and lowering links 74, 76.”

328. Similarly, the actuator 80, 82 of Hubalek is configured to lift or lower the toolbar 78 in relation to the frame element 12 based on the sensed position (provided in column 4, lines 42 a 51).

329. Even if it isn't clear in Hubalek that the actuator 80, 82 is configured to rotate the toolbar 78, it is easy to understand that the toolbar 78 rotates too, as disclosed in the '989 patent. From figure 11 on, when the cylinder 80, 82 is activated, the link 74, 76 rotates around the link 70, 72, and as a consequence, executes the rotation motion of the toolbar 78 around its own axis, as provided in presentation below, which shows the full cylinder stroke 80, 82 when activated.

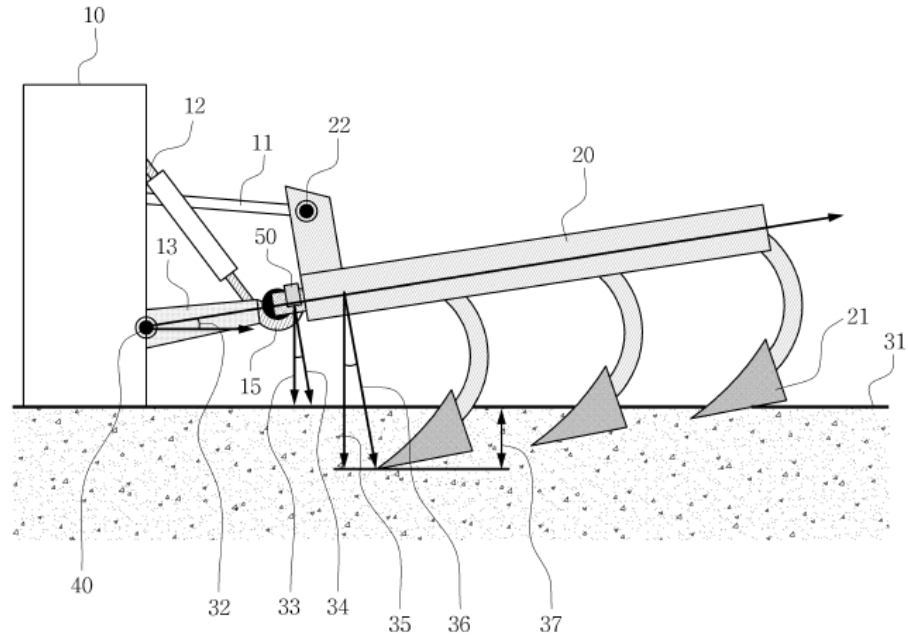
330. Deere I teaches a toolbar 85, 285 coupled to the frame element 20, 220 by means of an articulation link. (See column 4, lines 7-16, Fig. 3 and column 6, lines 46-49, Fig. 10). “With reference to FIG. 3, illustratively, a third frame section 85 is pivotally coupled to the first frame section 20, rearward of the first ground engaging tool 30. A third ground-engaging tool 90 is coupled to the third frame section 85. The illustrated third ground-engaging tool 90 is a closing disk assembly 95. Other ground-engaging tools (e.g., ripper, disk gang assembly) are contemplated by this disclosure.

331. A third adjustment device 100 (e.g., extendable and retractable hydraulic cylinder) is coupled to the first frame section 20 and the third frame section 85.” “With continued reference to FIG. 10, a third adjustment device 300 (e.g., electronic linear actuator, electronic rotational actuator) is coupled to the first frame section 220 and a third frame section 285.”

332. Amazonen discloses the claimed arrangement as well. “The supporting frame 6 is attached to the machine frame 1 by means of an articulated coupling 15. This articulated coupling 15 has a pivot axle 17 running transversely to the direction of travel 16. Furthermore, at least one motor-driven actuating device in the form of a hydraulic cylinder 18 is arranged between the supporting frame 6 and the machine frame 1. By means of this hydraulic cylinder 18, the supporting frame 6 with the soil cultivating elements 8 and associated rollers 9 arranged thereon can be pivoted about the pivot axle 18 running transversely to the direction of travel 16.” EX1008 at 3.

333. Poettinger also discloses an actuator (34) coupled between a frame element (2) and the toolbar (15). (See paras. [0032] and [0033] of the translation of the machine and figure 1 and 2).

334. KR’062 also discloses an actuator coupled with the lower link 13 to drive up and down the lower link 13 to raise and lower a plough frame 20 connected to the lower connecting portion 15.



335.

336. As discussed above in Section IV.C, during prosecution, AGCO argued that the prior art did not “rotate” the toolbar relative to the frame, because of the use of parallel linkages. I disagree with the argument that the use of parallel linkages in Houck, Hubalek and Deere I do not “rotate” the tool bar.

337. The difference between revolving and rotating in the context of the patent claims is a distinction without a difference. The applicant made no argument during prosecution of the '989 patent that rotating the toolbar provides an advantage over Deere I. The Specification likewise fails to disclose any advantage of rotation versus revolution. The patent applicant admitted that Deere I moves the toolbar both vertically and laterally. EX1004 at 51. In my opinion, the arrangement of Deere I

performs the same function as that of the '989 patent. See EX1001, Col. 6, lines 24-30 (“In general, to enable the toolbar 38A (and hence toolbar 38A) to follow the contour of the field, sensor information is received about the (relative) position of the toolbar 38A (and by extension, the relative position of the 30 row unit 33B) relative to the ground.” (underlining added)). The '989 patent measures the relative angle of the toolbar using a sensor 48 positioned in an angular position between the toolbar and the frame at a pivot point. *Id.*, lines 54-59. In Deere I, the position sensor 132 is likewise located on a pivot point to measure the relative angle of the toolbar to the frame, using a Hall Effect rotational sensor. *Id.* col. 5, lines 2-3. This arrangement is equivalent to, if not the same as the arrangement of claim 1.

338. In fact, it is not clear from the disclosure of Deere I that rotation does not occur. Deere I merely discloses that “a third frame section 85 is pivotally coupled to the first frame section 20, rearward of the first ground engaging tool 30.” EX1007, Col. 4, lines 7-9. Pivotaly connected suggest rotation. There is no description that a parallel linkage is required, although one is shown in the figures. Fig. 7 shows an enlarged view of an embodiment of Deere I. In my opinion, when the linkages differ in size or shape, the arrangement is simply a four-bar linkage that allows some rotation of the tool bar. Here, in the arrangement of Deere I, there is

going to be some rotation and the movement will not be only revolution. Regardless, the effect is the same.

339. Coupling the toolbar to a farm implement frame using a hinged joint was well-known by December 2016, as disclosed by Deere II. Therefore, it would have been obvious to the POSITA to modify the device of Deere I to include a hinged joint similar to the one discloses by Deere II. Both patents are in the same field of endeavor and the skilled person would not have any problem making the proposed modification.

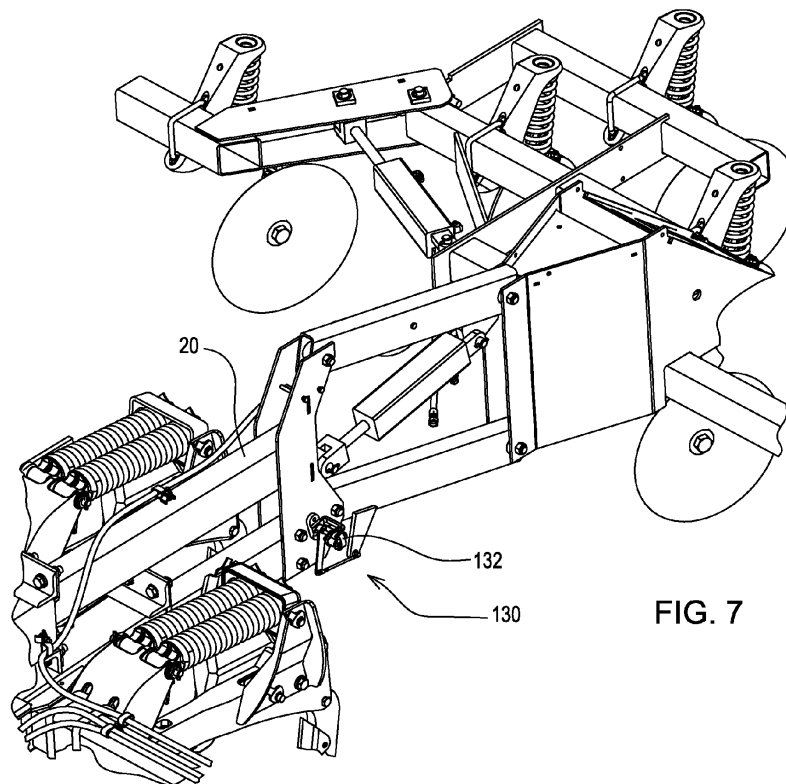
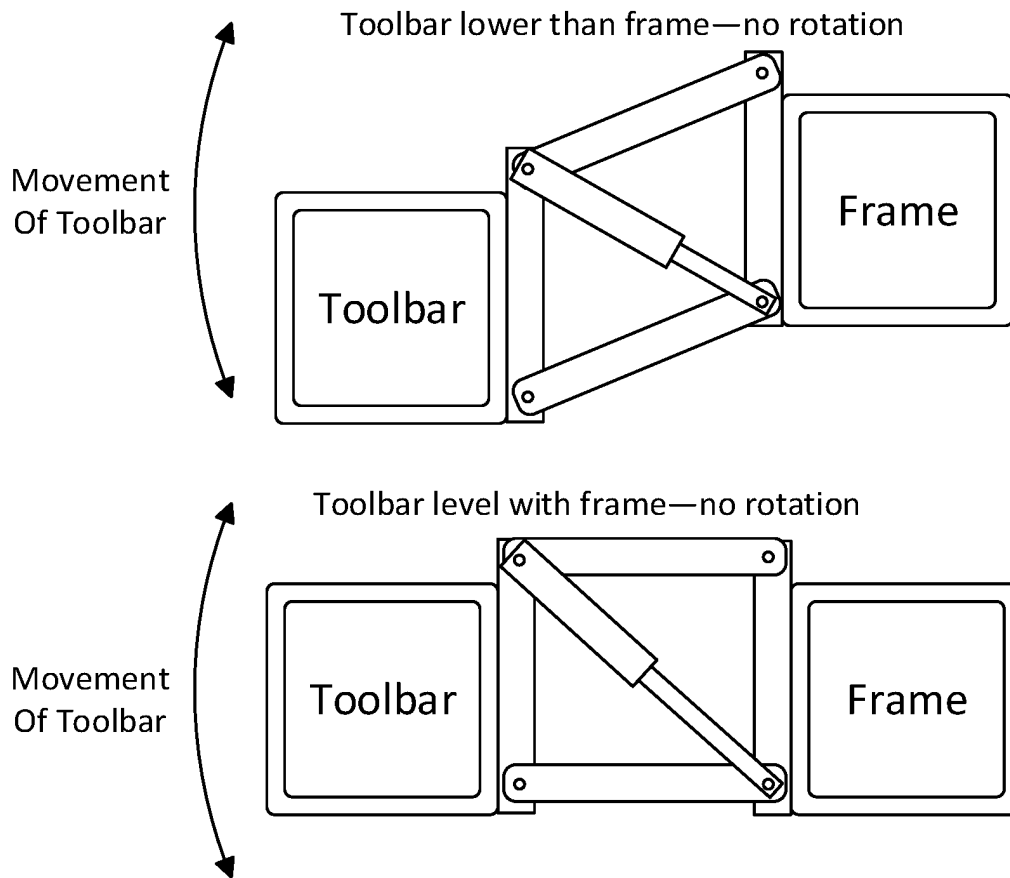


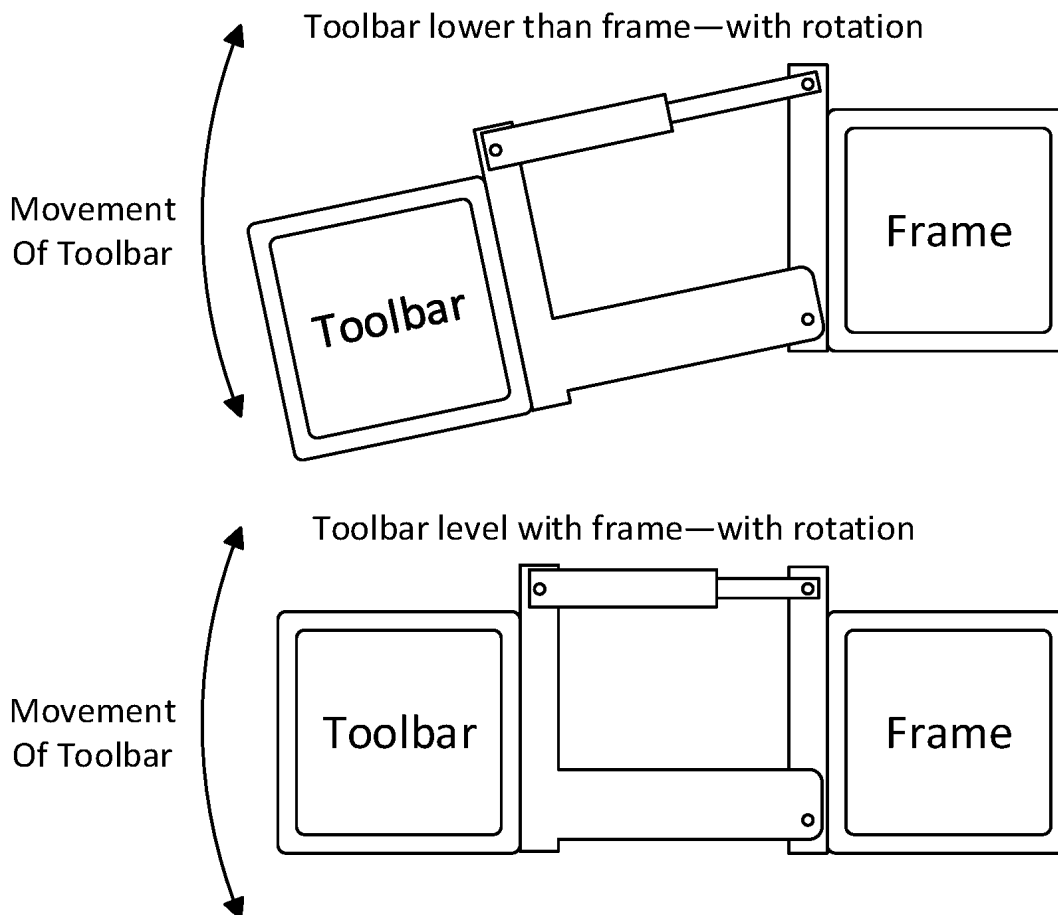
FIG. 7

340.

341. The arrangement is clearly not a perfect parallelogram and the position of the actuator suggests that some rotation likely occurs. It looks to me like the actuators position and the extra couplings will allow the toolbar to rotate. I compare the figures AGCO submitted during appeal with the one above.



Deere I as represented by AGCO during prosecution



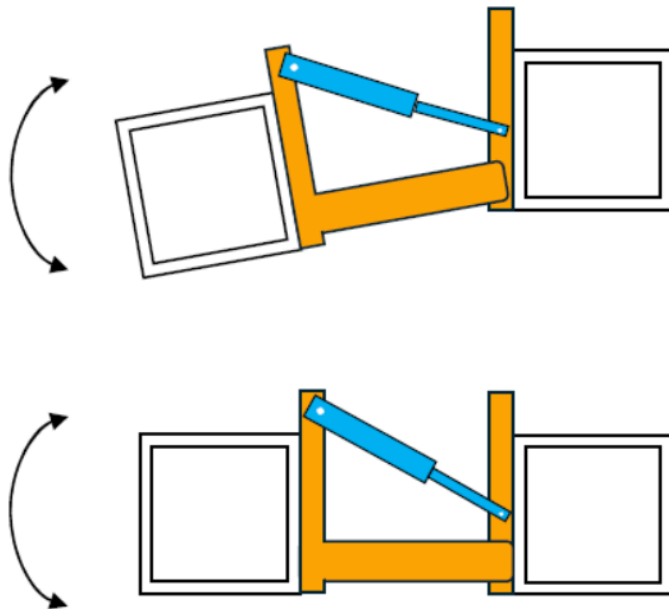
The claimed arrangement as represented by AGCO during prosecution

EX1004 at 50-51. In the Deere I drawing, the position of the actuator is in a different location, as is the shape of the linkages, as compared to Deere I. In neither drawing are the tools shown and the claims do not include any limitations regarding how the tools are attached to the toolbar.

342. In my opinion, it would have been an obvious design consideration to modify the linkage of Deere I to rotate. A person having ordinary skill would have

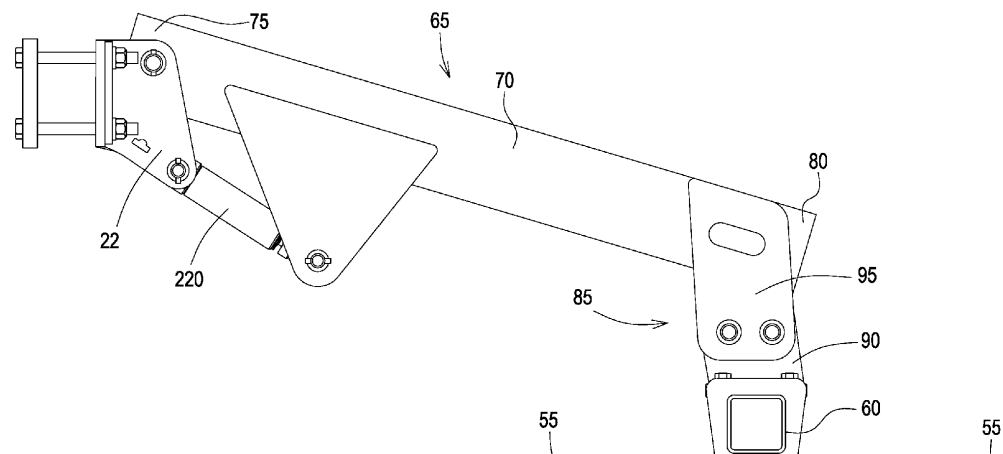
known that removing one of the parallel linkages from Deere I would eliminate one of the articulation points of the parallel link, and would result in a more pronounced rotation movement. See image below:

343.

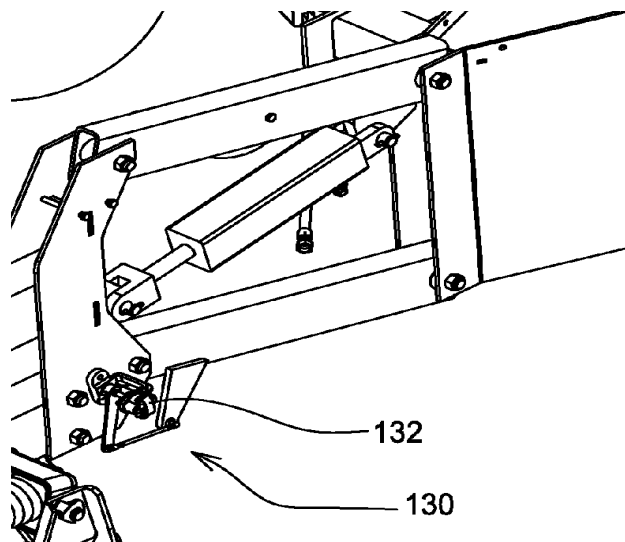


344. Thus, it would have been obvious to modify Deere I's linkage to pivot to provide more range of movement. In my opinion, Deere I discloses this element expressly, but it is also an obvious design choice to modify Deere I.

345. Even if it would not have been an obvious design choice to modify the linkages in Deere I, Deere II teaches that a hinged linkage that rotates in nearly an identical machine as Deere I. I compare the drawings below.



Deere II



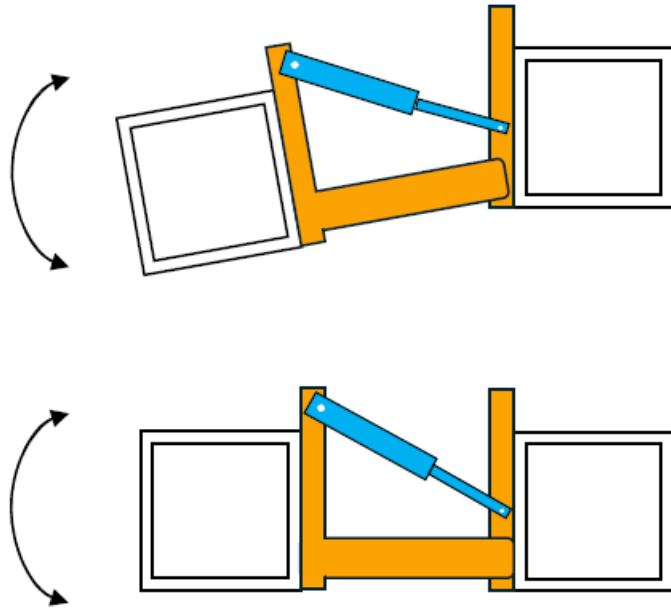
Deere I

346. Removing the lower linkage from Deere I results in nearly the same linkage as Deere II. I believe it would have been an obvious to use a hinged linkage in Deere I, like the one shown in Deere II or as shown in other references, such as Hubalek or KR'062 as already discussed above in Section VI.B.

347. It would have been well within the skilled person's average skill to make such a modification and I do not believe it would have taken any experimentations and there would have been a strong expectation of success.

348. Reaching a rotation motion of the toolbar in relation to the frame element is obvious and usual for a technician in the subject matter. In my opinion, it is just a question of choice regarding the articulation way desired to be applied to the toolbar, that is, if one requires that the toolbar rotates or that it just revolves in relation to the frame element of the agricultural implement. In fact, the '989 patent does not describe any advantage for its hinged joint over parallel linkages.

349. For a technician in the subject matter, it would be obvious to obtain the rotation motion, that is, rotate the toolbar in relation to the frame element of the agricultural implement, according to the teachings of Deere II. A technician in the subject matter with usual knowledge would obviously know that by just removing one of the parallel tie rods and eliminate one of the articulation points of the parallel link of the implement taught in Deere II to obtain the rotation movement, as provided in the drawings below.



350. Consequently, it would be obvious for a technician in the subject matter to obtain the same configuration with the same result reached by the '989 patent application.

vii. wherein the toolbar remains parallel to the frame member throughout the rotation of the toolbar.

351. This element *vii* logically follows the arrangement claimed and would have been well-known by December 2016. Namely, if the toolbar is hinged to a frame member, when it is rotated, it will remain parallel to the frame member. This is shown in the references described in Section VI.B. Houck, Hubalek, Deere I,

Deere II, Amazonen, and Poettinger all disclose that the toolbar remains parallel to the back side of the frame member that it is attached to.

352. There was a clear motivation to combine the references and the skilled person in the art would have had a reasonable expectation of success when making this combination.

353. For example, Hubalek discloses the basic arrangement claim 1, but only discloses a single sensor. It would have been obvious to the POSITA by December 2016, to use two sensors, a first sensor for measuring the distance to the ground, and a second sensor for measuring the angle of the coupling for the tool bar, in order to calculate and maintain the proper ground depth for the ground working tools as clearly taught by KR'062. It therefore would have been obvious to add the sensors of KR'062 to the implement of Hubalek in order to improve the operation of the tools 22 in Hubalek to better control the depth of the tools 22. Such modification would result in a device having each and every element of claim 1. Hubalek and KR'062 are in the same field of endeavor and the additional of a second sensor to Hubalek would have been well within the skill of the POSITA by December 2016, and the POSITA would have had an expectation that such modification would have been successful.

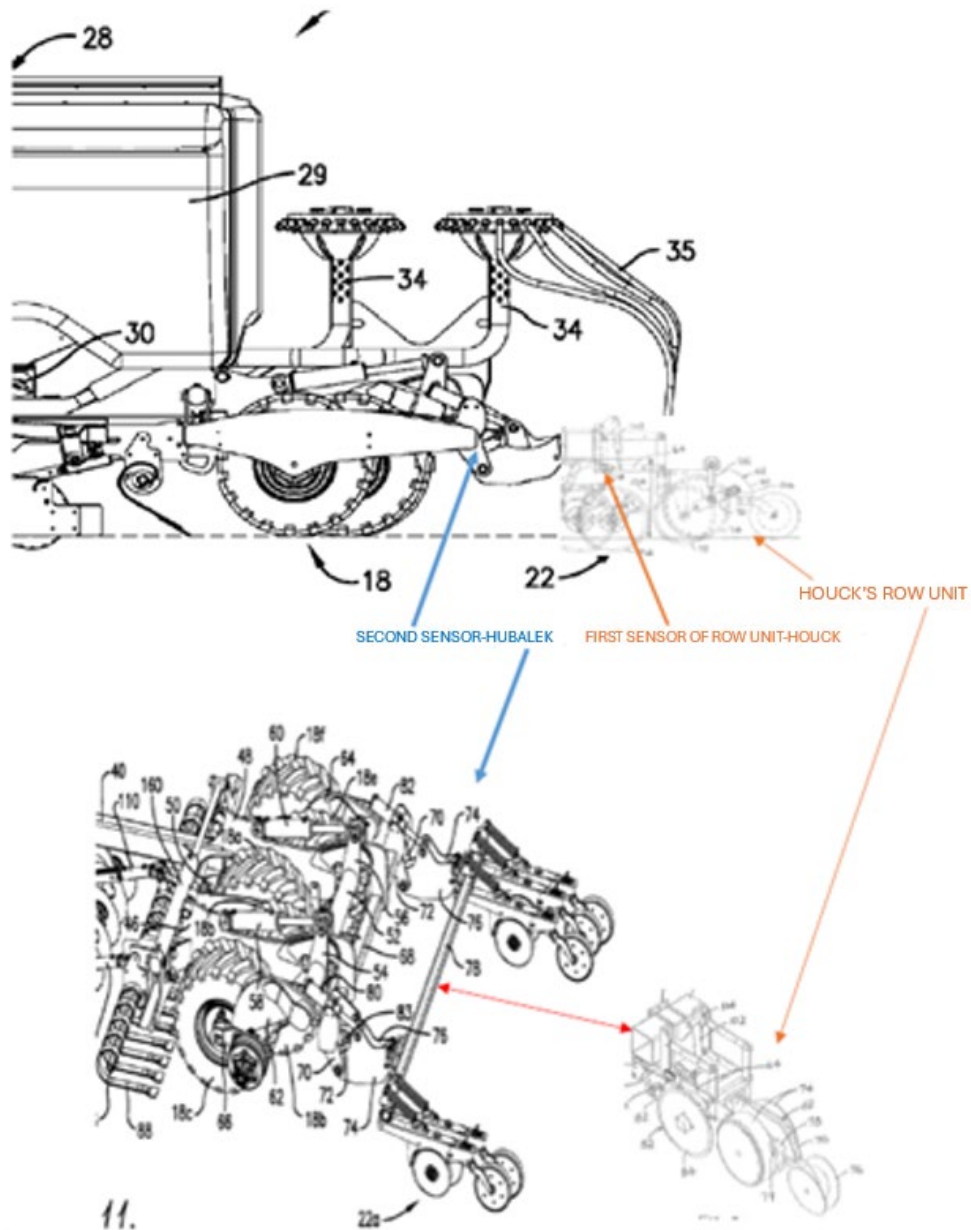
354. Houck also discloses the basic arrangement claim 1, but was distinguished as using parallel linkages instead of a hinged joint. Coupling the toolbar to a farm implement frame using a hinged joint was well-known by December 2016, as disclosed by Hubalek and Deere II. Therefore, it would have been obvious to the POSITA to modify the device of Houck to include a hinged joint similar to the one discloses by Deere II. Both patents are in the same field of endeavor and the skilled person would not have any problem making the proposed modification.

355. Deere I clearly discloses an elongate toolbar pivotably coupled with the implement frame. To the extent that Houck does not disclose an elongated tool bar, it would have been obvious to the POSITA to use an elongated toolbar in the device of Houck, such as the one disclosed by Deere I, to improve the system. For example, adding the toolbar of Deere I to Houck would simply the implement of Houck and reduce the number of actuators required.

356. It would also have been obvious to the POSITA to add a second sensor (112, 114 and/or 206) of Houck to Hubalek to improve the measurement of the position of the tools and allow the tools to better follow the contours of the ground. Moreover, the POSITA would have found it obvious to simply replace the tool assemblies 22a of Hubalek with tool assemblies (70, 72, 74, 76, 112) of Houck in

order to improve further the ability of the tools to follow the contour of the earth being worked. This is shown below in the annotated figures.

357.



358. The POSITA would have understood this to be a natural modification to Hubalek, in my opinion, after having reviewed both references. Hubalek teaches the older concept of raising and lowering the tool bar for travelling and for cultivation, with automation, and the tools use a downpressure system to try to maintain contact with the ground. On the other hand, Houck is directed to a ‘next generation’ of improvements over Hubalek. Houck focuses on features that adjust the tools to follow the contours of the land at a desired depth. The sensors 83 of Hubalek and 112 of Houck would measure the position of the toolbar relative to the frame and relative to the ground. Sensor 112 measures the angle of the tool bar relative to the frame. Sensor 206 measures the elevation of the toolbar. Thus, the resulting combination has both the first and second sensors. Thus, it would have been obvious to add the tool assembly of Houck to Hubalek, which would result in a farm implement having all the elements of claim 1.

B. Claim 2 of the '989 Patent

359. In my opinion, each and every element of claim 2 was already disclosed by the prior art and the skilled person would have had no problem combining the teaching of the prior art to arrive at each and every element of claim 2 as arranged. Below I set forth non-limiting examples of where each element may be found in

selected prior art references. I note, however, that the subject matter of claim 2 was generally well-known as shown by the disclosures of many other references described above in Section VI. Therefore, to the extent an element may differ from the prior art, it would have been generally known to the skilled person by December 2016 given the extent and depth of the prior art on this subject matter.

2. The system of claim 1, further comprising a controller configured to receive first and second signals from the first and second sensors and cause actuation of the actuator based on the first and second signals.

360. Claim 2 depends from claim 1, but adds the element of a controller that receives signals from the sensors and controls the actuator based on the signals. As described above, all the elements of claim 1 are present in the prior art.

361. Hubalek discloses a programmable controller 274, which is the “brains” of a control circuit for controlling the components of its system, including receiving signals from its sensor 83 and controlling various valves and electric motors. See Fig. 15, Col. 8, lines 44-55.

362. KR’062 describes a controller (control unit 70) that receives the distance to the ground from a first sensor (distance sensor 50) and receives the angle of the

tool bar from a second sensor (angle sensor 40) and causes the actuator to raise or lower the toolbar based on the received signals.

363. It would have been obvious to include the features of KR'062 to use both sensors to control the actuator to rotate the tool bar.

364. Houck also discloses a controller for controlling the elevation of the toolbar. The control system 38 comprises a central controller 122 operatively coupled to a user interface 124 and a display 125. The central controller 122, user interface 124, and display 125 can be located on or within the towing unit 42, enabling the operator to make on the go changes. In some embodiments, a plurality of local controllers 126 is in communication with the central controller 122 via a communications link 128, for receiving, for example, set points from the central controller 122. In one embodiment, the communications link is a wired device, such as a cable or bus. In other embodiments, the communications link 128 is a wireless link (e.g., a BLUETOOTH or a WI-FI link) for wireless communication between the central controller 122 and the local controllers 126. EX1005 ¶0034. In my opinion, such a controller necessarily communicates using signals.

365. It would have been obvious to the POSITA to modify the controller of Houck to include the features of KR'062 to use both sensors to control the actuator to rotate the tool bar.

366. Poettinger discloses an agricultural machine according wherein the impression cylinder can be connected to a controllable pressure supply for influencing the ground contact pressure, a sensor device for detecting an actual value of the ground contact pressure of the working unit is provided and by an electronic control device, the pressure supply in response to a signal of the sensor device is controlled. EX1009 at 14. Naturally, such a controller communicates using signals. EX1002 ¶¶208.

367. Deere I discloses a control unit configured to receive the position signal and configured to control an adjustment device so that the depth indication targets a depth set point. EX1007, Abstract, Fig. 5, 5:13-20; EX1002 ¶¶136,149.

C. Claim 3 of the '989 Patent

368. In my opinion, each and every element of claim 3 was already disclosed by the prior art and the skilled person would have had no problem combining the teaching of the prior art. Below I set forth where each element may be found in selected prior art references. I note, however, that the subject matter of claim 3 was generally well-known as shown by the disclosures of many other references described above in Section VI.B. Therefore, to the extent an element may differ from the prior art, it would have been generally known to the skilled person by December 2016 given the extent and depth of the prior art on this subject matter.

3. The system of claim 2, further comprising a control component that actuates the actuator, wherein the controller is configured to cause actuation by sending a signal to the control component.

369. Claim 3 depends from claim 1 and, as described above, all the elements of claim 1 are present in the prior art.

370. Hubalek discloses control components (solenoid valves 268, 270) that are controlled by the controller 274, thereby controlling the actuator to rotate the toolbar. Col. 13, lines 15-31. Hubalek's controller is programmable and naturally would communicate by using signals.

371. KR'062 describes a controller (control unit 70) that controls a control component (flow rate control valve 85) to drive the actuator. KR'062 disclosures that its controller communicates using signals.

372. The combination of Hubalek with KR'062 would include a control component that actuates the actuator, wherein the controller is configured to cause actuation by sending a signal to the control component.

373. Houck discloses that "in certain embodiments, each actuator 102 for each seeding row unit 62 is in fluid communication with the hydraulic pressure source 44 via an adjustment device 146, such as an electro-hydraulic control valve.

In one embodiment, each adjustment device 146 is controlled by the central controller 122 via a multi-line cable 148.” Therefore, Hubalek discloses the claimed control components.

374. KR’062 describes a controller (control unit 70) that controls a control component (flow rate control valve 85) to drive the actuator. The combination of Houck with KR’062 would include a control component that actuates the actuator, wherein the controller is configured to cause actuation by sending a signal to the control component.

375. Poettinger discloses a controllable pressure supply for influencing the ground contact pressure is controlled in response to a signal of the sensor device via the electronic control device. EX1009 at 14.

D. Claim 4 of the ’989 Patent

376. In my opinion, each and every element of claim 4 was already disclosed by the prior art and the skilled person would have had no problem combining the teaching of the prior art to derive each and every element of claim 4. Below I set forth where each element may be found in selected prior art references. I note, however, that the subject matter of claim 4 was generally well-known as shown by the disclosures of many other references described above in Section VI.B. Therefore, to the extent an element may differ from the prior art, it would have been

generally known to the skilled person by December 2016 given the extent and depth of the prior art on this subject matter.

4. The system of claim 3, wherein the control component comprises a control valve, an air valve, an electronic control component, a magnetic control component, or an electromagnetic control component.

377. As shown above, the features of claim 3 are disclosed by the prior art. For instance, Hubalek discloses control components (solenoid valves 268, 270) that are controlled by the controller 274, thereby controlling the actuator to rotate the toolbar. Col. 13, lines 15-31. Solenoid valves satisfy this limitation.

378. KR'062 describes a controller (control unit 70) that controls a control component (flow rate control valve 85) to drive the actuator. A control valve satisfies this limitation.

379. The combination of Hubalek with KR'062 would therefore include a control component as claimed.

380. As described above with reference to claim 3, Houck discloses that the control component is an electro-hydraulic control valve. Thus, Houck discloses this element.

381. As described above, KR'062 also discloses a control valve. The combination of Houck with KR'062 would therefore include a control component as claimed.

382. Poettinger discloses a controllable pressure supply for influencing the ground contact pressure including a pump and a valve. EX1009 at 14.

383. Deere I discloses a control unit 140 (e.g., PID controller), using open loop, closed loop, or preferably proportional-integral-derivative "PID control methodology, is configured to receive the first, second, and third position signals 115, 125, 135 and the first, second, and third pressure signals 119, 129, 139, and generate a control signal 145, which is received by the controller 50. EX1007 5:13-21; EX1002 ¶159. The controller 50 is an electrical component. Id.

E. Claim 6 of the '989 Patent

384. In my opinion, each and every element of claim 6 was already disclosed by the prior art and the skilled person would have had no problem combining the teaching of the prior art to derive each and every element of claim 6. Below I set forth where each element may be found in selected prior art references. I note, however, that the subject matter of claim 6 was generally well-known as shown by the disclosures of many other references described above in Section VI.B.

Therefore, to the extent an element may differ from the prior art, it would have been generally known to the skilled person by December 2016 given the extent and depth of the prior art on this subject matter.

6. The system of claim 1, further comprising a controller, the controller configured to receive a signal from the first sensor and cause actuation of the actuator based on the signal.

385. As shown above, the features of claim 1 are disclosed by the prior art. For instance, Hubalek discloses a programmable controller 274, which is the “brains” of a control circuit for controlling the components of its system, including receiving signals from its sensor 83 and controlling various valves and electric motors. See Fig. 15, Col. 8, lines 44-55.

386. KR’062 describes a controller (control unit 70) that receives the distance to the ground from a first sensor (distance sensor 50) and receives the angle of the tool bar from a second sensor (angle sensor 40) and causes the actuator to raise or lower the toolbar based on the received signals.

387. It would have been obvious to the skilled person in the art to modify the controller of Hubalek to include the features of KR’062 to receive a signal from the first sensor and cause actuation of the actuator based on the signal.

388. Houck discloses a controller for controlling the elevation of the toolbar. The control system 38 comprises a central controller 122 operatively coupled to a user interface 124 and a display 125. The central controller 122, user interface 124, and display 125 can be located on or within the towing unit 42, enabling the operator to make on the go changes. In some embodiments, a plurality of local controllers 126 is in communication with the central controller 122 via a communications link 128, for receiving, for example, set points from the central controller 122. In one embodiment, the communications link is a wired device, such as a cable or bus. In other embodiments, the communications link 128 is a wireless link (e.g., a BLUETOOTH or a WI-FI link) for wireless communication between the central controller 122 and the local controllers 126. Para. [0034]. In my opinion, such a controller communicates using signals.

389. It would have been obvious to the POSITA to modify the controller of Houck to include the features of KR'062 to use both sensors to control the actuator to rotate the tool bar.

390. Poettinger discloses an agricultural machine according wherein the impression cylinder can be connected to a controllable pressure supply for influencing the ground contact pressure, a sensor device for detecting an actual value of the ground contact pressure of the working unit is provided and by an electronic

control device, the pressure supply in response to a signal of the sensor device is controlled. EX1009 at 14. Naturally, such a controller communicates using signals. EX1002 ¶208.

391. It would have been obvious to the POSITA to modify the controller of Poettinger to include the features of KR'062 to use both sensors to control the actuator to rotate the tool bar.

392. Deere I discloses a control unit 140 (e.g., PID controller), using open loop, closed loop, or preferably proportional-integral-derivative “PID control methodology, is configured to receive the first, second, and third position signals 115, 125, 135 and the first, second, and third pressure signals 119, 129, 139, and generate a control signal 145, which is received by the controller 50. EX1007 5:13-21; EX1002 ¶159.

F. Claim 7 of the '989 Patent

393. In my opinion, each and every element of claim 7 was already disclosed by the prior art and the skilled person would have had no problem combining the teaching of the prior art to derive each and every element of claim 7. Below I set forth where each element may be found in selected prior art references. I note, however, that the subject matter of claim 7 was generally well-known as shown by

the disclosures of many other references described above in Section VI.B. Therefore, to the extent an element may differ from the prior art, it would have been generally known to the skilled person by December 2016 given the extent and depth of the prior art on this subject matter.

7. The system of claim 6, further comprising a control component that actuates the actuator, wherein the controller is configured to cause actuation by sending a signal to the control component.

394. Hubalek discloses control components (solenoid valves 268, 270) that are controlled by the controller 274, thereby controlling the actuator to rotate the toolbar. Col. 13, lines 15-31.

395. KR'062 describes a controller (control unit 70) that controls a control component (flow rate control valve 85) to drive the actuator.

396. The combination of Hubalek with KR'062 would include a control component that actuates the actuator, wherein the controller is configured to cause actuation by sending a signal to the control component.

397. As described above with reference to claim 3, Houck discloses that the control component is an electro-hydraulic control valve. Thus, Houck discloses this element.

398. As described above, KR'062 also discloses a control valve. The combination of Houck with KR'062 would therefore include a control component as claimed.

399. Poettinger discloses a controllable pressure supply for influencing the ground contact pressure is controlled in response to a signal of the sensor device via the electronic control device. EX1009 at 14.

400. Deere I discloses a control unit 140 (e.g., PID controller), using open loop, closed loop, or preferably proportional-integral-derivative "PID control methodology, is configured to receive the first, second, and third position signals 115, 125, 135 and the first, second, and third pressure signals 119, 129, 139, and generate a control signal 145, which is received by the controller 50. EX1007 5:13-21; EX1002 ¶159.

E. Claim 8 of the '989 Patent

401. In my opinion, each and every element of claim 8 was already disclosed by the prior art and the skilled person would have had no problem combining the teaching of the prior art to derive each and every element of claim 8. Below I set forth where each element may be found in selected prior art references. I note, however, that the subject matter of claim 5 was generally well-known as shown by the disclosures of many other references described above in Section VI.B.

Therefore, to the extent an element may differ from the prior art, it would have been generally known to the skilled person by December 2016 given the extent and depth of the prior art on this subject matter.

8. The system of claim 7, wherein the control component comprises a control valve, an air valve, an electronic control component, a magnetic control component, or an electromagnetic control component.

402. Hubalek discloses control components (solenoid valves 268, 270) that are controlled by the controller 274, thereby controlling the actuator to rotate the toolbar. Col. 13, lines 15-31. Solenoid valves satisfy this limitation.

403. KR'062 describes a controller (control unit 70) that controls a control component (flow rate control valve 85) to drive the actuator. A control valve satisfies this limitation.

404. The combination of Hubalek with KR'062 would therefore include a control component as claimed.

405. As described above with reference to claim 3, Houck discloses that the control component is an electro-hydraulic control valve. Thus, Houck discloses this element.

406. As described above in, KR'062 also discloses a control valve. Thus, the combination of Houck with KR'062 would therefore include a control component as claimed.

407. Poettinger discloses a controllable pressure supply for influencing the ground contact pressure including a pump and a valve. EX1009 at 14.

408. Deere I discloses a control unit 140 (e.g., PID controller), using open loop, closed loop, or preferably proportional-integral-derivative "PID control methodology, is configured to receive the first, second, and third position signals 115, 125, 135 and the first, second, and third pressure signals 119, 129, 139, and generate a control signal 145, which is received by the controller 50. EX1007 5:13-21; EX1002 ¶159. The controller 50 is an electrical component. EX1002 ¶159.

F. Claim 10 of the '989 Patent

409. In my opinion, each and every element of claim 10 was already disclosed by the prior art and the skilled person would have had no problem combining the teaching of the prior art to derive each and every element of claim 10. Below I set forth where each element may be found in selected prior art references. I note, however, that the subject matter of claim 10 was generally well-known as shown by the disclosures of many other references described above in Section VI.B.

Therefore, to the extent an element may differ from the prior art, it would have been generally known to the skilled person by December 2016 given the extent and depth of the prior art on this subject matter.

10. The system of claim 1, wherein the sensed position is relative to a field surface, further comprising one or more Both Houck and KR'062 describe sensors coupled to the frame member, the toolbar, or a combination of the frame member and the toolbar, the one or more electromagnetic sensors configured to sense an absolute elevation or change in elevation between the field surface and the toolbar or a combination of both the frame member and the toolbar.

410. Houck discloses adding an additional sensor to its system (that already includes two sensors). “Alternatively, the seeding row assembly 172 can utilize a second position sensor (not depicted) for control of the elevation of the seeding row unit 62 to a predetermined depth, akin to the second position sensor 114 of FIGS. 2 and 3. Use of the second position sensor can be alternative to or in addition to the pressure sensor 192.” Para. 0042.

411. KR'062 describes a controller (control unit 70) that receives the distance to the ground from distance sensor 50. Therefore, it would have been obvious to

include another position sensor in the system of Houck coupled to the toolbar to sense absolute or change in elevation of the toolbar.

G. Claim 11 of the '989 Patent

412. In my opinion, each and every element of claim 11 was already disclosed by the prior art and the skilled person would have had no problem combining the teaching of the prior art to derive each and every element of claim 11. Below I set forth where each element may be found in selected prior art references. I note, however, that the subject matter of claim 11 was generally well-known as shown by the disclosures of many other references described above in Section VI.B. Therefore, to the extent an element may differ from the prior art, it would have been generally known to the skilled person by December 2016 given the extent and depth of the prior art on this subject matter.

11. The system of claim 10, further comprising a controller configured to receive one or more signals from the one or more electromagnetic sensors and cause actuation of the actuator based on the one or more signals.

413. As described above, Houck discloses adding an additional sensor to its system for control of the elevation of the seeding row unit 62. Both Houck and KR'062 describe the use of controllers. Naturally, it would have been obvious to

modify the controller of Houck to cause actuation of the actuator based on the one or more signals.

414. Deere I discloses a control unit 140 (e.g., PID controller), using open loop, closed loop, or preferably proportional-integral-derivative “PID control methodology, is configured to receive the first, second, and third position signals 115, 125, 135 and the first, second, and third pressure signals 119, 129, 139, and generate a control signal 145, which is received by the controller 50. EX1007 5:13-21; EX1002 ¶159.

H. Claim 12 of the '989 patent

415. In my opinion, each and every element of claim 12 was already disclosed by the prior art and the skilled person would have had no problem combining the teaching of the prior art to derive each and every element of claim 12. Below I set forth where each element may be found in selected prior art references. I note, however, that the subject matter of claim 12 was generally well-known as shown by the disclosures of many other references described above in Section VI.B. Therefore, to the extent an element may differ from the prior art, it would have been generally known to the skilled person by December 2016 given the extent and depth of the prior art on this subject matter.

12. The system of claim 11, further comprising a control component that actuates the actuator, wherein the controller is configured to cause actuation by sending a signal to the control component.

416. As described above with reference to claim 3, Houck discloses that the control component is an electro-hydraulic control valve. Thus, Houck discloses this element.

417. As described above KR'062 also discloses a control valve. The combination of Houck with KR'062 would therefore include a control component as claimed.

418. Deere I discloses a control unit 140 (e.g., PID controller), using open loop, closed loop, or preferably proportional-integral-derivative "PID control methodology, is configured to receive the first, second, and third position signals 115, 125, 135 and the first, second, and third pressure signals 119, 129, 139, and generate a control signal 145, which is received by the controller 50. EX1007 5:13-21; EX1002 ¶159.

I.Claim 13 of the '989 patent

419. In my opinion, each and every element of claim 13 was already disclosed by the prior art and the skilled person would have had no problem combining the teaching of the prior art to derive each and every element of claim 13. Below I set forth where each element may be found in selected prior art references. I note, however, that the subject matter of claim 13 was generally well-known as shown by the disclosures of many other references described above in Section VI.B. Therefore, to the extent an element may differ from the prior art, it would have been generally known to the skilled person by December 2016 given the extent and depth of the prior art on this subject matter.

13. The system of claim 12, wherein the control component comprises a control valve, an air valve, an electronic control component, a magnetic control component, or an electromagnetic control component.

420. As described above with reference to claim 3, Houck discloses that the control component is an electro-hydraulic control valve. Thus, Houck discloses this element.

421. As described above, KR'062 also discloses a control valve. The combination of Houck with KR'062 would therefore include a control component as claimed.

422. Deere I discloses a control unit 140 (e.g., PID controller), using open loop, closed loop, or preferably proportional-integral-derivative “PID control methodology, is configured to receive the first, second, and third position signals 115, 125, 135 and the first, second, and third pressure signals 119, 129, 139, and generate a control signal 145, which is received by the controller 50. EX1007 5:13-21; EX1002 ¶159.

J. Claim 15 of the '989 patent

423. In my opinion, each and every element of claim 15 was already disclosed by the prior art and the skilled person would have had no problem combining the teaching of the prior art to derive each and every element of claim 15. Below I set forth where each element may be found in selected prior art references. I note, however, that the subject matter of claim 15 was generally well-known as shown by the disclosures of many other references described above in Section VI.B. Therefore, to the extent an element may differ from the prior art, it would have been generally known to the skilled person by December 2016 given the extent and depth of the prior art on this subject matter.

15. The system of claim 10, wherein the one or more electromagnetic sensors comprise ultrasonic, lidar, or radar sensors.

424. KR'062 describes a distance sensor 50, which emits laser light to the ground and measures the reflection. This is the same kind of non-contact sensor that the 989 patent contemplated. EX1001, Col. 7, lines 26-29. Therefore, it is equivalent to a radar sensor.

K. Claim 16 of the '989 patent

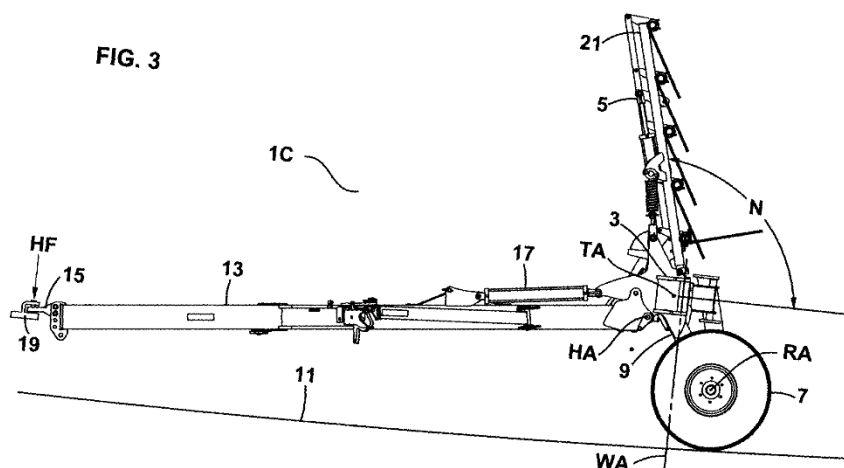
425. In my opinion, each and every element of claim 16 was already disclosed by the prior art and the skilled person would have had no problem combining the teaching of the prior art to derive each and every element of claim 16. Below I set forth where each element may be found in selected prior art references. I note, however, that the subject matter of claim 16 was generally well-known as shown by the disclosures of many other references described above in Section VI.B. Therefore, to the extent an element may differ from the prior art, it would have been generally known to the skilled person by December 2016 given the extent and depth of the prior art on this subject matter.

16. The system of claim 1, wherein the actuator is configured to rotate the toolbar throughout an obtuse angle range.

426. Claim 16 adds only a range of motion to claim 1. This would have been obvious. Most of the references related to farm implements that have a transport mode in which the toolbar is rotated up and far out of the way from the ground so that the farm implement may be turned without the tools engaging with the ground. For example, Hubalek and Deere I both disclose a transport mode. Rotating the toolbar up and out of the way for transport would move the actuator through an obtuse angle.

427. For example, Friesen discloses farm implement with a toolbar apparatus including an actuator configured to rotate the toolbar relative to the frame member based through an obtuse angle to ensure there is not damage to the toolbar or frame. Friesen discloses an agricultural implement with wings (toolbars) that rotate upward and then fold rearward for transport. EX1015 ¶0001. Importantly, the toolbar is rotated in the same manner as in the '989 patent.

428. FIG. 3 of Friesen is a side view of its farm implement in the transport position.



429.

430. As shown, the tools are rotated an angle N which is clearly an obtuse angle (i.e., greater than 90 degrees). “Comparing the position of FIG. 1 and FIG. 3 it can be seen that the center tool bar 3 pivots about the hitch pivot axis HA through an angle N greater than ninety degrees when moving from the field operating position of FIG. 1 to the transport position of FIG. 3.” EX1015 ¶0026. This rotation is the same as the rotation shown in Fig. 3 of the '989 patent.

431. Allowing the actuator of a farm implement to rotate the toolbar throughout an obtuse angle range was well known by December 2016. In my opinion, it would have been a common way to do it by December 2016. It would have been obvious to modify the implements of Hubalek, Deere I, Amazonen or

Poettinger so that the transport position is similar to that in Friesen. The modified implement thus would have the features of claim 16.

432. Hubalek, Deere I, Poettinger, Amazonen and Friesen are in the same field of endeavor and the skilled person would not have any problem making the proposed modification.

L. Claim 17 of the '989 patent

433. In my opinion, each and every element of claim 17 was already disclosed by the prior art and the skilled person would have had no problem combining the teaching of the prior art to derive each and every element of claim 17. Below I set forth where each element may be found in selected prior art references. I note, however, that the subject matter of claim 17 was generally well-known as shown by the disclosures of many other references described above in Section VI.B. Therefore, to the extent an element may differ from the prior art, it would have been generally known to the skilled person by December 2016 given the extent and depth of the prior art on this subject matter.

17. A control system for an implement comprising a frame member and a toolbar coupled to the frame member parallel to the frame member via a hinged joint such that the toolbar

remains parallel to the frame member throughout the rotation of the toolbar about the hinged joint, wherein a plurality of row units are secured to the toolbar, the control system comprising:

a controller;

a first sensor configured to sense a position of the toolbar relative to ground;

a second sensor configured to sense an angle of the toolbar relative to the frame member; and

an actuator coupled between the frame member and the toolbar, wherein the controller is configured to receive at least one signal from the at least one sensor indicating the position of the toolbar relative to the ground and cause the actuator to rotate the toolbar based on the sensed position of the toolbar.

434. Claim 17 is nearly identical to claim 1 except the structural features regarding the implement itself is recited in the preamble of the claim and the body of the claim is directed to a control system including the controller, first sensor, second sensor, and actuator. As I understand it, the preamble is not typically given patentable weight, but the features of the preamble of claim 17 are recited in claim 1

in elements 1.i-1.iii and 1.vii, and were disclosed in the prior art as I discuss above with reference to claim 1.

435. The elements of claim 17 correspond to elements 1.iv – 1.vi, and to the limitations of claim 2, and were disclosed in the prior art as I discuss above with reference to claims 1-2. I incorporate my above analysis of claims 1-2 in view of the prior art herein.

436. Claim 17 also recites that the controller is configured to receive at least one signal from the at least one sensor indicating the position of the toolbar relative to the ground and cause the actuator to rotate the toolbar based on the sensed position of the toolbar. To the extent this is different from claim 1, the controller is configured to receive at least one signal from the at least one sensor indicating the position of the toolbar relative to the ground was disclosed in many of the references including Hubalek, Houck, Deere I, Amazonen and KR'062. Thus, this would have been obvious as already disclosed above.

437. Thus, all the features of claim 17 would have been obvious for the same reasons as disclosed above with reference to claims 1 and 2.

M. Claim 18 of the '989 patent

438. In my opinion, each and every element of claim 18 was already disclosed by the prior art and the skilled person would have had no problem

combining the teaching of the prior art to derive each and every element of claim 18. Below I set forth where each element may be found in selected prior art references. I note, however, that the subject matter of claim 18 was generally well-known as shown by the disclosures of many other references described above in Section VI.B. Therefore, to the extent an element may differ from the prior art, it would have been generally known to the skilled person by December 2016 given the extent and depth of the prior art on this subject matter.

18. The system of claim 1, further comprising at least one wheel coupled to the frame member and at least partially supporting the frame member relative to the ground.

439. Claim 18 adds only a wheel to at least partially support the frame member. Using wheels or wheel assemblies to support the frame member were well known and were not novel or unique in December 2016. Most of the references disclose herein include at least one wheel to at least partially support the frame member. For example, Deere I includes a plurality of wheel assemblies 40 are coupled to the first frame section 20 to support the frame member. EX1007 at 3:27-28. Hubalek includes wheels 18 to support the frame member. See EX1006, Fig. 1. Amazonen also includes a wheel coupled with the frame. See EX1008, Fig. 2, above

element 19. Thus, this would have been obvious as already disclosed above. Pottinger includes wheels 4 to support the frame member. See EX1009, Fig. 1.

440. Thus, all the features of claim 18 would have been obvious for the same reasons as disclosed above.

VIII. SUMMARY OF ANALYSIS

441. In summary, each feature of the challenged claims are found in the prior art. In particular, Houck, Hubalek, Deere I, Deere II, Amazonen, KR'062, and Poettinger all disclose the same type of system as claims in claim 1. These references are in the same field of endeavor and the skilled person would have no problem combining their teachings without undue experimentation. Motivation for making such combinations can be found in the prior art references themselves, but also, the skilled person would have been aware of the advantages and benefits of making such combinations. For instance, combining the features would provide a system that is easier and more desirable to use and easier to identify risks.

442. In my opinion, all of the elements of at least claims 1-4, 6-8 and 15-18 are disclosed by the combination of Hubalek and KR'062. Hubalek discloses the basic arrangement claim 1, but does not expressly disclose the use of two sensors. It would have been obvious to the POSITA by December 2016, to use two sensors,

a first sensor for measuring the distance to the ground, and a second sensor for measuring the angle of the coupling for the tool bar, in order to calculate and maintain the proper ground depth for the ground working tools as taught by KR'062. It therefore would have been obvious to add the sensors of KR'062 to the implement of Hubalek in order to improve the operation of the tools 22 in Hubalek to better control the depth of the tools 22. Such modification would result in a device having each and every element of claim 1. Hubalek and KR'062 are in the same field of endeavor and the use of two sensors in Hubalek, one measuring the angle of the toolbar relative to the frame and one measuring the distance from the toolbar to the ground, would have been well within the skill of the POSITA by December 2016, and the POSITA would have had an expectation that such modification would have been successful.

443. I set forth below in Appendix A, claim charts showing examples where each of the elements of claims 1-4, 6-8 and 17-18 is disclosed in Hubalek and KR'062.

444. In my opinion, all of the elements of at least claims 1-4, 6-8, 10-13, 15 and 17-18 are disclosed by the combination of Deere I alone or in view of Deere II and KR'062. In my opinion, Deere I discloses the basic arrangement claim 1, but uses four-bar linkages instead of a hinge. Coupling the toolbar to a farm implement

frame using a hinged joint was well-known by December 2016, as disclosed by Deere II. Therefore, it would have been obvious to the POSITA to modify the device of Deere I to include a hinged joint similar to the one disclosed by Deere II. Both patents are in the same field of endeavor and the skilled person would not have any problem making the proposed modification.

445. It would have been obvious to the POSITA by December 2016, to use two sensors, a first sensor for measuring the distance to the ground, and a second sensor for measuring the angle of the coupling for the tool bar, in order to calculate and maintain the proper ground depth for the ground working tools as taught by KR'062. It therefore would have been obvious to add the sensors of KR'062 to the implement of Deere I (and Deere II) in order to improve the operation of the tools in Deere to better control the depth of the tools. Such modification would result in a device having each and every element of claim 1. Deere I and KR'062 are in the same field of endeavor and the use of two sensors in Deere I, one measuring the angle of the toolbar relative to the frame and one measuring the distance from the toolbar to the ground, would have been well within the skill of the POSITA by December 2016, and the POSITA would have had an expectation that such modification would have been successful.

446. I set forth below in Appendix A, claim charts showing examples where each of the elements of the challenged claims is disclosed in Deere I, Deere II and KR'062.

447. In my opinion, each of the elements of claims 1-4, 6-8 and 17-18 are disclosed by the combination of Poettinger and KR'062. Poettinger discloses each and every element of claim 1 except the use of the second sensor as claimed. It would have been obvious to use two sensors in the device of Poettinger as taught by any one of the KR'062, Houck, Hubalek, and Deere I. As discussed above, KR'062 discloses the use of a first position sensor measure the distance from the frame to the ground, and a second angular sensor measuring the angle of the toolbar. It would have been obvious to the skilled person to add the second sensor as taught by the other references, such as KR'062, to the device of Poettinger in order to further improve its ability to finely control the depth of the tools in the soil.

448. In my opinion, the use of parallelogram or four bar linkages to position and control soil engaging tools is not new or unique. Also in my opinion, such linkages can provide rotation and a good range of motion. Poettinger is an example of using two parallelogram linkages together to provide greater range of rotational motion control for maintain desired soil tool positioning over a contoured surface.

449. I set forth below in Appendix A, claim charts showing examples where each of the elements of all of the claims 1-4, 6-8 and 17-18 is disclosed in Poettinger and KR'062.

450. It is my opinion that the linkages of Deere I, Hubalek and Houck provide rotational movement.

451. In my opinion, all of the elements of at least claims 1-4, 6-8, 10-13, 15 and 17-18 are disclosed by the combination of Deere I, Deere II and KR'062. In my opinion, Deere I discloses the basic arrangement claim 1, but uses parallel linkages instead of a hinge. Coupling the toolbar to a farm implement frame using a hinged joint was well-known by December 2016, as disclosed by Deere I and Deere II. Although I believe Deere I discloses a hinged joint that allows the toolbar to rotate relative to the frame, it also would have been obvious to the POSITA to modify the device of Deere I to include a hinged joint similar to the one discloses by Deere II to provide for even more range of rotation. Both patents are in the same field of endeavor and the skilled person would not have any problem making the proposed modification. In my opinion, Deere I discloses the first and second sensor of claim 1. However, it would have been obvious to add the position sensor of KR'062 to directly measure the elevation of the toolbar in order to more accurately control the depth of the tools. Set forth below in Appendix A are claim charts showing examples

where each of the elements of the challenged claims is disclosed in Houck, Deere I, Deere II and KR'062.

452. Deere I, Deere II and KR'062 demonstrate the use of a hinge or pivot point to realize the desired soil tool positioning. Likewise, the use of angular sensors were shown in Deere I and KR'062 to provide input data to the position control system. These hinge or pivot point arrangements are interchangeable with the arrangements of Deere I, Hubalek and Houck

453. Thus, every single claim element and all of the features were disclosed and taught by the prior art references. The skilled person would have had no problem combining the teachings and would have had expectations of success without any requirement of hindsight.

454. It is also my opinion that all the features of claims 1-4, 6-8, 10-13 and 17-18 were taught by the combination of Hubalek in view of Houck. As disclosed above, Houck teaches the use of several sensors, which the skilled person would have found obvious to incorporate into Hubalek to improve the following of the tools over ground. In my opinion, the skilled person also would have found it obvious to add the tool arrangement of Houck to Hubalek, which would result in all the elements of claims 1-4, 6-8, 10-13, and 17-18 being found in the combination.

455. Houck and Hubalek are in the same field of endeavor. The skilled person would have had no problem combining the teachings and would have had expectations of success without any requirement of hindsight.

456. I set forth below in Appendix A, claim charts showing examples of where each and every feature of claims 1-4, 6-8, 10-13 and 17-18 can be found in the combination of Hubalek in view of Houck.

457. It is also my opinion that all the features of claims 1-4, 6-8 and 17-18 were taught by the combination of Hubalek in view of Amazonen. Hubalek discloses the basic arrangement claim 1, including each of elements thereof, but does not expressly disclose two sensors. Amazonen discloses a farm implement that uses a joint between the toolbar and the frame member to maintain the toolbar parallel to the frame member when it is rotated is widely known in the prior art. Amazonen also discloses sensor 20 positioned on toolbar 12 configured to detect deflection of the tools and therefore, the position of the toolbar 12 relative to the ground. It therefore would have been obvious to add sensor of Amazonen to the implement of Hubalek in order to improve the operation of the tools 22 in Hubalek to better control the depth of the tools 22.

458. Hubalek and Amazonen are in the same field of endeavor. The additional of a second sensor to Hubalek as taught by Amazonen would have been

well within the skill of the POSITA by December 2016, and the POSITA would have had an expectation that such modification would have been successful.

459. I set forth below in Appendix A, claim charts showing examples of where each and every feature of claims 1-4, 6-8 and 17-18 can be found in the combination of Hubalek in view of Amazonen.

460. It is also my opinion that the features of claim 16 was taught by Friesen. Therefore, since all of the combinations discussed above disclose all the features of claim 1, it would have been obvious in light of Friesen to modify those combinations (Hubalek and KR'062: Poettinger in view of KR'062; Deere I alone or in view of Deere II and KR'062; Hubalek in view of Houck; or Hubalek in view of Amazonen) to rotate the toolbar through an obtuse angle to lift the tools over the frame of the implement for transit.

461. All of the references are in the same field of endeavor. The modification in view of Friesen would have been well within the skill of the POSITA by December 2016, and the POSITA would have had an expectation that such modification would have been successful.

462. I set forth below in Appendix A, claim charts showing examples of where each and every feature of claim 16 can be found in prior art.

463. In my opinion, all of the references discussed above are combinable – that is, the references are in the same field of endeavor and the skilled person would have no problem combining their teachings without undue experimentation. Motivation for making such combinations can be found in the prior art references themselves, but also, the skilled person would have been aware of the advantages and benefits of making such combinations. For instance, combining the features taught in the references would provide an implement that would be easier and more efficient to use and would do a better job on contoured surfaces.

464. Although more than one reference may be identified above disclosing each element, I do not intend to suggest that each reference identified is necessary to complete the disclosure of that respective element. I am merely giving examples of where the disclosure can be found and, in most cases, they can be found in multiple references. In fact, many of the claim features were so well-known that they could be found in myriad references.

IX. CONCLUDING STATEMENTS

465. 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 this 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.

466. I reserve the right to revise this declaration to correct any inaccuracies.

467. 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 that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under

Section 1001 of Title 18 of the United States Code.



Dated: 9-19-24

Dr. Paul Weckler

X. APPENDIX A – CLAIM CHARTS

1. Claims 1-4, 6-8 and 17-18 are obvious in light of Hubalek in view of

KR'062

Element of Claim 1	Disclosure of the Prior Art
1. A system, comprising:	Hubalek discloses a seeder system. EX1006, Abstract.
an elongate frame member;	The planting system of Hubalek includes an elongated frame element 12. EX1006, 2:59, Fig. 1;
a plurality of row units coupled to the toolbar;	Hubalek discloses a plurality of row units 22 coupled to a toolbar 78. EX1006 4:29, Figs. 1, 11.
an elongate toolbar coupled to the frame member via a hinged joint, the toolbar oriented parallel to the frame member;	Hubalek teaches an elongate toolbar 78 coupled to the frame element 12 by means of a hinged, articulation link 70, 72. EX1006 4:29-38, Figs. 1, 11;
a first sensor configured to sense a position of the toolbar relative to ground;	KR'062 discloses a distance sensor 50 positioned on a tool bar and configured to measure the distance from the ground surface. EX1012 at 3.
a second sensor configured to sense an angle of the toolbar relative to the frame member; and	Hubalek discloses a sensor (83) coupled to the frame element configured to sense the position of the toolbar relative to the frame member. EX1006 4:47-51, Fig. 11; KR'062 discloses an angle sensor 40 provided in a coupling that measures the angle of the lower link 1 and

Element of Claim 1	Disclosure of the Prior Art
	transmits the measured angle to the control unit 70. EX1012 at 3.
an actuator coupled between the frame member and the toolbar, the actuator configured to rotate the toolbar relative to the frame member based on a sensed position of the toolbar,	Hubalek discloses an actuator (80, 82), known as hydraulic cylinders connected to the links (74, 76) and coupled between the frame element (12) and toolbar (78) configured to rotate the toolbar relative to the frame member based on a sensed position of the toolbar. EX1006 4:39-57, Fig. 11.
wherein the toolbar remains parallel to the frame member throughout the rotation of the toolbar.	Hubalek discloses the toolbar 78, which remains in parallel to the frame element 12 under any rotation motion.
2. The system of claim 1, further comprising a controller configured to receive first and second signals from the first and second sensors and cause actuation of the actuator based on the first and second signals.	Hubalek discloses a programmable controller 274, which is the “brains” of a control circuit for controlling the components of its system, including receiving signals from its sensor 83 and controlling various valves and electric motors. See Fig. 15, Col. 8, lines 44-55. KR’062 describes a controller (control unit 70) that receives the distance to the ground from a first sensor (distance sensor 50) and receives the angle of the tool bar from a second sensor (angle sensor 40) and causes the actuator to raise or lower the toolbar based on the received signals. EX1012 at 3. It would have been obvious to the POSITA to modify the controller of

Element of Claim 1	Disclosure of the Prior Art
	Hubalek to include the features of KR'062 to use both sensors to control the actuator to rotate the tool bar.
3. The system of claim 2, further comprising a control component that actuates the actuator, wherein the controller is configured to cause actuation by sending a signal to the control component.	Hubalek discloses control components (solenoid valves 268, 270) that are controlled by the controller 274, thereby controlling the actuator to rotate the toolbar. Col. 13, lines 15-31. Hubalek's controller is programmable and naturally would communicate by using signals. KR'062 describes a controller (control unit 70) that controls a control component (flow rate control valve 85) to drive the actuator. KR'062 disclosures that its controller communicates using signals. EX1012 at 3. The combination of Hubalek with KR'062 would include a control component that actuates the actuator, wherein the controller is configured to cause actuation by sending a signal to the control component.
4. The system of claim 3, wherein the control component comprises a control valve, an air valve, an electronic control component, a magnetic control component, or an electromagnetic control component.	Hubalek discloses control components (solenoid valves 268, 270) that are controlled by the controller 274, thereby controlling the actuator to rotate the toolbar. Col. 13, lines 15-31. Solenoid valves satisfy this limitation.

Element of Claim 1	Disclosure of the Prior Art
	KR'062 describes a controller (control unit 70) that controls a control component (flow rate control valve 85) to drive the actuator. A control valve satisfies this limitation. EX1012 at 3. The combination of Hubalek with KR'062 would therefore include a control component as claimed.
6. The system of claim 1, further comprising a controller, the controller configured to receive a signal from the first sensor and cause actuation of the actuator based on the signal.	Hubalek discloses a programmable controller 274, which is the “brains” of a control circuit for controlling the components of its system, including receiving signals from its sensor 83 and controlling various valves and electric motors. See Fig. 15, Col. 8, lines 44-55. KR'062 describes a controller (control unit 70) that receives the distance to the ground from a first sensor (distance sensor 50) and receives the angle of the tool bar from a second sensor (angle sensor 40) and causes the actuator to raise or lower the toolbar based on the received signals. EX1012 at 3. It would have been obvious to the POSITA to modify the controller of Hubalek to include the features of KR'062 to receive a signal from the first sensor and cause actuation of the actuator based on the signal.

Element of Claim 1	Disclosure of the Prior Art
7. The system of claim 6, further comprising a control component that actuates the actuator, wherein the controller is configured to cause actuation by sending a signal to the control component.	Hubalek discloses control components (solenoid valves 268, 270) that are controlled by the controller 274, thereby controlling the actuator to rotate the toolbar. Col. 13, lines 15-31. KR'062 describes a controller (control unit 70) that controls a control component (flow rate control valve 85) to drive the actuator. EX1012 at 3. The combination of Hubalek with KR'062 would include a control component that actuates the actuator, wherein the controller is configured to cause actuation by sending a signal to the control component.
8. The system of claim 7, wherein the control component comprises a control valve, an air valve, an electronic control component, a magnetic control component, or an electromagnetic control component.	Hubalek discloses control components (solenoid valves 268, 270) that are controlled by the controller 274, thereby controlling the actuator to rotate the toolbar. Col. 13, lines 15-31. Solenoid valves satisfy this limitation. KR'062 describes a controller (control unit 70) that controls a control component (flow rate control valve 85) to drive the actuator. A control valve satisfies this limitation. EX1012 at 3.

Element of Claim 1	Disclosure of the Prior Art
	The combination of Hubalek with KR'062 would therefore include a control component as claimed.
17. A control system for an implement comprising a frame member and a toolbar coupled to the frame member parallel to the frame member via a hinged joint such that the toolbar remains parallel to the frame member throughout the rotation of the toolbar about the hinged joint, wherein a plurality of row units are secured to the toolbar, the control system comprising:	Hubalek discloses a seeder system. EX1006, Abstract. The planting system of Hubalek includes an elongated frame element 12. EX1006, 2:59, Fig. 1. Hubalek discloses a plurality of row units 22 coupled to a toolbar 78. EX1006 4:29, Figs. 1, 11. Hubalek teaches an elongate toolbar 78 coupled to the frame element 12 by means of a hinged, articulation link 70, 72. EX1006 4:29-38, Figs. 1, 11. Hubalek discloses the toolbar 78, which remains in parallel to the frame element 12 under any rotation motion.
a controller;	Hubalek discloses a programmable controller 274, which is the “brains” of a control circuit for controlling the components of its system, including receiving signals from its sensor 83 and controlling various valves and electric motors. See Fig. 15, Col. 8, lines 44-55. KR'062 describes a controller (control unit 70) that receives the distance to the

Element of Claim 1	Disclosure of the Prior Art
	ground from a first sensor (distance sensor 50) and receives the angle of the tool bar from a second sensor (angle sensor 40) and causes the actuator to raise or lower the toolbar based on the received signals. EX1012 at 3. It would have been obvious to the POSITA to modify the controller of Hubalek to include the features of KR'062 to use both sensors to control the actuator to rotate the tool bar.
a first sensor configured to sense a position of the toolbar relative to ground;	KR'062 discloses a distance sensor 50 positioned on a tool bar and configured to measure the distance from the ground surface. EX1012 at 3.
a second sensor configured to sense an angle of the toolbar relative to the frame member;	Hubalek discloses a sensor (83) coupled to the frame element configured to sense the position of the toolbar relative to the frame member. EX1006 4:47-51, Fig. 11; KR'062 discloses an angle sensor 40 provided in a coupling that measures the angle of the lower link 1 and transmits the measured angle to the control unit 70. EX1012 at 3.
and an actuator coupled between the frame member and the toolbar,	Hubalek discloses an actuator (80, 82), known as hydraulic cylinders connected to the links (74, 76) and coupled between the frame element

Element of Claim 1	Disclosure of the Prior Art
	(12) and toolbar (78) configured to rotate the toolbar relative to the frame member based on a sensed position of the toolbar. EX1006 4:39-57, Fig. 11.
wherein the controller is configured to receive at least one signal from the at least one sensor indicating the position of the toolbar relative to the ground and cause the actuator to rotate the toolbar based on the sensed position of the toolbar.	Hubalek discloses a programmable controller 274, which is the “brains” of a control circuit for controlling the components of its system, including receiving signals from its sensor 83 and controlling various valves and electric motors. See Fig. 15, Col. 8, lines 44-55. KR’062 describes a controller (control unit 70) that receives the distance to the ground from a first sensor (distance sensor 50) and receives the angle of the tool bar from a second sensor (angle sensor 40) and causes the actuator to raise or lower the toolbar based on the received signals. EX1012 at 3. It would have been obvious to the POSITA to modify the controller of Hubalek to include the features of KR’062 to use both sensors to control the actuator to rotate the tool bar.
18. The system of claim 1, further comprising at least one wheel coupled to the frame member and at least partially supporting the frame member relative to the ground.	Hubalek includes wheels 18 to support the frame member. See EX1006, Fig. 1.

2. Claims 1-4, 6-8 and 17-18 are obvious in light of Poettinger in view

KR'062

Element of Claims	Disclosure of the Prior Art
1. A system, comprising:	Poettinger discloses a planting system. EX1009 at 2.
an elongate frame member;	The planting system of Poettinger also includes an elongate frame element. EX1009, 8, Fig. 1.
a plurality of row units coupled to the toolbar;	Pottinger discloses row units 9 coupled to the toolbar 15. EX1009 at 9, Fig. 1.
an elongate toolbar coupled to the frame member via a hinged joint, the toolbar oriented parallel to the frame member;	Poettinger discloses an elongate toolbar 15 coupled to the frame element 2 by means of a hinged articulation link. EX1009 at 9, Fig. 1.
a first sensor configured to sense a position of the toolbar relative to ground;	Poettinger teaches a sensor in the row unit 9 which acts as a position sensor for the ground-engaging tools to maintain the desired position. EX1009 at 14; KR'062 discloses a distance sensor 50 position on a tool bar and configured to measure the distance from the ground surface. EX1012 at 3.
a second sensor configured to sense an angle of the toolbar relative to the frame member; and	KR'062 discloses an angle sensor 40 provided in a coupling that measures the angle of the lower link 13 and transmits the measured angle to the control unit 70. EX1012 at 3.

Element of Claims	Disclosure of the Prior Art
an actuator coupled between the frame member and the toolbar, the actuator configured to rotate the toolbar relative to the frame member based on a sensed position of the toolbar,	Poettinger discloses an actuator 34 coupled between a frame element 2 and the toolbar 15; the actuator configured to rotate the toolbar relative to the frame member based on a sensed position of the toolbar. EX1009 at 10, Figs. 1-2).
wherein the toolbar remains parallel to the frame member throughout the rotation of the toolbar.	Poettinger discloses the toolbar 15, which remains in parallel to the frame element 2- under any rotation motion.
2. The system of claim 1, further comprising a controller configured to receive first and second signals from the first and second sensors and cause actuation of the actuator based on the first and second signals.	Poettinger discloses an agricultural machine according wherein the impression cylinder can be connected to a controllable pressure supply for influencing the ground contact pressure, a sensor device for detecting an actual value of the ground contact pressure of the working unit is provided and by <u>an electronic control device</u>, the pressure supply in response to a signal of the sensor device is controlled. EX1009 at 14. Naturally, such a controller communicates using signals. See above. It would have been obvious to the POSITA to modify the controller of Poettinger to include the features of KR'062 to use both sensors to control the actuator to rotate the tool bar.
3. The system of claim 2, further comprising a control component that actuates the actuator, wherein the controller is configured to cause	Poettinger discloses a controllable pressure supply for influencing the ground contact pressure is controlled in response to a signal of the sensor device

Element of Claims	Disclosure of the Prior Art
actuation by sending a signal to the control component.	via the electronic control device. EX1009 at 14.
4. The system of claim 3, wherein the control component comprises a control valve, an air valve, an electronic control component, a magnetic control component, or an electromagnetic control component.	Poettinger discloses a controllable pressure supply for influencing the ground contact pressure including a pump and a valve. EX1009 at 14.
6. The system of claim 1, further comprising a controller, the controller configured to receive a signal from the first sensor and cause actuation of the actuator based on the signal.	Poettinger discloses an agricultural machine according wherein the impression cylinder can be connected to a controllable pressure supply for influencing the ground contact pressure, a sensor device for detecting an actual value of the ground contact pressure of the working unit is provided and by <u>an electronic control device</u>, the pressure supply in response to a signal of the sensor device is controlled. EX1009 at 14. Naturally, such a controller communicates using signals. See above. It would have been obvious to the POSITA to modify the controller of Poettinger to include the features of KR'062 to use both sensors to control the actuator to rotate the tool bar.
7. The system of claim 6, further comprising a control component that actuates the actuator, wherein the controller is configured to cause	Poettinger discloses a controllable pressure supply for influencing the ground contact pressure is controlled in response to a signal of the sensor device

Element of Claims	Disclosure of the Prior Art
actuation by sending a signal to the control component.	via the electronic control device. EX1009 at 14.
8. The system of claim 7, wherein the control component comprises a control valve, an air valve, an electronic control component, a magnetic control component, or an electromagnetic control component.	Poettinger discloses a controllable pressure supply for influencing the ground contact pressure including a pump and a valve. EX1009 at 14.
17. A control system for an implement comprising a frame member and a toolbar coupled to the frame member parallel to the frame member via a hinged joint such that the toolbar remains parallel to the frame member throughout the rotation of the toolbar about the hinged joint, wherein a plurality of row units are secured to the toolbar, the control system comprising:	Poettinger discloses a planting system. EX1009 at 1. The planting system of Poettinger also includes an elongate frame element. EX1009 at 8. Fig. 1. Pottinger discloses row units 9 coupled to the toolbar 15. EX1009 at 9, Fig. 1. Poettinger discloses an elongate toolbar 15 coupled to the frame element 2 by means of a hinged articulation link. EX1009 at 9, Fig. 1. Poettinger discloses the toolbar 15, which remains in parallel to the frame element 2- under any rotation motion.
a controller;	Poettinger discloses an agricultural machine according wherein the impression cylinder can be connected to a controllable pressure supply for influencing the ground contact pressure, a sensor device for detecting an actual value of the ground contact pressure of

Element of Claims	Disclosure of the Prior Art
	the working unit is provided and by <u>an electronic control device</u>, the pressure supply in response to a signal of the sensor device is controlled. EX1009, 14. Naturally, such a controller communicates using signals. KR'062 describes a controller (control unit 70) that receives the distance to the ground from a first sensor (distance sensor 50) and receives the angle of the tool bar from a second sensor (angle sensor 40) and causes the actuator to raise or lower the toolbar based on the received signals. EX1012 at 3. It would have been obvious to the POSITA to modify the controller of Pottinger to include the features of KR'062 to use both sensors to control the actuator to rotate the tool bar.
a first sensor configured to sense a position of the toolbar relative to ground;	Poettinger teaches a sensor in the row unit 9 which acts as a position sensor for the ground-engaging tools to maintain the desired position. EX1009.14; KR'062 discloses a distance sensor 50 position on a tool bar and configured to measure the distance from the ground surface. EX1012 at 3.
a second sensor configured to sense an angle of the toolbar relative to the frame member;	KR'062 discloses an angle sensor 40 provided in a coupling that measures the angle of the lower link 13 and transmits

Element of Claims	Disclosure of the Prior Art
	the measured angle to the control unit 70. EX1012 at 3.
and an actuator coupled between the frame member and the toolbar,	Poettinger discloses an actuator 34 coupled between a frame element 2 and the toolbar 15; the actuator configured to rotate the toolbar relative to the frame member based on a sensed position of the toolbar. EX1009 at 10, Figs. 1-2).
wherein the controller is configured to receive at least one signal from the at least one sensor indicating the position of the toolbar relative to the ground and cause the actuator to rotate the toolbar based on the sensed position of the toolbar.	Poettinger discloses an agricultural machine according wherein the impression cylinder can be connected to a controllable pressure supply for influencing the ground contact pressure, a sensor device for detecting an actual value of the ground contact pressure of the working unit is provided and by <u>an electronic control device</u>, the pressure supply in response to a signal of the sensor device is controlled. EX1009, 14. Naturally, such a controller communicates using signals. KR'062 describes a controller (control unit 70) that receives the distance to the ground from a first sensor (distance sensor 50) and receives the angle of the tool bar from a second sensor (angle sensor 40) and causes the actuator to raise or lower the toolbar based on the received signals. EX1012 at 3. See above. It would have been obvious to the POSITA to modify the controller of Poettinger to include the features of

Element of Claims	Disclosure of the Prior Art
	KR'062 to use both sensors to control the actuator to rotate the tool bar.
18. The system of claim 1, further comprising at least one wheel coupled to the frame member and at least partially supporting the frame member relative to the ground.	Pottinger includes wheels 4 to support the frame member. See EX1009, Fig. 1.

3. Claims 1-4, 6-8, 10-13 and 15-18 is unpatentable over Deere I alone or in view of Deere II, in view of KR'062

Element of Claim 1	Disclosure of the Prior Art
1. A system, comprising:	Deere I disclose an agricultural instrument. EX1007, Abstract.
an elongate frame member;	Deere I discloses an implement comprising an elongated frame element (20) with wheels (40) coupled to it. EX1007, Figs. 1-3 and column 3, lines 27-29.
a plurality of row units coupled to the toolbar;	Deere I discloses toolbar 85 coupled to row units 90. EX1007 4:7-16, Fig. 3 and 6:46-49, Fig. 10.
an elongate toolbar coupled to the frame member via a hinged joint, the toolbar oriented parallel to the frame member;	Deere I discloses an elongate toolbar (85, 285) coupled to the frame element (20, 220) by means of an articulation link, the toolbar being oriented in

Element of Claim 1	Disclosure of the Prior Art
	parallel and at the back of the frame element (20, 220). Column 4, lines 7-16, Fig. 3 and col. 6, lines 46-49, Fig. 10.
a first sensor configured to sense a position of the toolbar relative to ground;	Deere I discloses position sensors for each one of the toolbars of the row unit of the agricultural implement, which is, a first sensor position (110) for the first ground-engaging tool (30), a second position sensor (120) for the second ground-engaging tool (70), and a third position sensor (130) See Deere I column 4, lines 27-38, lines 47-55 and column 4, line 64a, column 5, line 4). A third pressure sensor 137 (e.g., pressure transducer, load cell, draft link, instrumented pin) is configured to measure a third pressure indication (e.g., line pressure) of an actual operating pressure of the third ground-engaging tool 90 and configured to generate a corresponding third pressure signal 139. The illustrated third pressure sensor 137 is a third pressure transducer 138. Other types of the third pressure sensor 137 are contemplated by this disclosure. (Id., 5:5-13.) Each of sensors 110, 120 and 130 are configured to sense a position of the toolbar relative to the ground.

Element of Claim 1	Disclosure of the Prior Art
	KR'062 discloses a distance sensor 50 position on a tool bar and configured to measure the distance from the ground surface. EX1012 at 3.
a second sensor configured to sense an angle of the toolbar relative to the frame member; and	Deere I discloses position sensor 130 is a third hall effect rotational sensor 132 and is position at a joint to sense an angle of the toolbar relative to the frame member. See Deere I column 4, lines 27-38, lines 47-55 and column 4, line 64a, column 5, line 4). KR'062 discloses an angle sensor 40 provided in a coupling that measures the angle of the lower link 1 and transmits the measured angle to the control unit 70.
an actuator coupled between the frame member and the toolbar, the actuator configured to rotate the toolbar relative to the frame member based on a sensed position of the toolbar,	Deere I also comprises an actuator (100, 300) coupled between the frame element (20, 220) and the toolbar (85, 285), configured to rotate the toolbar relative to the frame member based on a sensed position of the toolbar. Deere I, col. 4, line 64 – col. 5, line 4, Fig. 7, 10.
wherein the toolbar remains parallel to the frame member throughout the rotation of the toolbar.	Deere I discloses the toolbar (85), which remains in parallel to the frame element (20) under any rotation motion.
2. The system of claim 1, further comprising a controller configured to receive first and second signals from the first and second sensors and cause	Deere I discloses a control unit configured to receive the position signal and configured to control an

Element of Claim 1	Disclosure of the Prior Art
actuation of the actuator based on the first and second signals.	adjustment device so that the depth indication targets a depth set point. EX1007, Abstract, Fig. 5, 5:13-20.
3. The system of claim 2, further comprising a control component that actuates the actuator, wherein the controller is configured to cause actuation by sending a signal to the control component.	Deere I discloses a control unit 140 (e.g., PID controller), using open loop, closed loop, or preferably proportional-integral-derivative “PID control methodology, is configured to receive the first, second, and third position signals 115, 125, 135 and the first, second, and third pressure signals 119, 129, 139, and generate a control signal 145, which is received by the controller 50. EX1007 5:13-21.
4. The system of claim 3, wherein the control component comprises a control valve, an air valve, an electronic control component, a magnetic control component, or an electromagnetic control component.	Deere I discloses a control unit 140 (e.g., PID controller), using open loop, closed loop, or preferably proportional-integral-derivative “PID control methodology, is configured to receive the first, second, and third position signals 115, 125, 135 and the first, second, and third pressure signals 119, 129, 139, and generate a control signal 145, which is received by the controller 50. EX1007 5:13-21. The controller 50 is an electrical component.
6. The system of claim 1, further comprising a controller, the controller configured to receive a signal from the first sensor and cause actuation of the actuator based on the signal.	Deere I discloses a control unit 140 (e.g., PID controller), using open loop, closed loop, or preferably proportional-integral-derivative “PID control methodology, is configured to receive the first, second, and third position signals 115, 125, 135 and the first, second, and third pressure signals 119,

Element of Claim 1	Disclosure of the Prior Art
	129, 139, and generate a control signal 145, which is received by the controller 50. EX1007 5:13-21.
7. The system of claim 6, further comprising a control component that actuates the actuator, wherein the controller is configured to cause actuation by sending a signal to the control component.	Deere I discloses a control unit 140 (e.g., PID controller), using open loop, closed loop, or preferably proportional-integral-derivative “PID control methodology, is configured to receive the first, second, and third position signals 115, 125, 135 and the first, second, and third pressure signals 119, 129, 139, and generate a control signal 145, which is received by the controller 50. EX1007 5:13-21.
8. The system of claim 7, wherein the control component comprises a control valve, an air valve, an electronic control component, a magnetic control component, or an electromagnetic control component.	Deere I discloses a control unit 140 (e.g., PID controller), using open loop, closed loop, or preferably proportional-integral-derivative “PID control methodology, is configured to receive the first, second, and third position signals 115, 125, 135 and the first, second, and third pressure signals 119, 129, 139, and generate a control signal 145, which is received by the controller 50. EX1007 5:13-21. The controller 50 is an electrical component.
10. The system of claim 1, wherein the sensed position is relative to a field surface, further comprising one or more electromagnetic sensors coupled to the frame member, the toolbar, or a combination of the frame member and the toolbar, the one or more electromagnetic sensors configured to sense an absolute elevation or change	KR’062 describes a controller (control unit 70) that receives the distance to the ground from distance sensor 50, which measures the elevation directly utilizing electromagnetic energy in a laser. Therefore, it would have been obvious to include another position sensor in the system of Deere I coupled to the toolbar

Element of Claim 1	Disclosure of the Prior Art
in elevation between the field surface and the toolbar or a combination of both the frame member and the toolbar.	to sense absolute or change in elevation of the toolbar.
11. The system of claim 10, further comprising a controller configured to receive one or more signals from the one or more electromagnetic sensors and cause actuation of the actuator based on the one or more signals.	Deere I discloses a control unit 140 (e.g., PID controller), using open loop, closed loop, or preferably proportional-integral-derivative “PID control methodology, is configured to receive the first, second, and third position signals 115, 125, 135 and the first, second, and third pressure signals 119, 129, 139, and generate a control signal 145, which is received by the controller 50. EX1007 5:13-21.
12. The system of claim 11, further comprising a control component that actuates the actuator, wherein the controller is configured to cause actuation by sending a signal to the control component.	Deere I discloses a control unit 140 (e.g., PID controller), using open loop, closed loop, or preferably proportional-integral-derivative “PID control methodology, is configured to receive the first, second, and third position signals 115, 125, 135 and the first, second, and third pressure signals 119, 129, 139, and generate a control signal 145, which is received by the controller 50. EX1007 5:13-21. The controller 50 is an electrical component.
13. The system of claim 12, wherein the control component comprises a control valve, an air valve, an electronic control component, a magnetic control component, or an electromagnetic control component.	Deere I discloses a control unit 140 (e.g., PID controller), using open loop, closed loop, or preferably proportional-integral-derivative “PID control methodology, is configured to receive the first, second, and third position signals 115, 125, 135 and the first, second, and third pressure signals 119, 129, 139, and generate a control signal

Element of Claim 1	Disclosure of the Prior Art
	145, which is received by the controller 50. EX1007 5:13-21. The controller 50 is an electrical component.
15. The system of claim 10, wherein the one or more electromagnetic sensors comprise ultrasonic, lidar, or radar sensors.	KR'062 describes a distance sensor 50, which emits laser light to the ground and measures the reflection. EX1012 at 3. This is the same kind of non-contact sensor that the 989 patent contemplated. EX1001, Col. 7, lines 26-29. Therefore, it is equivalent to a radar sensor.
17. A control system for an implement comprising a frame member and a toolbar coupled to the frame member parallel to the frame member via a hinged joint such that the toolbar remains parallel to the frame member throughout the rotation of the toolbar about the hinged joint, wherein a plurality of row units are secured to the toolbar, the control system comprising:	Deere I disclose an agricultural instrument. EX1007, Abstract. The implement comprises an elongated frame element (20) with wheels (40) coupled to it. EX1007, Figs. 1-3 and column 3, lines 27-29. Deere I discloses toolbar 85 coupled to row units 90. EX1007 4:7-16, Fig. 3 and 6:46-49, Fig. 10. Deere I discloses an elongate toolbar (85, 285) coupled to the frame element (20, 220) by means of an articulation link, the toolbar being oriented in parallel and at the back of the frame element (20, 220). Column 4, lines 7-16, Fig. 3 and col. 6, lines 46-49, Fig. 10. Deere I discloses the toolbar (85), which remains in parallel to the frame element (20) under any rotation motion.

Element of Claim 1	Disclosure of the Prior Art
a controller;	KR'062 describes a controller (control unit 70) that receives the distance to the ground from a first sensor (distance sensor 50) and receives the angle of the tool bar from a second sensor (angle sensor 40) and causes the actuator to raise or lower the toolbar based on the received signals. EX1012 at 3. It would have been obvious to the POSITA to modify the controller of Deere I to include the features of KR'062 to use both sensors to control the actuator to rotate the tool bar.
a first sensor configured to sense a position of the toolbar relative to ground;	Deere I discloses position sensors for each one of the toolbars of the row unit of the agricultural implement, which is, a first sensor position (110) for the first ground-engaging tool (30), a second position sensor (120) for the second ground-engaging tool (70), and a third position sensor (130) See Deere I column 4, lines 27-38, lines 47-55 and column 4, line 64a, column 5, line 4). KR'062 discloses a distance sensor 50 position on a tool bar and configured to measure the distance from the ground surface. EX1012 at 3.
a second sensor configured to sense an angle of the toolbar relative to the frame member;	Deere I discloses sensor 130 is a third hall effect rotational sensor 132 and is position at a joint to sense an angle of

Element of Claim 1	Disclosure of the Prior Art
	the toolbar relative to the frame member. See Deere I column 4, lines 27-38, lines 47-55 and column 4, line 64a, column 5, line 4). KR'062 discloses an angle sensor 40 provided in a coupling that measures the angle of the lower link 1 and transmits the measured angle to the control unit 70. KR'062 discloses an angle sensor 40 provided in a coupling that measures the angle of the lower link 13 and transmits the measured angle to the control unit 70. EX1012 at 3.
and an actuator coupled between the frame member and the toolbar,	Deere I also comprises an actuator (100, 300) coupled between the frame element (20, 220) and the toolbar (85, 285), configured to rotate the toolbar relative to the frame member based on a sensed position of the toolbar. Deere I, col. 4, line 64 – col. 5, line 4, Fig. 7, 10.
wherein the controller is configured to receive at least one signal from the at least one sensor indicating the position of the toolbar relative to the ground and cause the actuator to rotate the toolbar based on the sensed position of the toolbar.	Deere I discloses a control unit configured to receive the position signal and configured to control an adjustment device so that the depth indication targets a depth set point. EX1007, Abstract, Fig. 5, 5:13-20. KR'062 describes a controller (control unit 70) that receives the distance to the ground from a first sensor (distance sensor 50) and receives the angle of the

Element of Claim 1	Disclosure of the Prior Art
	tool bar from a second sensor (angle sensor 40) and causes the actuator to raise or lower the toolbar based on the received signals. EX1012 at 3. See above. It would have been obvious to the POSITA to modify the controller of Deere I to include the features of KR'062 to use both sensors to control the actuator to rotate the tool bar.
18. The system of claim 1, further comprising at least one wheel coupled to the frame member and at least partially supporting the frame member relative to the ground.	Deere I includes a plurality of wheel assemblies 40 are coupled to the first frame section 20 to support the frame member. EX1007 at 3:27-28.

4. Claims 1-4, 6-8, 10-13 and 17-18 are unpatentable over Hubalek in view of Houck

Claims Elements of the '989 Patent	Disclosure of the Prior Art
1. A system, comprising:	Hubalek discloses a seeder system. EX1006, Abstract. Houck also discloses a planting system. EX1005, Abstract.
an elongate frame member;	The planting system of Hubalek includes an elongated frame element 12. EX1006, 2:59, Fig. 1.

Claims Elements of the '989 Patent	Disclosure of the Prior Art
a plurality or row units coupled to the toolbar;	Hubalek discloses row units 22 coupled with the toolbar 78. EX1006 4:29-38, Figs. 1, 11. Houck discloses row units.
an elongate toolbar coupled to the frame member via a hinged joint, the toolbar oriented parallel to the frame member;	Hubalek teaches an elongate toolbar 78 coupled to the frame element 12 by means of a hinged, articulation link 70, 72. EX1006 4:29-38, Figs. 1, 11. Houck also discloses an elongate tool bar 34. EX1005, Fig. 1.
a first sensor configured to sense a position of the toolbar relative to ground;	Hubalek discloses a sensor 83 coupled to the frame element configured to determine if the tools are in the lowered position. EX1006 4:47-51, Fig. 11. Houck discloses a position sensor 206 that measures the elevation 204 of the tool bar. EX1005 ¶¶0047, Fig. 6.
a second sensor configured to sense an angle of the toolbar relative to the frame member; and	Hubalek discloses a sensor 83 coupled to the frame element configured to sense the position of the toolbar relative to the frame member. EX1006 4:47-51, Fig. 11. Houck teaches a sensor 112, 114 configured to sense an angle of the toolbar relative to frame member. EX1005 ¶¶0033, 36-37, Fig. 2.
an actuator coupled between the frame member and the toolbar, the actuator configured to rotate the toolbar relative to the frame member based on a sensed position of the toolbar,	Hubalek discloses an actuator 80, 82, known as hydraulic cylinders connected to the links 74, 76 and coupled between the frame element 12 and toolbar 78 configured to rotate the toolbar relative to the frame member based on a sensed position of the toolbar. EX1006 4:39-57, Fig. 11. Houck also disclose an actuator 102 coupled between the frame element 34 and the structure 70

Claims Elements of the '989 Patent	Disclosure of the Prior Art
	to adjust the position of the tools (72, 74, 76). EX1005 ¶¶0031, 36-37, Fig. 4.
wherein the toolbar remains parallel to the frame member throughout the rotation of the toolbar.	The toolbar 78 of Hubalek remains in parallel to the frame element 12 under any rotation motion.
2. The system of claim 1, further comprising a controller configured to receive first and second signals from the first and second sensors and cause actuation of the actuator based on the first and second signals.	Hubalek discloses a programmable controller 274, which is the “brains” of a control circuit for controlling the components of its system, including receiving signals from its sensor 83 and controlling various valves and electric motors. EX1006, Fig. 15, 8:44-55. Houck discloses a controller for controlling the elevation of the toolbar. The control system 38 comprises a central controller 122 operatively coupled to a user interface 124 and a display 125. The central controller 122, user interface 124, and display 125 can be located on or within the towing unit 42, enabling the operator to make on the go changes. In some embodiments, a plurality of local controllers 126 is in communication with the central controller 122 via a communications link 128, for receiving, for example, set points from the central controller 122. In one embodiment, the communications link is a wired device, such as a cable or bus. In other embodiments, the communications link 128 is a wireless link (e.g., a BLUETOOTH or a WI-FI link) for wireless communication between the central controller 122 and the local controllers 126. EX1005 ¶¶0034. Naturally, such a controller communicates using signals.

Claims Elements of the '989 Patent	Disclosure of the Prior Art
3. The system of claim 2, further comprising a control component that actuates the actuator, wherein the controller is configured to cause actuation by sending a signal to the control component.	Hubalek discloses control components (solenoid valves 268, 270 that are controlled by the controller 274, thereby controlling the actuator to rotate the toolbar. Col. 13, lines 15-31. Hubalek's controller is programmable and naturally would communicate by using signals. Houck discloses that "in certain embodiments, each actuator 102 for each seeding row unit 62 is in fluid communication with the hydraulic pressure source 44 via an adjustment device 146, such as an electro-hydraulic control valve. In one embodiment, each adjustment device 146 is controlled by the central controller 122 via a multi-line cable 148." Therefore, Houck discloses the claimed control components. The combination of Hubalek and Houck would include a control component that actuates the actuator, wherein the controller is configured to cause actuation by sending a signal to the control component.
4. The system of claim 3, wherein the control component comprises a control valve, an air valve, an electronic control component, a magnetic control component, or an electromagnetic control component.	Hubalek discloses control components (solenoid valves 268, 270 that are controlled by the controller 274, thereby controlling the actuator to rotate the toolbar. EX1006 13:15-31. Solenoid valves satisfy this limitation.

Claims Elements of the '989 Patent	Disclosure of the Prior Art
	As described above with reference to claim 3, Houck discloses that the control component is an electro-hydraulic control valve. Thus, Houck discloses this element. The combination of Hubalek and Houck would therefore include a control component as claimed.
6. The system of claim 1, further comprising a controller, the controller configured to receive a signal from the first sensor and cause actuation of the actuator based on the signal.	Hubalek discloses a programmable controller 274, which is the “brains” of a control circuit for controlling the components of its system, including receiving signals from its sensor 83 and controlling various valves and electric motors. EX1006 Fig. 15, 8:44-55. Houck discloses a controller for controlling the elevation of the toolbar. The control system 38 comprises a central controller 122 operatively coupled to a user interface 124 and a display 125. The central controller 122, user interface 124, and display 125 can be located on or within the towing unit 42, enabling the operator to make on the go changes. In some embodiments, a plurality of local controllers 126 is in communication with the central controller 122 via a communications link 128, for receiving, for example, set points from the central controller 122. In one embodiment, the communications link is a wired device, such as a cable or bus. In other embodiments, the communications link 128 is a wireless link (e.g., a BLUETOOTH or a WI-FI link) for wireless communication between the central controller 122 and the local controllers 126. EX1005 ¶0034.

Claims Elements of the '989 Patent	Disclosure of the Prior Art
	Naturally, such a controller communicates using signals.
7. The system of claim 6, further comprising a control component that actuates the actuator, wherein the controller is configured to cause actuation by sending a signal to the control component.	Hubalek discloses control components (solenoid valves 268, 270) that are controlled by the controller 274, thereby controlling the actuator to rotate the toolbar. EX1006 13:15-31. As described above with reference to claim 3, Houck discloses that the control component is an electro-hydraulic control valve. Thus, Houck discloses this element.
8. The system of claim 7, wherein the control component comprises a control valve, an air valve, an electronic control component, a magnetic control component, or an electromagnetic control component.	Hubalek discloses control components (solenoid valves 268, 270) that are controlled by the controller 274, thereby controlling the actuator to rotate the toolbar. EX1006 13:15-31. Solenoid valves satisfy this limitation. As described above with reference to claim 3, Houck discloses that the control component is an electro-hydraulic control valve. Thus, Houck discloses this element.
10. The system of claim 1, wherein the sensed position is relative to a field surface, further comprising one or more electromagnetic sensors coupled to the frame member, the toolbar, or a combination of the frame member and the	Houck discloses adding an additional sensor to its system (that already includes two sensors). "Alternatively, the seeding row assembly 172 can utilize a second position sensor (not depicted) for control of the elevation of the seeding row unit 62 to a predetermined depth, akin to the second position sensor 114 of FIGS. 2 and 3. Use of the second position sensor can be alternative to or in

Claims Elements of the '989 Patent	Disclosure of the Prior Art
toolbar, the one or more electromagnetic sensors configured to sense an absolute elevation or change in elevation between the field surface and the toolbar or a combination of both the frame member and the toolbar.	addition to the pressure sensor 192.” EX1005 ¶0042.
11. The system of claim 10, further comprising a controller configured to receive one or more signals from the one or more electromagnetic sensors and cause actuation of the actuator based on the one or more signals.	As described above, Houck discloses adding an additional sensor to its system for control of the elevation of the seeding row unit 62. .
12. The system of claim 11, further comprising a control component that actuates the actuator, wherein the controller is configured to cause actuation by sending a signal to the control component.	As described above with reference to claim 3, Houck discloses that the control component is an electro-hydraulic control valve. Thus, Houck discloses this element.
13. The system of claim 12, wherein the control component comprises a control valve, an air valve, an electronic control component, a magnetic control component, or an	As described above with reference to claim 3, Houck discloses that the control component is an electro-hydraulic control valve. Thus, Houck discloses this element.

Claims Elements of the '989 Patent	Disclosure of the Prior Art
electromagnetic control component.	
17. A control system for an implement comprising a frame member and a toolbar coupled to the frame member parallel to the frame member via a hinged joint such that the toolbar remains parallel to the frame member throughout the rotation of the toolbar about the hinged joint, wherein a plurality of row units are secured to the toolbar, the control system comprising:	Hubalek discloses a seeder system. EX1006, Abstract. Houck also discloses a planting system. EX1005, Abstract. The planting system of Hubalek includes an elongated frame element 12. EX1006, 2:59, Fig. 1. Hubalek discloses row units 22 coupled with the toolbar 78. EX1006 4:29-38, Figs. 1, 11. Houck discloses row units. Hubalek teaches an elongate toolbar 78 coupled to the frame element 12 by means of a hinged, articulation link 70, 72. EX1006 4:29-38, Figs. 1, 11. Houck also discloses an elongate tool bar 34. EX1005, Fig. 1. The toolbar 78 of Hubalek remains in parallel to the frame element 12 under any rotation motion.
a controller;	Hubalek discloses a programmable controller 274, which is the “brains” of a control circuit for controlling the components of its system, including receiving signals from its sensor 83 and controlling various valves and electric motors. EX1006, Fig. 15, 8:44-55. Houck discloses a controller for controlling the elevation of the toolbar. The control system 38 comprises a central controller 122 operatively coupled to a user interface 124 and a display 125. The central controller 122, user interface 124, and

Claims Elements of the '989 Patent	Disclosure of the Prior Art
	display 125 can be located on or within the towing unit 42, enabling the operator to make on the go changes. In some embodiments, a plurality of local controllers 126 is in communication with the central controller 122 via a communications link 128, for receiving, for example, set points from the central controller 122. In one embodiment, the communications link is a wired device, such as a cable or bus. In other embodiments, the communications link 128 is a wireless link (e.g., a BLUETOOTH or a WI-FI link) for wireless communication between the central controller 122 and the local controllers 126. EX1005 ¶0034. Naturally, such a controller communicates using signals.
a first sensor configured to sense a position of the toolbar relative to ground;	Hubalek discloses a sensor 83 coupled to the frame element configured to determine if the tools are in the lowered position. EX1006 4:47-51, Fig. 11. Houck discloses a position sensor 206 that measures the elevation 204 of the tool bar. EX1005 ¶0047, Fig. 6.
a second sensor configured to sense an angle of the toolbar relative to the frame member;	Houck teaches a sensor 112, 114 configured to sense an angle of the toolbar relative to frame member. EX1005 ¶¶0033, 36-37, Fig. 2.
and an actuator coupled between the frame member and the toolbar,	Hubalek discloses an actuator 80, 82, known as hydraulic cylinders connected to the links 74, 76 and coupled between the frame element 12 and toolbar 78 configured to rotate the toolbar relative to the frame member based on a sensed position of the toolbar. EX1006 4:39-57, Fig. 11.

Claims Elements of the '989 Patent	Disclosure of the Prior Art
	Houck also disclose an actuator 102 coupled between the frame element 34 and the structure 70 to adjust the position of the tools (72, 74, 76). EX1005 ¶¶0031, 36-37, Fig. 4.
wherein the controller is configured to receive at least one signal from the at least one sensor indicating the position of the toolbar relative to the ground and cause the actuator to rotate the toolbar based on the sensed position of the toolbar.	Hubalek discloses a programmable controller 274, which is the “brains” of a control circuit for controlling the components of its system, including receiving signals from its sensor 83 and controlling various valves and electric motors. EX1006, Fig. 15, 8:44-55. Houck discloses a controller for controlling the elevation of the toolbar. The control system 38 comprises a central controller 122 operatively coupled to a user interface 124 and a display 125. The central controller 122, user interface 124, and display 125 can be located on or within the towing unit 42, enabling the operator to make on the go changes. In some embodiments, a plurality of local controllers 126 is in communication with the central controller 122 via a communications link 128, for receiving, for example, set points from the central controller 122. In one embodiment, the communications link is a wired device, such as a cable or bus. In other embodiments, the communications link 128 is a wireless link (e.g., a BLUETOOTH or a WI-FI link) for wireless communication between the central controller 122 and the local controllers 126. EX1005 ¶0034. Naturally, such a controller communicates using signals.

Claims Elements of the '989 Patent	Disclosure of the Prior Art
18. The system of claim 1, further comprising at least one wheel coupled to the frame member and at least partially supporting the frame member relative to the ground.	Hubalek includes wheels 18 to support the frame member. See EX1006, Fig. 1.

5. Claims 1-4, 6-8 and 17-18 is unpatentable over Hubalek in view of Amazonen.

Claims Elements of the '989 Patent	Disclosure of the Prior Art
1. A system, comprising:	Hubalek discloses a seeder system. EX1006, Abstract. Amazonen also refers to a planting system. EX1008 ¶0002.
an elongate frame member;	The planting system of Hubalek includes an elongated frame element 12. EX1006, 2:59, Fig. 1. The planting system of Amazonen also comprises an elongated frame element 1 with wheels 19. EX1008 ¶0009.
a plurality of row units coupled to the toolbar;	Hubalek discloses row units 22 coupled with the toolbar 78. EX1006 4:29-38, Figs. 1, 11.

Claims Elements of the '989 Patent	Disclosure of the Prior Art
	Amazonen discloses a plurality of row units 7 are coupled with the toolbar 12. EX1008 Fig. 2 and ¶¶0010-11.
an elongate toolbar coupled to the frame member via a hinged joint, the toolbar oriented parallel to the frame member;	Hubalek teaches an elongate toolbar 78 coupled to the frame element 12 by means of a hinged, articulation link 70, 72. EX1006 4:29-38, Figs. 1, 11. Amazonen teaches a toolbar 12 coupled to the frame element 1 by means of an articulation link 15 formed by the structure 6. EX1008 Fig. 2 and ¶¶0010-11.
a first sensor configured to sense a position of the toolbar relative to ground;	Amazonen teaches a first sensor 20 to detect the position of the ground-engaging tools 8 and the toolbar relative to the ground. EX1008 ¶0014 and Fig. 4.
a second sensor configured to sense an angle of the toolbar relative to the frame member; and	Hubalek discloses a sensor 83 coupled to the frame element that can sense the position of the toolbar relative to the frame member. EX1006 4:47-51, Fig. 11.
an actuator coupled between the frame member and the toolbar, the actuator configured to rotate the toolbar relative to the frame member based on a sensed position of the toolbar,	Hubalek discloses an actuator 80, 82, known as hydraulic cylinders connected to the links 74, 76 and coupled between the frame element 12 and toolbar 78 configured to rotate the toolbar relative to the frame member based on a sensed position of the toolbar. EX1006 4:39-57, Fig. 11.

Claims Elements of the '989 Patent	Disclosure of the Prior Art
	Amazonen also discloses an actuator 18, known as a hydraulic cylinder, between the frame element 1 and the articulation link 15 formed by the structure 6 that comprises the toolbar (12). EX1008 ¶0011 and figure 1.
wherein the toolbar remains parallel to the frame member throughout the rotation of the toolbar.	The toolbar 78 of Hubalek remains in parallel to the frame element 12 under any rotation motion.
2. The system of claim 1, further comprising a controller configured to receive first and second signals from the first and second sensors and cause actuation of the actuator based on the first and second signals.	Hubalek discloses a programmable controller 274, which is the “brains” of a control circuit for controlling the components of its system, including receiving signals from its sensor 83 and controlling various valves and electric motors. EX1006, Fig. 15, 8:44-55.
3. The system of claim 2, further comprising a control component that actuates the actuator, wherein the controller is configured to cause actuation by sending a signal to the control component.	Hubalek discloses control components (solenoid valves 268, 270 that are controlled by the controller 274, thereby controlling the actuator to rotate the toolbar. Col. 13, lines 15-31. Hubalek’s controller is programmable and naturally would communicate by using signals. .
4. The system of claim 3, wherein the control component comprises a control valve, an air valve, an electronic control component, a magnetic control component, or an electromagnetic control component.	Hubalek discloses control components (solenoid valves 268, 270 that are controlled by the controller 274, thereby controlling the actuator to rotate the toolbar. EX1006 13:15-31. Solenoid valves satisfy this limitation.

Claims Elements of the '989 Patent	Disclosure of the Prior Art
6. The system of claim 1, further comprising a controller, the controller configured to receive a signal from the first sensor and cause actuation of the actuator based on the signal.	Hubalek discloses a programmable controller 274, which is the “brains” of a control circuit for controlling the components of its system, including receiving signals from its sensor 83 and controlling various valves and electric motors. EX1006 Fig. 15, 8:44-55.
7. The system of claim 6, further comprising a control component that actuates the actuator, wherein the controller is configured to cause actuation by sending a signal to the control component.	Hubalek discloses control components (solenoid valves 268, 270) that are controlled by the controller 274, thereby controlling the actuator to rotate the toolbar. EX1006 13:15-31.
8. The system of claim 7, wherein the control component comprises a control valve, an air valve, an electronic control component, a magnetic control component, or an electromagnetic control component.	Hubalek discloses control components (solenoid valves 268, 270) that are controlled by the controller 274, thereby controlling the actuator to rotate the toolbar. EX1006 13:15-31. Solenoid valves satisfy this limitation.
17. A control system for an implement comprising a frame member and a toolbar coupled to the frame member parallel to the frame member via a hinged joint such that the toolbar remains parallel to the frame member throughout the rotation of the toolbar about the hinged joint, wherein a plurality of row units are secured to the toolbar, the control system comprising:	Hubalek discloses a seeder system. EX1006, Abstract. Amazonen also refers to a planting system. EX1008 ¶0002. The planting system of Hubalek includes an elongated frame element 12. EX1006, 2:59, Fig. 1.

Claims Elements of the '989 Patent	Disclosure of the Prior Art
	The planting system of Amazonen also comprises an elongated frame element 1 with wheels 19. EX1008 ¶0009. Hubalek discloses row units 22 coupled with the toolbar 78. EX1006 4:29-38, Figs. 1, 11. Amazonen discloses a plurality of row units 7 are coupled with the toolbar 12. EX1008 Fig. 2 and ¶¶0010-11. Hubalek teaches an elongate toolbar 78 coupled to the frame element 12 by means of a hinged, articulation link 70, 72. EX1006 4:29-38, Figs. 1, 11. Amazonen teaches a toolbar 12 coupled to the frame element 1 by means of an articulation link 15 formed by the structure 6. EX1008 Fig. 2 and ¶¶0010-11. The toolbar 78 of Hubalek remains in parallel to the frame element 12 under any rotation motion.
a controller;	Hubalek discloses a programmable controller 274, which is the “brains” of a control circuit for controlling the components of its system, including receiving signals from its sensor 83 and controlling various valves and electric motors. EX1006, Fig. 15, 8:44-55.

Claims Elements of the '989 Patent	Disclosure of the Prior Art
a first sensor configured to sense a position of the toolbar relative to ground;	Amazonen teaches a first sensor 20 to detect the position of the ground-engaging tools 8 and the toolbar relative to the ground. EX1008 ¶0014 and Fig. 4.
a second sensor configured to sense an angle of the toolbar relative to the frame member;	Hubalek discloses a sensor 83 coupled to the frame element configured to determine if the tools are in the lowered position. EX1006 4:47-51, Fig. 11.
and an actuator coupled between the frame member and the toolbar,	Hubalek discloses an actuator 80, 82, known as hydraulic cylinders connected to the links 74, 76 and coupled between the frame element 12 and toolbar 78 configured to rotate the toolbar relative to the frame member based on a sensed position of the toolbar. EX1006 4:39-57, Fig. 11. Amazonen also discloses an actuator 18, known as a hydraulic cylinder, between the frame element 1 and the articulation link 15 formed by the structure 6 that comprises the toolbar (12). EX1008 ¶0011 and figure 1.
wherein the controller is configured to receive at least one signal from the at least one sensor indicating the position of the toolbar relative to the ground and cause the actuator to rotate the toolbar	Hubalek discloses a programmable controller 274, which is the “brains” of a control circuit for controlling the components of its system, including receiving signals from its sensor 83 and

Claims Elements of the '989 Patent	Disclosure of the Prior Art
based on the sensed position of the toolbar.	controlling various valves and electric motors. EX1006, Fig. 15, 8:44-55. Houck discloses a controller for controlling the elevation of the toolbar. The control system 38 comprises a central controller 122 operatively coupled to a user interface 124 and a display 125. The central controller 122, user interface 124, and display 125 can be located on or within the towing unit 42, enabling the operator to make on the go changes. In some embodiments, a plurality of local controllers 126 is in communication with the central controller 122 via a communications link 128, for receiving, for example, set points from the central controller 122. In one embodiment, the communications link is a wired device, such as a cable or bus. In other embodiments, the communications link 128 is a wireless link (e.g., a BLUETOOTH or a WI-FI link) for wireless communication between the central controller 122 and the local controllers 126. EX1005 ¶0034. Naturally, such a controller communicates using signals.
18. The system of claim 1, further comprising at least one wheel coupled to the frame member and at least partially supporting the frame member relative to the ground.	Hubalek includes wheels 18 to support the frame member. See EX1006, Fig. 1.

6. Claim 16 was obvious in light of any of the combinations above, in view with Friesen.

Element of Claim 16	Disclosure of the Prior Art
16. The system of claim 1,	See claim 1 above in each of the claim charts.
wherein the actuator is configured to rotate the toolbar throughout an obtuse angle range.	Friesen discloses farm implement with a toolbar apparatus including an actuator configured to rotate the toolbar relative to the frame member based through an obtuse angle. EX1015 ¶¶0001, 0012-0014, 0026, Figs. 1-3. This rotation is the same as the rotation shown in Fig. 3 of the '989 patent. It would have been obvious to modify Hubalek, Deere I, Amazonen or Poettinger in light of Friesen in order to better protect the tools for transit.

XI. APPENDIX B – LIST OF MATERIALS CONSIDERED

Exhibit No.	Document Description
1001	The '989 Patent – U.S. Patent No. 11,665,989
1002	[Intentionally Left Blank]
1003	C.V. of Paul R. Weckler
1004	Excerpts from the File History of the '989 Patent
1005	U.S. Patent Application Publication 2015/0230391 to Houck
1006	U.S. Patent No. 9,031,749 to Hubalek et al.
1007	U.S. Patent No. 8,573,319 to Casper et al.
1008	EP2335465 to AMAZONEN (Translation)

1009	DE102006034798 to POETTINGER LANDTECHNIK GMBH (Translation)
1010	U.S. Patent Application Publication 2014/0209335 to Casper et al.
1011	EP3192343 to POETTINGER LANDTECHNIK GMBH (Translation)
1012	KR101877062 B1 to LS MTRON (“KR’062”) (Translation)
1013	U.S. Pat. Pub. No. 2016/0302350 to Kinzenbaw (Kinze Manufacturing Inc.)(“the ’350 application”)
1014	U.S. Patent 8,567,517 to Friggstad (CNH Canada, Ltd.)(“the ’517 patent”)
1015	U.S. Patent Application Publication No. 2014/0069670 to Friesen et al.
1016	EP2335465 to AMAZONEN (Original)

1017	DE102006034798 to POETTINGER LANDTECHNIK GMBH (Original)
1018	EP3192343 to POETTINGER LANDTECHNIK GMBH (Original plus ESPACENET translation)
1019	KR101877062 B1 to LS MTRON (“KR’062”) (Original)
1020	Certificate of translation (affidavit) for DE102006034798
1021	Certificate of translation (affidavit) for EP3192343
1022	Certificate of translation (affidavit) for KR101877062 B1