

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

SYNGENTA CROP PROTECTION
AG,
Petitioner,

v.

INFLEXION POINT
TECHNOLOGIES, LLC
Patent Owner.

Case PGR2025-00045
Patent 12,102,027 B2

**DECLARATION OF DURHAM K. GILES, Ph.D., IN SUPPORT OF
PETITION FOR POST-GRANT REVIEW OF U.S. PATENT NO. 12,102,027**

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I, Durham Kenimer Giles, hereby declare as follows:

I. INTRODUCTION

A. Scope of Work

1. I have been retained by Baker & Hostetler LLP on behalf of Syngenta Crop Protection AG (“Syngenta” or “Petitioner”) as an independent expert to provide my opinions on the subject matter recited in U.S. Patent No. 12,102,027 (Exhibit 1001, “the ’027 Patent”) in view of the state of the art at the time and various references that predate the ’027 Patent, all of which I refer to in this declaration.

2. I understand that Syngenta is petitioning the Patent Trial and Appeal Board (PTAB) to institute a post-grant review (PGR) of the ’027 Patent, and is requesting that the PTAB cancel each of claims 1-19 (the “Challenged claims”) as unpatentable due to anticipation, obviousness, lack of enablement, and/or indefiniteness. I understand that this declaration is being filed as an Exhibit in the PGR.

3. I make this declaration based upon personal knowledge. I am over the age of 21 and otherwise competent to make this declaration.

4. I am being compensated at my normal and customary rate for work performed on this matter. My compensation does not depend on the nature of my findings, the presentation of my findings in testimony, or the outcome of this proceeding. I have no financial interest in Petitioner or Patent Owner.

B. Qualifications

5. I am an Emeritus Professor of Biological & Agricultural Engineering in both the College of Engineering and the College of Agricultural & Environmental Sciences at the University of California, Davis.

6. In 1979 I received a Bachelor of Science degree in Agricultural Engineering from the University of Georgia. In 1983 I earned my Master of Science degree in Agricultural Engineering from the University of Georgia. In 1987 I earned my Ph.D. in Agricultural Engineering with a minor in Mechanical Engineering from Clemson University.

7. I joined the faculty of the University of California, Davis in 1987, first as an assistant professor and then as an associate professor. I was promoted to professor in 1997 and became an Emeritus Professor in 2019.

8. Prior to my academic career, I grew up on a working dairy farm where we grew our own forage and I operated and maintained conventional field equipment for planting, tillage and harvest of corn, silage and hay. Concurrently, I developed and operated a small truck farm operation for seasonal vegetables at local farmer's markets.

9. Since 1987 I have taught numerous undergraduate and graduate level courses in engineering design and development, agricultural chemical application, pesticide regulation and use, project management and intellectual property for

engineers. I have taught numerous portions of courses in precision agriculture and pest control. I have supervised and mentored graduate students (M.S. and Ph.D. level) working on projects related to agricultural chemical application, pesticide spraying, planter technology, harvesting equipment and particle coating, including a number of projects involving the targeted spraying of agricultural chemicals onto moving targets, sensing of spray target location, trajectory and characteristics and design and control of spray system components. In my work with graduate students who hold undergraduate engineering degrees and often have some industrial experience before returning to graduate school, I have experience and insight as to the skills and capabilities of those of reasonable skill in the art.

10. I have extensive experience with agricultural equipment, in particular all aspects of agrochemical application and targeted delivery. I hold a number of patents on spray target sensing and control systems, nozzle designs, droplet size and spray volume control systems and actuators. Many of these patents have achieved commercial success and are currently in widespread use in agricultural production.

11. Over the course of my career, I have published extensively on the subjects of spray droplets, nozzles, sprayer control systems, particle coating, agricultural chemical application and precision agriculture including numerous book chapters, and more than 100 peer-reviewed articles in scientific journals. In addition, I have authored a significant number of abstracts that are included in the proceedings

of various scientific conferences. These publications have largely centered around the use of liquid spray applications for agricultural and industrial chemical processes, including field application of crop production inputs.

12. I have given hundreds of talks or presentations at various scientific conferences, providing insights on a variety of topics in the fields of precision agriculture, agricultural chemical application and liquid spray sensing and control systems. I have consulted with a number of consumer products companies on process development and design for production line systems for high throughput coating and spray treatment systems. I have conducted training and education courses in precision spray applications for industry and agriculture for private companies and public entities. I am also an active member in a number of professional societies including the American Society of Agricultural and Biological Engineers, Association of Applied Biologists, American Chemical Society, National Agricultural Aviation Association, and the National Academy of Inventors. I have served as an Editor and on the Editorial Boards of the journals: Atomization and Sprays, Transactions of the American Society of Agricultural and Biological Engineers, and Applied Engineering in Agriculture. I have served as a reviewer for peer-reviewed articles in multiple international journals and as a study reviewer for the United States Environmental Protection Agency.

13. Additional information regarding my background, qualifications and

expertise is included in my *curriculum vitae*, which is attached as Appendix A.

14. It is for at least the foregoing reasons that I am an expert in the field of precision agriculture and in-field application of crop production and protection materials with focused experience and expertise in precision agrochemical application, including sprayer sensing, control and targeting systems.

C. Materials Reviewed

15. In forming my opinions, I have reviewed the '027 Patent and considered each of the documents listed in the Exhibit List appended to this declaration (Appendix B) and the other references cited in my declaration. In reaching my opinions, I have relied upon my experience in the field and also considered the viewpoint of a person of ordinary skill in the art at the time of the earliest claimed Priority Date of the '027 Patent, i.e., June 23, 2015. Based on my experience mentoring graduate engineering students and as explained below, I am familiar with the level of skill of a person of ordinary skill in the art regarding the relevant technology at issue as of that time.

II. SUMMARY OF OPINIONS

16. I have been asked to consider and provide my opinions on certain topics related to '027 Patent, including:

- The level of a person of ordinary skill in the art (POSA) at the time of the alleged invention described in the claims of

the '027 Patent;

- How a person of ordinary skill in the art (POSA) would interpret the claims of the '027 Patent;
- Whether any of the claims of the '027 Patent were anticipated by certain prior art references;
- Whether any of the claims of the '027 Patent were obvious in view of certain prior art references; and
- Whether the claims of the '027 Patent are enabled to their full scope.

17. In forming my opinions, I reviewed the documents cited in this declaration.

18. My opinions are based upon my education, training, and experience in the discipline of agricultural engineering and the specific field of precision agriculture and precision agrochemical application, with an emphasis on targeted spray application with sprayer target sensing and control systems as well as the documents I considered.

19. As I discuss below in more detail, it is my opinion that:

- Claims 1-4, 6, 7, 11, and 13-16 of the '027 Patent are anticipated by Wagers (Ex. 1004);

- Claims 1-7 and 11-16 of the '027 Patent are rendered obvious by Wagers in view of Mitchell (Ex. 1005);
- Claim 8 of the '027 Patent is rendered obvious by Wagers in view of Wilkerson (Ex. 1006);
- Claims 9 and 10 of the '027 Patent are rendered obvious by Wagers in view of Batcheller (Ex. 1007);
- Claim 17 of the '027 Patent is rendered obvious by Wagers in view of Memory (Ex. 1008);
- Claims 18 and 19 of the '027 Patent are rendered obvious by Wagers in view of Garner (Ex. 1009); and
- Claims 1-19 of the '027 Patent are unpatentable for lack of an enabling disclosure in the patent.

III. LEGAL STANDARDS

20. My understanding of relevant legal standards, as discussed throughout this declaration, is based on instructions from Petitioner's counsel.

21. In this section I describe my understanding of certain legal standards. I have been informed of these legal standards by Petitioner's counsel. I am not an attorney, and I am relying only on instructions from Petitioner's counsel for these legal standards. I have applied these understandings in my analysis as detailed below.

A. Unpatentability

22. I understand that patent protection may be granted for any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof. I understand that a patent or other publication must first qualify as prior art before it can be used to invalidate a patent claim. I understand that the law provides categories of information that constitute prior art that may be used to anticipate or render obvious patent claims. To be prior art to a particular patent, a reference must have been made, known, used, published, or patented, or described in a patent application by another, before the Priority Date of the patent at issue. I also understand that a POSA is presumed to have knowledge of the relevant prior art as of the Priority Date. I have reviewed the teachings of the prior art with the understanding of a POSA. I have also reviewed the '027 Patent and relevant portions of the '027 Patent's file history with this understanding.

23. I understand that documents and materials that qualify as prior art can be used to render a claim unpatentable as anticipated under 35 U.S.C. § 102 or as obvious under 35 U.S.C. § 103.

24. I have been told that Syngenta bears the burden of proving unpatentability by a preponderance of the evidence. I am informed that this preponderance of the evidence standard means that Syngenta must show that unpatentability is more probable than not. I have taken this principle into account

when forming my opinions here.

25. I understand that the '027 Patent issued from an application filed in the U.S. Patent & Trademark Office (USPTO) based on international application (PCT/US2015/037230) filed on June 23, 2015. I understand that the international application filed on June 23, 2015 is the earliest effective filing date of the '027 Patent, and it is the filing date I have considered for my analyses ("Priority Date").

26. I understand that the first step in comparing prior art to patent claims is to properly construe the claims to determine claim scope and meaning. I understand that in post-grant review proceedings, claim terms are given their ordinary and customary meaning, as understood by a person of ordinary skill in the art (POSA) in the context of the entire disclosure of the specification, as well as in view of statements made during the prosecution of the patent. I also understand that an inventor may act as his own lexicographer and define terms in the patent.

27. I understand once the claims of a patent have been properly construed, the second step in determining whether or not a claim is patentable requires a comparison of the properly construed claim to the prior art.

B. Anticipation

28. I understand that a prior art reference "anticipates" a claim, and thus renders the claim unpatentable, if all elements of the claim were disclosed in that prior art reference, either explicitly or inherently (i.e., necessarily present or

implied).

29. I am told anticipation requires that each and every element of a challenged claim is present in a single reference. I also understand that an anticipatory reference does not need to explicitly describe each element because anticipation can occur when a claimed limitation is necessarily inherent or otherwise implicit in the reference.

30. I understand that a person of ordinary skill in the art provides a reference point from which the prior art and claimed invention should be viewed.

C. Obviousness

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

32. I have been told the determination of obviousness is resolved on the basis of several underlying factual inquiries including: (1) the scope and content of the prior art; (2) the differences between the claimed subject matter and the prior art; (3) the level of ordinary skill in the art; and (4) if in the record, objective evidence of non-obviousness.

33. Such objective evidence of non-obviousness may include: (1) a long

felt but unmet need in the prior art that was satisfied by the invention of the patent; (2) commercial success of processes covered by the patent; (3) unexpected results achieved by the claimed subject matter; (4) praise of the invention by others skilled in the art; (5) taking of licenses under the patent by others; (6) deliberate copying of the invention; (7) failure of others to find a solution to the long felt need; and (8) skepticism by experts.

34. I also understand that there must be a nexus between any such objective evidence of non-obviousness and the claimed subject matter. I further understand that any such objective evidence must be reasonably commensurate with the scope of the claimed subject matter.

35. I have also been informed that when there is some recognized reason to solve a problem—and there are a finite number of identified, predictable, known solutions—a POSA is motivated and has good reason to pursue the known options within his or her technical grasp. If this approach leads to the expected success, it is likely the product of ordinary skill and common sense rather than the product of innovation. Where a patent simply arranges old elements, with each element performing its known function and the whole yielding no more than would be expected, the combination is obvious.

36. I have also been informed that the USPTO supplies its examining corps with a Manual of Patent Examining Procedure that provides exemplary rationales

that may support a conclusion of obviousness, including:

- (a) Combining prior art elements according to known methods to yield predictable results;
- (b) Simple substitution of one known element for another to obtain predictable results;
- (c) Use of known technique to improve similar devices (methods, or products) in the same way;
- (d) Applying a known technique to a known device (method, or product) ready for improvement to yield predictable results;
- (e) “Obvious to try” – choosing from a finite number of identified, predictable solutions, with a reasonable expectation of success;
- (f) Known work in one field of endeavor may prompt variations of it for use in either the same field or a different one based on design incentives or other market forces if the variations are predictable to one of ordinary skill in the art; or
- (g) Some teaching, suggestion, or motivation in the prior art that would have led one of ordinary skill to modify the

prior art reference or to combine prior art reference
teachings to arrive at the claimed invention.

MPEP § 2143. I apply these principles in my analysis below.

D. Enablement Requirement

37. It is my understanding that a claimed invention is not patentable under 35 U.S.C. § 112 for lack of enablement if the specification does not contain a sufficiently full and clear description of how to make and use the full scope of the claimed invention. To be enabling, the patent must permit one of skill in the art to make and use the full scope of the claimed invention at the time of original filing without having to conduct undue experimentation. In deciding whether a person having skill in the art would have to experiment unduly in order to make and use of the invention, I understand several factors may be considered: (1) the quantity of experimentation necessary, (2) the amount of direction or guidance presented, (3) the presence or absence of working examples, (4) the nature of the invention, (5) the state of the prior art, (6) the relative skill of those in the art, (7) the predictability or unpredictability of the art, and (8) the breadth of the claims. I understand that no one or more of these factors alone is dispositive. Rather, whether the degree of experimentation required is undue requires weighing these factors in the context of the claimed invention and the state of the art at the time of the original application.

IV. BACKGROUND OF THE TECHNOLOGY AND THE LEVEL OF ORDINARY SKILL IN THE ART

A. General Background

38. Precision agriculture, also (and originally) known as site-specific agriculture, is defined as crop production practiced on a tighter (i.e., smaller) spatial resolution than an entire field or geographic boundary. Traditionally, an agricultural field received the typical crop inputs of seed, fertilizer, and pesticides uniformly across the field, with no adjustment and compensation for variability in the characteristics and production capacity of the soil at different locations within the field. In precision agriculture (the term was functionally adopted when the First International Conference on Precision Agriculture was held in Minneapolis, MN in June 1992), the management of the crop—specifically, the types and quantities of inputs, such as irrigation water, seeds and plants, fertilizers, pesticides, biostimulants, and even mechanical cultivation—is tailored to highly specific locations and areas in a field, even down to the single or fractional plant level of resolution.

39. Precision agriculture is based on three foundational technologies, all of which are necessary for implementation, and all of which were readily available as early as the mid-1990s. The first technology is rapid, precise and accurate positioning and navigation of the agricultural implement, including sensors and actuator systems. This foundation was realized in 1993 when commercial and public

access to the Global Positioning System (GPS) became common, through an agreement between the U.S. Department of Defense and U.S. Department of Transportation, and commercial signal correction technologies were introduced that allowed precision to the sub-meter level to be realized on moving vehicles.

40. The second foundation for precision agriculture, Geographic Information Systems (GIS), is the software for mapping and spatial reference for data related to characteristics of a specific location on earth. In 1982, the software product, ARC/INFO, was introduced and provided a standardized format and methodology for GIS analysis. In 1990, the U.S. Census Bureau completed a national digital map of roads, boundaries and waterways, and in 1995, the U.K. completed the first complete national mapping program. By 2005, the consumer GIS-based products Google Maps and Google Earth were common, and by 2006, cloud computing was available through Amazon Web Services, accelerating the ease of data flow and processing for mobile and distributed devices. Specifically for agriculture, the locational characteristics that had been mapped included soil fertility, texture, weed populations, land slope, moisture and other historical and current parameters critical to crop management. Each parameter of the soil or field condition could be archived in a separate layer in a localized digital map of the field. This map was and is used for storage of the data, manipulation of the data to create specific management decisions such as amount of fertilizer or pesticide to apply at

each location, and finally to create a prescription for localized management of the field; for example, a specific type and amount of fertilizer to be applied to each location in the field.

41. The third type of critical technology for precision agriculture is the sensor and mechanical actuator systems that provide the input data on soil, plant and field characteristics for the GIS and prescription creation and then implement the prescription application, e.g., rate of fertilizer applied, as the field is managed. Such actuator systems were available by the mid-1990s.

42. Thus, by the mid-1990's, precision agriculture was established as a growing, commercially viable means of production and the agricultural equipment industry expanded as the three foundation technologies developed quickly. In 1997, Tyler Industries introduced the AIM Command™ product on mobile ag equipment (e.g., the Patriot™ self-propelled sprayer) that integrated all the foundational technologies, namely, a GPS system (from Trimble Navigation, Inc.), the GIS mapping and prescription software (from SSToolbox, Inc.) and a pesticide spray system controller/actuator (from Capstan Ag Systems, Inc.) into a single product offering.

43. Other equipment manufacturers quickly followed with similarly configured products. Concurrently, the research and development was rapidly expanding as North American and European conferences on precision agriculture

provided forums for collaboration and standardization of hardware and software structures and protocols.

44. As on-board and cloud computing capabilities rapidly advanced, sensor technology, particularly video imaging and processing components, became more capable and more robust, and actuator technology became faster and more precise, leading to corresponding advancements in the speed and spatial resolution of precision agriculture. In the 2005-2007 time frame, the fusion of GPS navigation, on-vehicle data processing, GIS-mapping and robotic technologies resulted in crop management at the individual plant level. By at least as early as 2010, the capabilities of precision agriculture technology were well integrated into delivery of all crop inputs at the commercial level.

45. Modern agriculture, while exploiting the development and adoption of the physical technology of precision agriculture, has experienced a similar biological advancement in seed technology. Concurrent with the development of the physical systems of precision agriculture, genetically modified organisms (GMO's) were introduced beginning in or around 1996 in the form of commodity crops modified to be resistant to chemical herbicides. The most notable, at the time, was the introduction of Roundup Ready™ crops, which were designed to be resistant to the herbicide glyphosate, marketed as Roundup™. This development allowed targeted use of non-selective herbicides to be integrated into weed management programs.

For control of insects, genetic modification of the crop seeds could incorporate insecticidal compounds that would be expressed through the plant and target insects that attempted to feed on the plant. In 1996, genes from the bacterium *Bacillus thuringiensis* (Bt), which has natural insecticidal properties, were incorporated into corn and cotton seeds, providing control of common insect pests in those crops. These GMO incorporations of weed and insect control strategies and compounds into the seeds created highly proprietary seed products and strengthened the technology and market links between seed and crop protection products and companies. With these developments, seeds became an even more highly specialized and expensive crop input.

46. As seeds became more advanced, through both the GMO processes and conventional breeding approaches, and the use of precision agriculture advanced, the two trends merged as the demand for higher precision and accuracy in seed handling and placement was combined with the capabilities of highly localized crop inputs and individual seed/plant mapping to create a seed-by-seed approach to farming. In the 2000's, the term, biostimulants came into use, as biological compounds other than traditional fertilizers or pesticides were realized as potentially providing notable benefits when applied to, or in the proximity, of seeds. Maximizing the potential yields of advanced seeds, while optimizing and targeting the dosing of crop inputs such as fertilizers, pesticides, biostimulants, and other

additives required tight tolerances on seed depth, spacing, and plant populations. These demands, combined with the constant desire for faster ground speeds and higher productivity, as measured by acres per day, led to advances in planter technology, with the notable commercial example of Precision Planting, Inc., a company focused on development of high speed, precise planters, which was formed in 1993 and acquired by Monsanto in 2012, demonstrating the commercial linkage of planting technology with seed and agrochemical enterprises. Higher speed handling systems for seed, including more reliable singulation and spacing control, were increasingly emphasized commercially. With the ability to accurately control seeding rates and placement, the link with highly precise placement of crop chemical inputs could be realized and the concept of individual seed/plant crop management could be achieved.

B. The '027 Patent

1. Specification

47. The '027 Patent is directed to a prescriptive seed treatment method for a planter including calculating a planting location in a field, selecting a combination of a seed type and a substance to apply to the seed, calculating an application amount of the substance, which can vary on the planting location, and applying the substance to each seed while delivering the treated seed to the planting location. Ex. 1001, claim 1. The seed treatment method of the '027 Patent “permits precise selection of

which seed and the type and amount of seed treatment substances that should be planted in a particular location,” where “calculating” a location may be based on “visual observation, GPS coordinates” or “prescription field maps.” *Id.*, 4:3-12, 28:56-61. Furthermore, the seed treatment method of the ’027 Patent is “based at least in part on a condition” or “any circumstance that can impact what seed to be planted at a particular location and/or the type and/or amount of seed applied substance(s) applied to such seed.” *Id.*, 8:27-33. Furthermore, the ’027 Patent characterizes “planter” as including “past planters, currently existing planters, future planters and other current and future equipment used in the planting process.” *Id.*, 7:25-30.

48. According to the ’027 Patent, the planter used in the seed treatment method includes “components” which “a person having ordinary skill in the art is familiar with the operation of.” Ex. 1001, 10:10-17. These components include a multi-row unit planter with row units including a seed hopper, a seed meter, a seed drop tube, an opening disc, seed firmer wheels, and closing wheels. *Id.*, 10:4-10. Moreover, the ’027 patent recognized farmers have already “adopted tools and techniques such as variable rate planters, variable blend and variable rate fertilizers, multi-hybrid and multi-variety planters (i.e., planters capable of planting multiple, different types of hybrids during the same planting session), and the like” and “prescriptive agriculture systems” currently exist. *Id.*, 3:63 - 4:3, 13-15. The planter

used in the seed treatment method shown in the Figures uses a seed drop tube with substance applicators, which “includ[e] means commonly known in the art.” *Id.*, 12:35-41.

2. The Prosecution History

49. I understand the '027 Patent issued from an application that was originally filed with 27 claims and that the U.S. Patent & Trademark Office (USPTO) rejected the claims on various grounds and that Inflexion amended the claims and filed responses, ultimately replacing all of the claims, until the application was eventually allowed.

50. While I have reviewed the prosecution in its entirety and have fully considered it in rendering my opinions, I provide below only a brief summary of the correspondence between the Applicant and Examiner as the application was considered and ultimately issued as the '027 Patent.

51. The '027 Patent was filed as a Patent Cooperation Treaty (“PCT”) application on June 23, 2015, and entered under 37 C.F.R. as Application No. 15/739,606 (“the '606 Application”) on December 22, 2017. Ex. 1001, cover. The '606 application claimed priority to PCT application No. PCT/US2015/037230 filed June 23, 2015. *Id.*

52. In the first and second office actions, dated April 30, 2020, and February 2, 2021, the Examiner rejected the claims over various prior art references

including Fick (U.S. Patent No. 5,931,882), Wendte (US2015/0223391); Bender (U.S. Patent No. 5,915,313); and Knake (U.S. Patent No. 5,356,934). Ex. 1002, 99-110; 133-44. The Applicant substantively responded on May 3, 2021, and attempted to distinguish Fick by arguing the reference does not disclose treatment of a seed before the seed is planted. *Id.*, 116-23.

53. In the Examiner's next Office Action of August 5, 2021, the Examiner relied on a new set of references in rejecting the claims, including Bardi (U.S. Patent No. 6,148,748) Wendte, and Ochampaugh (US2013/0121101). Ex. 1002, 172-83. On November 4, 2021, the Applicant responded by arguing that: Bardi "would necessarily require 'engineering modifications of the apparatus'" (*Id.*, 201); "the in-line mixing chamber 22' of Bardi is for mixing seed and treatment fluid, but not applying a determined amount of the seed-applied substance to a seed" (*Id.*, 203); and "the combination of Bardi and Wendte provides a system that has to change out modules for different seed after each use..." (*Id.*, 209).

54. On February, 16, 2022, the Examiner then rejected all claims under 35 U.S.C. 112(a) as lacking written description, noting it is "unclear where the support for the new limitations particularly the combination of the seed and seed-applied substance can vary as the planter changes location." Ex. 1002, 227. Maintaining the 103 rejections of the claims, the Examiner stated the claim "simply requires generating a combination from seed and seed-applied substance" and that the claims

“do not preclude switching out modules for different types of seeds.” *Id.*, 228-39.

55. This was followed by an Examiner Interview with the Examiner’s Summary for March 28, 2022 noting a number of new statements by Applicant as to the purported invention, including: (1) “the prior art of record are mainly directed to “macro seed application, whereas the Applicant’s invention is directed to micro seed application;” (2) the “invention uses a micro nozzle that deposits pico scale amounts to the seed;” (3) the “invention can be adjusted in real time;” and (4) the “applicant’s portable nozzle is located near the seed drop chute, where the seed is place[d] right before the nozzle before dropping to the soil.” Ex. 1002, 246. The Examiner rejected these arguments, pointing out that such features “are not claimed.” *Id.*

56. The Applicant’s August 16, 2022 response argued that the then-pending claims were directed to a prescriptive process and pointed to dependent claims requiring treatment of seed “proximate to the seed drop tube.” Ex. 1002, 295. The Applicant also added new claims directed to “microscale” applications of seed-applied substance to the seed. *Id.*, 252-63. The Applicant then attempted to distinguish the prior art based on the same arguments made in its prior response. *Id.*, 264-304.

57. The Examiner’s office action of October 6, 2022, issued new rejections of the claims based on Wilkerson (US2008/0202398) and a series of other references including Wendte. Ex. 1002, 308-19. This was followed by another Examiner

Interview on December 20, 2022. *Id.*, 322. The Examiner's notes indicate she disagreed with Applicant's position that Wilkerson "teaches treating the seed after being dropped in the soil" and suggested possible amendments to the claims that might distinguish the claims over Wilkerson and "other furrow applications" including: (1) "a limitation of not applying substance to the soil during the seed applying step"; 2) "include more structure of when or where the seed is treated in the system"; (3) "that the seeds are treated in a singular or singulated manner"; (4) narrowing the term "planting" to distinguish, for example, "topping the seeds with soil" versus "a simple drop to the soil from the planter" and (5) "describing the micro amount of substance being applied to the seed and/or nozzle or application structure being used to coat the seeds." *Id.*

58. Applicant responded April 6, 2023, by maintaining most of its existing claims and amending a few claims to replace "plant"/"planting" with "delivered (or delivering) to the soil" and to specify that the combination of seed and seed-applied substance is created "between the discharge of the seed drop tube and the soil." Ex. 1002, 338-56. No other amendments suggested by the Examiner were made to the claims. *Id.*, 325-37. The Applicant then attempted to distinguish Wilkerson primarily on the basis that, in Applicant's view, Wilkerson disclosed application of the seed-applied substance after the seeds are placed in the furrow. *Id.*, 338-56.

59. In the Final Rejection on August 29, 2023, the Examiner cited

paragraphs [0031]-[0032] of Wilkerson, responding that the “pre-determined time” in Wilkerson for treating the seed “can be selected to be greater than or less than [the] time for the seed to reach target location” and that “in one option the seed will at least be partially coated or treated with the liquid prior to falling in the furrow as it is traveling to the target location.” Ex. 1002, 372-73.

60. The Applicant then canceled its claims and added new claims 36-53, which included a limitation requiring that “the delivered amount of the selected type of the seed-applied substance is greater than the desired application amount of the selected type of the seed-applied substance and calculated to enable the substance applicator to apply the desired application amount of the selected type of the seed-applied substance to the seed.” Ex. 1002, 386-95.

61. On May 10, 2024, the Examiner rejected the new claims, finding that the new limitation lacked support in the application. Ex. 1002, 428-32. This was followed by a series of communications, including undisclosed emails, between the Applicant and Examiner that are noted in a single Interview Summary dated July 24, 2024. *Id.*, 455. These communications led to an Examiner’s Amendment that: (1) dropped the language from the independent claim found lacking descriptive support; and (2) amended the independent claim to include the language “individually applying the desired application amount of the selected type of the seed-applied substance to each seed as it is being delivered to the soil.” *Id.*, 460-67. In addition,

the dependent claims were replaced. *Id.* The Examiner stated with little explanation that Knake (U.S. Patent No. 4,356,934), Bardi (U.S. Patent No. 6,148,748), Romans (U.S. Patent No. 6,216,615), and Muhr (US2002/0104262) failed to teach the “individually applying...” limitation. *Id.* A Notice of Allowance issued on August 15, 2024. *Id.*, 457-58.

3. The Claimed Subject Matter

62. Due to their length, the full language of each challenged claim (claims 1-19) is provided in attached Appendix C.

4. The Level of Skill in the Art

63. With respect to the level of ordinary skill in the art at the relevant times applicable to the subject patent, I understand that factors such as the education level of those working in the field, the sophistication of the technology, the types of problems encountered in the art, the prior art solutions to those problems, and the speed at which innovations are made may help establish the level of skill in the art. One with ordinary skill has the ability to understand the technology and make modest adaptations or advances. A person of ordinary skill in the art (“POSA”) is also a person of ordinary creativity, not an automaton.

64. In my opinion, a POSA at the time of the alleged invention described in the subject patent would have a Bachelor of Science degree in Agricultural or Mechanical Engineering with 5-10 years of practical, applied experience in the field

of agricultural machinery, including systems integration and fluid handling and sprayer control systems. Further, one skilled in the art would have a good understanding of sensors and actuators used in the foundational technologies of precision agriculture. A person of ordinary skill in the art relevant to the '027 Patent would easily have understood the prior art references referred to herein and would have had the capacity to draw inferences from them.

65. In determining the qualifications of a POSA I considered, among other factors, the field of the alleged invention and use thereof described in the subject patent, and my experience with the educational level of practitioners in the fields of agricultural engineering. In addition, my opinion is based upon my background, education, and personal experience devoted to the field of supervision of graduate (M.S. and Ph.D. level) students that would meet the qualifications of having a B.S. degree in Agricultural or Mechanical Engineering and 5+ years of educational or industrial experience.

V. CLAIM TERMS

66. I understand that in construing claim terms, only those terms that are in controversy need be construed, and only to the extent necessary to resolve the controversy. In my opinion, the claim terms of the '027 patent should be afforded their plain and ordinary meaning as understood by one of ordinary skill in the art consistent with the scope of the terms as addressed at 7:25 to 8:57, and the remainder

of the '027 patent specification. Ex. 1001, 7:25 to 8:57.

VI. OVERVIEW OF PRIOR ART

A. Wagers (Ex. 1004)

67. I have reviewed the Wagers patent application published on September 18, 2014 as US2014/0277959 and filed on March 15, 2013. Ex. 1004, cover. Wagers is titled “Multi-Seed Planter Control System and Method for the Same.” *Id.* Wagers qualifies as prior art to the '027 Patent because it was filed before the June 23, 2015 Priority Date of the '027 Patent.

68. Wagers discloses a multi-row unit planter 104, 200 having “separate components for each of the respective row units” which include coulters, seed metering systems, seed wheels, seed hoppers “and the like.” Ex. 1004, [0028]-[0029]. The multi-row unit planter also utilizes spray units for each of the row units to apply an agricultural product, such as liquid fertilizer or herbicide, stored in agricultural product reservoirs to seeds. *Id.*, [0028].

69. In operation, Wagers utilizes a control system to effectuate a seed treatment method by selecting a seed type as well as the agricultural product and application rate of the agricultural product based on the planting location from a “prescription map”. Ex. 1004, [0008], [0028], [0033], [0053], [0063], [0089], [0116]. Wagers discloses the seed types, agricultural products, and application rates can vary by “dynamically changing” these “adjustable planting characteristics”

based on the planting location which is continuously updated as the planter moves through the field. *Id.*, [0008], [0028], [0033], [0053], [0062], [0089], [0116].

70. Moreover, the seed treatment method in Wagers uses the “prescription map” to calculate the planting location and divide the field into zones based on conditions of the terrain and include the desired type and amount of the respective agricultural product. Ex. 1004, [0008], [0028], [0033], [0040]. The seed treatment method of Wagers also occurs “contemporaneously” with the delivery of the seeds at the planting location and includes a seed metering system to hold each seed while the sprayer or pneumatic dispenser applies the substance to each seed. *Id.*, [0028], [0037], [0040], [0051]. Such a metering system includes a variety of controllable variables to ensure the device can reliably hold each seed independent of the size, shape, and weight of the seed and to control the “rates or types of agricultural product dispensed” and “rate of seed dispensing for planting based on the prescription map.” *Id.*, [0028], [0037], [0040], [0058], [0059]. Accordingly, the seed treatment method of Wagers “ensures that each of a variety of seed types are handled and planted according to the characteristics of the seed” and “characteristics of the field.” *Id.*, [0008].

B. Mitchell (Ex. 1005)

71. I have reviewed the Mitchell patent, U.S. Patent No. 1,409,564, filed on April 9, 1919, and issued on March 14, 1922. Ex. 1005, cover. Mitchell is titled

“Antismut Grain and Soil Treating Process and Apparatus.” *Id.* Mitchell qualifies as prior art to the '027 Patent because it was issued before the June 23, 2015 Priority Date of the '027 Patent.

72. Mitchell is directed to a seed treatment method utilizing “an ordinary” planter. Ex. 1005, page 2:8-18. This “ordinary” planter included a seed hopper 7, a seed drop tube 8, teeth points to open furrows in the soil 10, and closing wheels 12 as well as a substance receptacle 13, a substance applicator 17, and a seed-applied substance “formalin” to apply to the seed. *Id.*, page 2:8-54. Mitchell further disclosed a seed-applied substance and applying the desired application amount of the selected type of the seed-applied substance to each seed as it is being delivered to the soil “as the seed is about to enter the earth at the lower extremities 10 of the hollow teeth, the liquid is applied to the grain” and “spraying the seed as it falls.” *Id.*, page 2:54-64, 101-105.

73. Moreover, Mitchell disclosed the seed “is conducted to the earth by” the seed drop tubes 8 and the seed treatment method includes “spraying the seed as it drops to the ground.” Ex. 1005, page 2:106-109, 116-124. Accordingly, Mitchell disclosed planters including seed drop tubes, provide for the release of seed at or near the ground, and allow precision in seed placement and may be used in conjunction with a spraying system in order to provide treated seeds as the seed drops into the ground.

C. Wilkerson (Ex. 1006)

74. I have reviewed the Wilkerson patent application published on November 25, 2004 as US2004/0231575 and filed on April 23, 2004. Ex. 1006, cover. Wilkerson is titled “Systems and Methods for Fluid Dispensing.” *Id.* Wilkerson qualifies as prior art to the ’027 Patent because it was filed before the June 23, 2015 Priority Date of the ’027 Patent.

75. Wilkerson disclosed a “conventional planter” which includes a seed hopper, a seed meter, a seed drop tube, an opening disc, seed firmer wheels, and closing wheels as well as a nozzle for applying a seed-applied substance. Ex. 1006, Fig. 1, [0005], [0027]. Moreover, Wilkerson disclosed a seed treatment method for a planter to “time the release of fluid F from fluid dispenser FD such that fluid F is released on ***and/or*** near each seed 202 in furrow 204” and to calculate the time “for seed 202 to move from sensed location SL” in the seed drop tube “to target location TL”. *Id.*, [0030], [0031]. Accordingly, Wilkerson disclosed the seed treatment method “can ensure that system performance is not solely dependent on the ability of the meter and seed tube ST to deliver seeds 202 at uniform intervals to a location for receiving fluid F from fluid dispenser FD ... [and] ensures that the dispensing of fluid F corresponds with the actual dropping of each seed 202, rather than the expected dropping of each seed 202.” *Id.*, [0030], [0033].

D. Batcheller (Ex. 1007)

76. I have reviewed the Batcheller patent application published on December 25, 2014 as US2014/0379228 and filed on June 21, 2014. Ex. 1007, cover. Batcheller is titled “Method and System for Optimizing Planting Operations.” *Id.* Batcheller qualifies as prior art to the ’027 Patent because it was filed before the June 23, 2015 Priority Date of the ’027 Patent.

77. Batcheller is directed to a seed treatment method using a multi-row unit planter with row units 1104 including a seed hopper 1112, a seed meter 1112, an opening disc 1124, seed firmer wheels 1122, and closing wheels 1120 with a “nutrient system 1110”. Ex. 1007, [0131], [0133], [0134]. This “nutrient system 1110” in figure 13 “contains several types of chemicals, which may include fertilizers and pesticides, individual soil nutrients, and water, all of which can be added to the furrow or to the seed itself as required based on the soil conditions,” which according to Batcheller “may be separated by type and mixed together in the nutrient system 1100 as required to create the proper supplement to add to the soil.” *Id.*, [0143].

E. Memory (Ex. 1008)

78. I have reviewed the Memory patent, U.S. Patent No. 6,155,185, filed on July 15, 1999, and issued on December 5, 2000. Ex. 1008, cover. Memory is titled “Method and Apparatus for Coating Seeds.” *Id.* Memory qualifies as prior art to the

'027 Patent because it was issued before the June 23, 2015 Priority Date of the '027 Patent.

79. Memory is directed to a seed treatment method using a planter including a seed hopper 32, a seed meter 40, a tube 49 with a substance applicator 22 used to deposit a quantity of a seed applied substance uniformly to each seed through the seed flow path. Ex. 1008, 4 lines 11-51. Memory disclosed the seed treatment method utilizes an air tube to entrain the seeds and direct them through the device and seed deposition outlets, where the seeds enter the ground. *Id.*, 1 lines 24-29, 2:66 – 3:5, 4:46-51.

F. Garner (Ex. 1009)

80. I have reviewed the Garner patent, U.S. Patent No. 8,850,995, filed on February 2, 2009, and issued on October 7, 2014. Ex. 1009, cover. Garner is titled “Seeding Machine and Seed Delivery System.” *Id.* Garner qualifies as prior art to the '027 Patent because it was issued before the June 23, 2015 Priority Date of the '027 Patent.

81. Garner is directed to a seed delivery system for use in a multi-row unit planter with row units 16 including a seed hopper 24, a seed meter 26, a seed brush tube 28, an opening disc 30, seed firmer wheels 32, and closing wheels 34. Ex. 1009, 3 lines 1-19. Garner disclosed the seed brush delivery system 28 “can be used in any of a variety of planting machine types” and recognized the “most common seed

delivery may be categorized as a gravity drop system [with a seed tube]” which is prone to velocity differences between seeds “as each seed comes to rest” in the soil. *Id.*, 1:43-49 and 3:24-27.

82. Garner also disclosed the seed meter 26 uses “a vacuum disk” and transfers the seeds to the seed brush tube 26 including bristles and includes a seed accelerator through use of a belt where “bristle distal ends thus cause the linear speed of the seeds to accelerate relative to the speed of the belt base member 66 and the housing as shown by the two arrows 94 and 96. The seeds are then propelled by the bristles over the ramp 84 and discharged through the lower opening 78 into the seed trench.” Ex. 1009, 3:8-10, 4:27-33.

VII. GROUNDS FOR UNPATENTABILITY

83. A claim chart summarizing the unpatentability of each of claims 1 through 19 based on the prior art is provided in Appendix C.

A. Ground 1: Claims 1-4, 6, 7, 11, and 13-16 of the '027 Patent are Anticipated by Wagers

1. Claim 1 is anticipated by Wagers

84. Independent claim 1 recites a “prescriptive seed treatment method” comprising five steps:

- 1) “providing a planter, a seed drop tube, a substance receptacle, a substance applicator, a seed, and a seed-applied substance;”
- 2) “calculating a location within a field where the seed will be delivered to the soil by the planter;”

- 3) “selecting, based at least in part on a condition, a combination of the seed and seed-applied substance and calculating a desired application amount of the selected type of the seed-applied substance to be applied to and carried by the seed to the soil;”
- 4) “generating the combination of the seed and selected type of the seed-applied substance at least in part by individually applying the desired application amount of the selected type of the seed-applied substance to each seed as it is being delivered to the soil; and”
- 5) “delivering the combination of the seed and selected type of the seed-applied substance to the soil at the calculated location within the field for planting;

“wherein the type of the seed-applied substance and the desired application amount of the selected type of the seed-applied substance can vary as the planter changes locations within the field.”

85. As addressed more fully in the claim charts attached as Appendix C, Wagers disclosed each of the limitations of independent claim 1.

86. In summary, Wagers disclosed a method that “monitors planter location on a prescriptive map of a field,” “selects a seed type based on the monitored location”, and then “dynamically changes one or more planter characteristics based on that selected seed type.” Ex. 1004, [0008]. The “planter characteristics of Wagers include “agricultural product selection and application rate or the like.” *Id.* Exemplary “agricultural products” in Wagers include a “liquid fertilizer or herbicide.” *Id.* at [0028].

87. Wagers further disclosed a “multi-seed planter” configured to plant

“differing varieties of a seed or differing seeds” that include “agricultural product reservoirs” with associated “spray units.” Ex. 1004, [0026], [0028]. As disclosed in Wagers, the “multi-seed planter” further comprises multiple sets of individual “row units” each in turn comprising “coulters, seed metering systems including seed wheels, seed hoppers, and the like.” *Id.* at [0029].

88. As further disclosed in Wagers, the coulters and seed metering systems are “individually controlled” through, for example, variable “down pressure” on the coulters and “vacuum level” within the seed metering disks, to establish desired seed planting depths and rates as those parameters vary with seed type and planter location. Ex. 1004, at [0033], [0040], [0088]-[0090], [0116].

89. A POSA would read and understand the multi-seed planters disclosed in Wagers (as summarized above and in the attached claim charts) to necessarily include seed drop tubes below the seed metering wheels for placing the seeds at the rate set by the metering wheel in the furrow set by the coulters. Seed drop tubes are a well understood and necessary component ubiquitous in all such multi-seed planters and have been used in planters since the advent of mechanized agriculture over a century ago. *See, e.g.*, Mitchell (Ex. 1005), which issued March 14, 1922. The planting precision disclosed in Wagers, as excerpted above, requires the use of seed drop tubes, which are a necessary component of the multi-seed planters disclosed therein.

90. Wagers also disclosed the use of GPS (Global Positioning Systems) to “determine()” and “monitor” “planter location”. Ex. 1004, [0039]. According to Wagers, for example, the desired seed type is determined “by way of cooperation between the GPS antenna 105 and the prescription map module 404.” *Id.*

91. Wagers further disclosed providing a “desired type and amount of the respective agricultural product” – i.e., seed-applied substance – “based on the seed selected and optionally one or more of the terrain characteristics.” Ex. 1004, at [0040]. The “selection of one or more agricultural products and the rate of application of the one or more agricultural products” is also determined by, for example, “seed type.” *Id.* at [0033]. According to Wagers, the “sprayer or pneumatic dispenser” is “adjusted to provide a desired type and amount of the respective agricultural product.” *Id.* at [0040]. For example, a “control valve” is used “to apply a particular rate of an agricultural product with the respective row unit.” *Id.* at [0051]. “The agricultural product reservoirs 118 are configured to provide the agricultural product contemporaneously with dispensing and planting of seeds.” *Id.* at [0028].

92. As excerpted above and in the attached claim charts, Wagers discloses the metering of individual seeds and applying an agricultural product or substance contemporaneously with the dispensing of the seed. A POSA would understand this to necessarily disclose the application of the substance to the individual seed just prior to placement in the ground.

93. As further excerpted above and in the attached claim charts, Wagers disclosed that the seed and seed-applied agricultural product or substance are placed in the ground at the calculated location within the field. According to Wagers, “the seed type prescribed in each of the Zones 302 correspondingly determines one or more planter characteristics of the multi-hybrid planter 104 including for instance ... the selection of one or more agricultural products and the rate of application of the one or more agricultural products.” Ex. 1004, [0033]. “The prescription map 300 provides indicates [sic] the seed type to be planted in each of one or more Zones and accordingly the seed type (optionally in combination with one or more characteristics) is used to adjust one or more of the planting characteristics of one or more of the row units 114 to achieve optimal planting of each of the seed types.” *Id.* at [0041].

94. Wagers further disclosed “dynamically changing one or more of the remotely adjustable planting characteristics” including, for example, “selecting an agricultural product (e.g., one or more of a liquid or granular product) for application according to the monitored planter location 104 on the prescription map.” Ex. 1004, [0062].

95. Thus, because Wagers (Ex. 1004) disclosed each and every limitation of claim 1, I conclude that claim 1 is anticipated by Wagers.

2. Claim 2 is anticipated by Wagers

96. Claim 2 depends from claim 1 and further recites “wherein the step of selecting, based at least in part on the condition, the combination of seed and seed-applied substance further comprises selecting a seed type.”

97. As addressed more fully in the claim charts attached as Appendix C, Wagers disclosed each of the limitations of dependent claim 2.

98. In summary, Wagers disclosed “select[ing] a seed type based on the monitored planter location on the prescription map.” Ex. 1004, [0008]. According to Wagers, the disclosed control system:

“is configured to select one of a plurality of seed types for instance provided within the seed hopper 108 and accordingly dispense the seed from one or more of the row units 114 according to the position of the multi-seed planter 104 within an agricultural field, for instance an agricultural field with indexed zones having prescriptions for particular seed types and planter characteristics.”

Id. at [0028].

99. Thus, because Wagers (Ex. 1004) disclosed the limitations of claim 2, it is my opinion that claim 2 is anticipated by Wagers.

3. Claim 3 is anticipated by Wagers

100. Claim 3 depends from claim 1 and further recites “wherein the combination of seed and the selected type of the seed-applied substance varies based at least in part on one of the following: a type of the seed, the type of seed-applied substance, and an application rate of the seed-applied substance.”

101. As addressed more fully in the claim charts attached as Appendix C, Wagers disclosed each of the limitations of dependent claim 3.

102. In summary, Wagers disclosed “select[ing] a seed type based on the monitored planter location on the prescription map, and then dynamically chang[ing] one or more of the planter characteristics based on at least the selected seed type.” Ex. 1004, [0008]. These planter characteristics include, for example, “agricultural product dispensation”, which is “adjusted to provide a desired type and amount of the respective agricultural product based on the seed selected and optionally one or more of the terrain characteristics.” *Id.* at [0037], [0040].

103. Thus, because Wagers (Ex. 1004) disclosed the limitations of claim 3, it is my opinion that claim 3 is anticipated by Wagers.

4. Claim 4 is anticipated by Wagers

104. Claim 4 depends from claim 1 and further recites a “controller” that “can be used to calculate the location where the seed will be delivered to the soil, select, based at least in part on the condition, the combination of seed and seed-applied substance to plant at the location, generate the combination of the seed and the selected type of the seed-applied substance, or plant the combination of seed and the selected type of the seed-applied substance.”

105. As addressed more fully in the claim charts attached as Appendix C, Wagers disclosed each of the limitations of dependent claim 4.

106. In summary, Wagers disclosed a “controller” in Fig. 4:

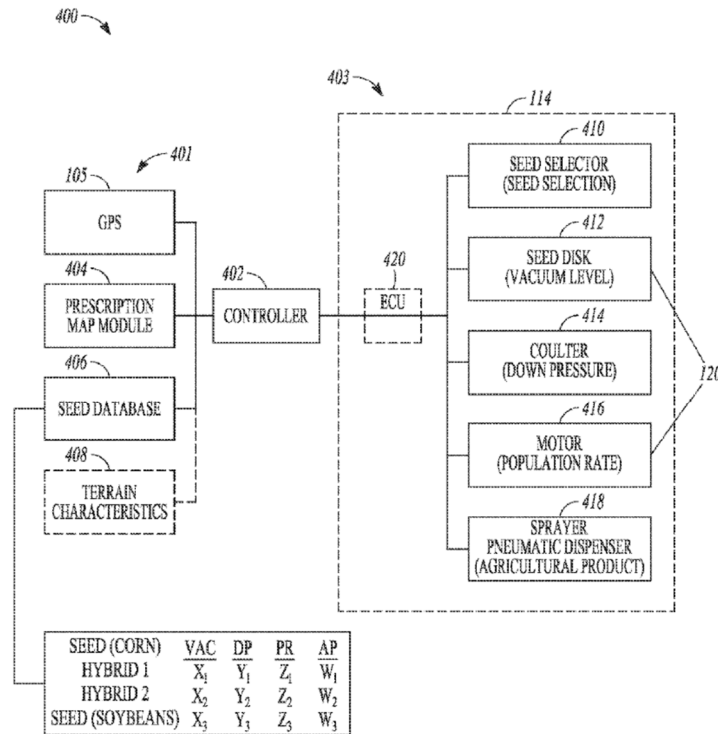


FIG. 4

107. The “controller” of Wagers, for example:

- “sends instructions ... corresponding to the seed type selected for the particular zone of the field” Ex. 1004, [0039];
- determines “the [seed] population rate controlled by the motor 416” Ex. 1004, [0040];
- “controls a down-pressure of the coulter 414 according to the seed type being planted” *Id.*; and
- adjusts “one or more of the sprayer or pneumatic dispenser 418 for liquid and granular agricultural products ... to provide a desired type and amount of the respective agricultural product.” *Id.*

108. Thus, because Wagers (Ex. 1004) disclosed the limitations of claim 4,

it is my opinion that claim 4 is anticipated by Wagers.

5. Claim 6 is anticipated by Wagers

109. Claim 6 depends from claim 1 and further recites “wherein the substance applicator comprises a nozzle to spray the selected type of the seed-applied substance onto the seed as the seed is delivered to the soil.”

110. As addressed more fully in the claim charts attached as Appendix C, Wagers disclosed each of the limitations of dependent claim 6.

111. In summary, Wagers disclosed “spray units associated with each of the one or more row units” and “agricultural product dispensers such as a sprayer or pneumatic dispenser.” Ex. 1004, [0028], [0036]. The “agricultural product reservoirs” of Wagers were “configured to provide the agricultural product contemporaneously with dispensing and planting of seeds.” *Id.* at [0028].

112. As excerpted above for claim 1, Wagers disclosed the metering of individual seeds and applying an agricultural product or substance contemporaneously with the dispensing of the seed. One of ordinary skill in the art would understand this to necessarily disclose application of the substance to the individual seed just prior to placement in the ground; that is, “contemporaneously”. Further, one of ordinary skill in the art would understand that the “spray unit” or “sprayer or pneumatic dispenser” would functionally and necessarily include a spray nozzle.

113. Thus, because Wagers (Ex. 1004) disclosed the limitations of claim 6, it is my opinion that claim 6 is anticipated by Wagers.

6. Claim 7 is anticipated by Wagers

114. Claim 7 depends from claim 1 and further recites “wherein the step of generating the combination of the seed and the selected type of the seed-applied substance further comprises:

“providing a metering device”; and

“metering an amount of the selected type of the seed-applied substance from the substance receptacle through a substance flow path to the substance applicator with the metering device.”

115. As addressed more fully in the claim charts attached as Appendix C, Wagers disclosed each of the limitations of dependent claim 7.

116. In summary, Wagers disclosed a “rate sensor 546” to:

“measure the opening of the control valve 544 and the actual dispensation rate (e.g., as a flow meter) from the agricultural product dispenser 418. The output from the rate sensor 546 is communicated to the valve controller 542 to achieve a desired target rate and type of agricultural product dispensation by feedback control.”

Ex. 1004, [0050].

117. Thus, because Wagers (Ex. 1004) disclosed the limitations of claim 7, it is my opinion that claim 7 is anticipated by Wagers.

7. Claim 11 is anticipated by Wagers

118. Claim 11 depends from claim 1 and further recites “wherein the

substance applicator is associated with at least one of:

- a. a mixer in fluid communication with the substance receptacle and a substance flow path;
- b. a seed hopper configured to receive the seed from a seed receptacle;
- c. a seed meter configured to receive the seed from the seed hopper and further transfer it through a seed flow path; and
- d. the seed drop tube.”

119. As addressed more fully in the claim charts attached as Appendix C, Wagers disclosed each of the limitations of dependent claim 11.

120. In summary, Wagers disclosed “spray units associated with each of the one or more row units” and, further, that “each of the first and second sets of row units 202, 204 includes separate components for each of the respective row units (e.g., coulters, seed metering systems including seed wheels, seed hoppers and the like).” Ex. 1004, [0028]-[0029].

121. Thus, because Wagers (Ex. 1004) disclosed the limitations of claim 11, it is my opinion that claim 11 is anticipated by Wagers.

8. Claim 13 is anticipated by Wagers

122. Claim 13 depends from claim 1 and further recites “wherein the desired application amount of the selected type of the seed-applied substance to be applied to the seed is either: always the same amount of seed-applied substance; or only either one specific amount of seed-applied substance or no amount of the seed-

applied substance.”

123. As addressed more fully in the claim charts attached as Appendix C, Wagers disclosed each of the limitations of dependent claim 13.

124. In my opinion, a POSA would understand the ordinary meaning of dependent claim 13 to require a method where the application amount of the seed-applied substance either: (1) is constant across all planter locations within the field; or (2) alternates between no application and the application of an unvarying amount across all planter locations within the field. This contrasts with claim 1, from which claim 13 depends, which requires that the application amount can vary as the planter changes locations within the field.

125. Wagers disclosed a “shutoff valve 548 is used to toggle between application or an interruption of application of the agricultural product at the rate provided by the control valve 544.” Ex. 1004, [0051].

126. Further, it was and is a common agricultural practice to apply an agricultural product at a fixed rate throughout a given field if the relevant conditions within the field are uniform or, alternatively to alternate between no application and a fixed application if, as an example, one variety of seed is planted on part of a field and another variety is planted in another part of the field. Thus, not only does Wagers anticipate claim 13, but it would have been obvious to use the shutoff valve of Wagers to apply an agricultural product in such a manner.

127. Thus, because Wagers (Ex. 1004) disclosed the limitations of claim 13, it is my opinion that claim 13 is anticipated by Wagers. Alternatively, it is my opinion that claim 13 would have been obvious over Wagers when combined with the knowledge of a POSA.

9. Claim 14 is anticipated by Wagers

128. Claim 14 depends from claim 1 and further recites “wherein the type of the seed-applied substance and the desired application amount of the selected type of the seed-applied substance can vary as the planter changes location within the field by changing the type, number or amount of one or more of the seed-applied substances applied to the seed when generating the combination of the seed and the seed-applied substance.”

129. As addressed more fully in the claim charts attached as Appendix C, Wagers disclosed each of the limitations of dependent claim 14.

130. In summary, Wagers disclosed “adjust[ing]” the “sprayer or pneumatic dispenser” to “provide a desired type and amount of the respective agricultural product based on the seed selected and optionally one or more of the terrain characteristics.” Ex. 1004, [0040]. Wagers further disclosed “selecting an agricultural product (e.g., one or more of a liquid or granular product) for application according to the monitored planter location 104 on the prescription map.” *Id.* at [0062].

131. Thus, because Wagers (Ex. 1004) disclosed the limitations of claim 14, it is my opinion that claim 14 is anticipated by Wagers.

10. Claim 15 is anticipated by Wagers

132. Claim 15 depends from claim 1 and further recites “wherein the combination of seed and the selected type of the seed-applied substance can vary based at least in part upon a seed-applied substance type, a number of seed-applied substances, or the desired application amount of one or more of the selected type of seed-applied substance.”

133. As addressed more fully in the claim charts attached as Appendix C, Wagers disclosed each of the limitations of dependent claim 15.

134. In summary, Wagers disclosed “adjust[ing]” the “sprayer or pneumatic dispenser” to “provide a desired type and amount of the respective agricultural product based on the seed selected and optionally one or more of the terrain characteristics.” Ex. 1004, [0040]. Wagers further disclosed “selecting an agricultural product (e.g., one or more of a liquid or granular product) for application according to the monitored planter location 104 on the prescription map.” *Id.* at [0062].

135. Thus, because Wagers (Ex. 1004) disclosed the limitations of claim 15, it is my opinion that claim 15 is anticipated by Wagers.

11. Claim 16 is anticipated by Wagers

136. Claim 16 depends from claim 1 and further recites “wherein the combination of seed and the selected type of the seed-applied substance can vary based at least in part upon a seed type.”

137. As addressed more fully in the claim charts attached as Appendix C, Wagers disclosed each of the limitations of dependent claim 16.

138. In summary, Wagers disclosed a method that includes “monitor[ing] a planter location on a prescription map of a field” and “select[ing] a seed type based on the monitored planter location on the prescription map, and then dynamically chang[ing] one or more of the planter characteristics based on at least the selected seed type.” Ex. 1004, [0008]. Wagers further disclosed “adjust[ing]” the “sprayer or pneumatic dispenser” to “provide a desired type and amount of the respective agricultural product based on the seed selected.” *Id.* at [0040].

139. Thus, because Wagers (Ex. 1004) disclosed the limitations of claim 16, it is my opinion that claim 16 is anticipated by Wagers.

B. Ground 2: Claims 1-7 and 11-16 of the '027 Patent are Obvious Over Wagers in view of Mitchell

1. Claim 1 is obvious over Wagers in view of Mitchell

140. While it is my opinion that claim 1 is anticipated by Wagers for the reasons I provide above in Section VII.A.1, claim 1 is further rendered obvious by Wagers in view of Mitchell (Ex. 1005).

141. Incorporating by reference my discussion of Wagers and claim 1 in Section VII.A.1 above, and as more fully described in the claim charts attached as Appendix C, it is my further opinion that Mitchell disclosed the use of seed tubes in figures 4, 6, and 7, which depict “hollow teeth 8 ... whereby the seed grain passes from the box into the hollow teeth and thence into the earth.” Ex. 1005, page 2:8-19.

142. Mitchell further disclosed a seed-applied substance and applying the desired application amount of the selected type of the seed-applied substance to each seed as it is being delivered to the soil. For example, Mitchell disclosed that “as the seed is about to enter the- earth at the lower extremities 10 of the hollow teeth, the liquid is applied to the grain.” Ex. 1005, page 2:54-64. Elsewhere, Mitchell disclosed “spraying the seed as it falls” (*id.* at page 2:101-105), “spraying with a liquid fungicide, the seed while in transit from a source of supply to the ground” (*id.* at page 3:3-6), and “spraying the seed while in motion with a liquid fungicide” (*id.* at page 3:11-12).

143. Mitchell also disclosed that “[t]he lower extremity of each of these spouts is equipped with a spray nozzle, 18, which is located just above the point 10 of the tooth, so that the liquid as it issues from the nozzle is deposited upon the grain and the soil or earth in which it is planted, simultaneously.” Ex. 1005, page 2:36-47. Mitchell further disclosed that “as the seed is about to enter the earth at the lower extremities 10 of the hollow teeth, the liquid is applied to the grain and also to the

earth, thus giving the seed and earth at the same time a treatment with the anti-smut liquid compound.” *Id.* at page 2:54-64.

144. A POSA at the time would understand that seed drop tubes, which provide for the release of seed at or near the ground, thereby allow much greater precision in seed placement, which is one of the goals of Wagers. Seed drop tubes are ubiquitous features of in-row planters, including multi-row planters, seed drills, air seeders, and the like, and have been for well over a century if not longer as reflected in Mitchell, which issued as a patent in 1922. Incorporating a seed drop tube like that of Mitchell in the multi-row planter disclosed in Wagers would have been straightforward. Indeed, given the widespread use of seed drop tubes, to the extent the planter disclosed in Wagers does not expressly or inherently include a seed drop tube, it would have been a standard part widely available at the time and readily added to the Wagers planter.

145. Further, as excerpted above in Section VII.A.1, Wagers discloses the metering and planting of individual seeds and the application of an agricultural substance contemporaneous with the dispensing of the seed. It was well understood at the time that there were numerous well-known means for applying substance to individual seeds during planting, all of which are readily incorporated in the multi-row planter disclosed in Wagers, and all of which are consistent with and would further the express objective of Wagers to improve planting precision.

146. One such example is the hollow teeth and spray nozzle configuration of Mitchell, which provides for the spray of seed while in transit to the ground. One would have been motivated to incorporate the spray nozzle configuration of Mitchell because of the precision it affords. Incorporating such a configuration in the multi-row planter disclosed in Wagers would have been straightforward. As excerpted above in Section VII.A.1, Wagers discloses spray nozzles that are associated with the individual row units, which include “coulters, seed metering systems including seed wheels, seed hoppers and the like.” Ex. 1004, [0028]-[0029].

147. Thus, because Wagers (Ex. 1004) in view of Mitchell (Ex. 1005), disclosed each and every limitation of claim 1, I conclude that claim 1 is rendered obvious by Wagers in view of Mitchell.

2. Claims 2-4, 7, and 13-16 are obvious over Wagers in view of Mitchell

148. Each of claims 2-4, 7, and 13-16 depend on claim 1. As discussed above, each limitation of claim 1 is disclosed by Wagers (Ex. 1004) alone, or in view of Mitchell (Ex. 1005).

149. As explained in Section VII.A above (incorporated herein by reference), Wagers (Ex. 1004) discloses each limitation of claims 2-4, 7-8, and 13-16.

150. Thus, because Wagers (Ex. 1004) in view of Mitchell (Ex. 1005) discloses or suggests each and every limitation of claims 2-4, 7-8, and 13-16, I

conclude that those claims are rendered obvious by Wagers in view of Mitchell.

3. Claims 5 and 12 are obvious over Wagers in view of Mitchell

151. Each of claims 5 and 12 depend on claim 1. As discussed above, each limitation of claim 1 is disclosed by Wagers (Ex. 1004) alone, or in view of Mitchell (Ex. 1005). Claim 5 further recites “wherein the selected type of the seed-applied substance is applied to the seed proximate to the seed drop tube.” Claim 12 further comprises the steps of: “transferring the seed into the seed drop tube; and applying the selected type of the seed-applied substance to the seed proximate to or within the seed drop tube.”

152. As addressed more fully in the claim charts attached as Appendix C, Mitchell disclosed each of the limitations of dependent claims 5 and 12.

153. In summary, and as illustrated in figures 4 and 5, Mitchell disclosed that:

Leading downwardly from the conduit, 15, is a number of spouts, 17, which pass through the hollow teeth, 8; of the seeder and are relatively small, whereby they do not interfere with the passage of the grain through the said teeth. The lower extremity of each of these spouts is equipped with a spray nozzle, 18, which is located just above the point 10 of the tooth, so that the liquid as it issues from the nozzle is deposited upon the grain and the soil or earth in which it is planted, simultaneously.

Ex. 1005, page 2:36-47.

154. Given the angled shape of the end of the hollow teeth 8 (seed drop tube) where only the tip of the angled end is in contact with the ground, as depicted in Fig.

4 of Wagers, one of ordinary skill in the art would understand that the anti-smut substance of Mitchell is necessarily applied to the seed both within hollow teeth 8 and just beyond (proximate to) the hollow teeth 8.

155. For the reasons I provide above in the context of claim 1, a POSA would have been motivated to combine Wagers and Mitchell.

156. Thus, because Wagers (Ex. 1004) in view of Mitchell (Ex. 1005), disclosed each and every limitation of claims 5 and 12, I conclude that claims 5 and 12 are rendered obvious by Wagers in view of Mitchell.

4. Claim 6 is obvious over Wagers in view of Mitchell

157. Claim 6 depends on claim 1. As discussed above, each limitation of claim 1 is disclosed by Wagers (Ex. 1004) alone, or in view of Mitchell (Ex. 1005).

158. While it is my opinion that claim 6 is anticipated by Wagers for the reasons I provide above in Section VII.A.5, claim 6 is further rendered obvious by Wagers in view of Mitchell.

159. Incorporating by reference my discussion of Wagers and claim 6 in Section VII.A.5 above, and as more fully described in the claim charts attached as Appendix C, it is my further opinion that Mitchell disclosed a seed-applied substance and applying the desired application amount of the selected type of the seed-applied substance to each seed as it is being delivered to the soil. For example, Mitchell disclosed that “as the seed is about to enter the- earth at the lower extremities 10 of

the hollow teeth, the liquid is applied to the grain.” Ex. 1005, page 2:54-64. Elsewhere, Mitchell disclosed “spraying the seed as it falls” (*id.* at page 2:101-105), “spraying with a liquid fungicide, the seed while in transit from a source of supply to the ground” (*id.* at page 3:3-6), and “spraying the seed while in motion with a liquid fungicide” (*id.* at page 3:11-12).

160. Mitchell also disclosed that “[t]he lower extremity of each of these spouts is equipped with a spray nozzle, 18, which is located just above the point 10 of the tooth, so that the liquid as it issues from the nozzle is deposited upon the grain and the soil or earth in which it is planted, simultaneously.” Ex. 1005, at page 2:36-47. Mitchell further disclosed that “as the seed is about to enter the- earth at the lower extremities 10 of the hollow teeth, the liquid is applied to the grain and also to the earth, thus giving the seed and earth at the same time a treatment with the anti-smut liquid compound.” *Id.* at page 2:54-64.

161. Further, as excerpted above in Section VII.A.5, Wagers discloses the metering and planting of individual seeds and the application of an agricultural substance contemporaneous with the dispensing of the seed. It was well understood at the time that there were numerous well-known means for applying substance to individual seeds during planting, all of which are readily incorporated in the multi-row planter disclosed in Wagers, and all of which are consistent with and would further the express objective of Wagers to improve planting precision.

162. One such example is the hollow teeth and spray nozzle configuration of Mitchell, which provides for the spray of seed while in transit to the ground. One would have been motivated to incorporate the spray nozzle configuration of Mitchell because of the precision it affords. Incorporating such a configuration in the multi-row planter disclosed in Wagers would have been straightforward. As excerpted above in Section VII.A.5, Wagers discloses spray nozzles that are associated with the individual row units, which include “coulters, seed metering systems including seed wheels, seed hoppers and the like.” Ex. 1004, [0028]-[0029].

163. Thus, because Wagers (Ex. 1004) in view of Mitchell (Ex. 1005), discloses each and every limitation of claim 6, I conclude that claim 6 is rendered obvious by Wagers in view of Mitchell.

5. Claim 11 is obvious over Wagers in view of Mitchell

164. Claim 11 depends on claim 1. As discussed above, each limitation of claim 1 is disclosed Wagers (Ex. 1004) alone, or in view of Mitchell (Ex. 1005).

165. While it is my opinion that claim 11 is anticipated by Wagers for the reasons I provide above in Section VII.A.7, claim 11 is further rendered obvious by Wagers in view of Mitchell.

166. Incorporating by reference my discussion of Wagers and claim 11 in Section VII.A.7 above, and as more fully described in the claim charts attached as Appendix C, it is my further opinion that Mitchell disclosed the elements of claim

11 as follows:

Leading downwardly from the conduit, 15, is a number of spouts, 17, which pass through the hollow teeth, 8; of the seeder and are relatively small, whereby they do not interfere with the passage of the grain through the said teeth. The lower extremity of each of these spouts is equipped with a spray nozzle, 18, which is located just above the point 10 of the tooth, so that the liquid as it issues from the nozzle is deposited upon the grain and the soil or earth in which it is planted, simultaneously.

Ex. 1005, page 2:36-47.

167. A POSA at the time would understand that seed drop tubes, which provide for the release of seed at or near the ground, thereby allow much greater precision in seed placement, which is one of the goals of Wagers. Seed drop tubes have been ubiquitous features of in-row planters, including multi-row planters, seed drills, air seeders, and the like, for well over a century if not longer as reflected in Mitchell, which issued as a patent in 1922. Incorporating a seed drop tube like that of Mitchell in the multi-row planter disclosed in Wagers would have been straightforward. Indeed, given the widespread use of seed drop tubes, to the extent the planter disclosed in Wagers does not expressly or inherently include a seed drop tube, it would have been a standard bolt-on part widely available at the time.

168. Further, as excerpted above in Section VII.A.7, Wagers discloses the metering and planting of individual seeds and the application of an agricultural substance contemporaneous with the dispensing of the seed. It was well understood at the time that there were numerous well-known means for applying substance to

individual seeds during planting, all of which are readily incorporated in the multi-row planter disclosed in Wagers, and all of which are consistent with and would further the express objective of Wagers to improve planting precision.

169. One such example is the hollow teeth and spray nozzle configuration of Mitchell, which provides for the spray of seed while in transit to the ground. One would have been motivated to incorporate the spray nozzle configuration of Mitchell because of the precision it affords. Incorporating such a configuration in the multi-row planter disclosed in Wagers would have been straightforward. As excerpted above in Section VII.A.7, Wagers discloses spray nozzles that are associated with the individual row units, which include “coulters, seed metering systems including seed wheels, seed hoppers and the like.” Ex. 1004, [0028]-[0029].

170. Thus, because Wagers (Ex. 1004) in view of Mitchell (Ex. 1005), discloses each and every limitation of claim 11, I conclude that claim 11 is rendered obvious by Wagers in view of Mitchell.

C. Ground 3: Claim 8 of the '027 Patent is Obvious Over Wagers in view of Wilkerson

171. Claim 8 depends from claim 1. As discussed above, each limitation of claim 1 is disclosed by Wagers (Ex. 1004) alone, or in view of Mitchell (Ex. 1005). Claim 8 further recites “wherein the step of generating the combination of the seed and the selected type of the seed-applied substance further comprises: providing a timing mechanism; and calculating, with the timing mechanism, both delivery time

of the selected type of the seed-applied substance from the substance receptacle through a substance flow path to the substance applicator and travel time of the seed through a seed flow path.”

172. As addressed more fully in the claim charts attached as Appendix C, Wilkerson (Ex. 1006) disclosed each of the limitations of dependent claim 8.

173. In summary, Wilkerson disclosed a seed treatment method for a multi-row planter with a system which can “time the release of fluid F from fluid dispenser FD such that fluid F is released on and/or near each seed 202 in furrow 204.” Ex. 1006, [0030], [0061]. This system also utilizes a seed sensor positioned between a seed meter and furrow to detect “each time one or more seeds 202 pass a sensed location SL in seed tube ST” and a second seed sensor “positioned at output 208 (FIG. 2) of seed tube ST and time durations between upper and lower seed sensor pulses can be calculated” to measure the time period of the seed within the seed tube and where the fluid is applied to the seed. *Id.*, [0030], [0065], [0066].

174. Wilkerson disclosed the system “can implement a process for calculating the predetermined time for seed arrival at target location TL” where “[t]he predetermined time can be selected as the time calculated for seed 202 to move from sensed location SL to target location TL where fluid dispenser FD dispenses fluid” and “can simultaneously process multiple seed arrival times” utilizing counters. Ex. 1006, [0032], [0035], [0037].

175. Planters utilizing timing mechanisms to measure both delivery time of the seed applied substance and travel time of the seed through the flow path, like those disclosed in Wilkerson, were well known and have been used in agricultural planters since well before the 2015 priority date of the '027 patent. As reflected in the similarity between the multi-row planters disclosed in Wagers and Wilkerson, one of ordinary skill in the art would have recognized that the multi-row planter of Wagers could have been readily equipped with any number of seed drop tubes incorporating a timing mechanism to calculate both the timing of the application of the seed applied substance and the timing of the seed to travel to the application location.

176. The timing mechanism would have furthered the goal in Wagers of maximizing precision in the application of the seed applied substance during planting. This goal is also shared by Wilkerson: “[seed detection] can ensure that system performance is not solely dependent on the ability of the meter and seed tube ST to deliver seeds 202 at uniform intervals to a location for receiving fluid F from fluid dispenser FD ... [and] ensures that the dispensing of fluid F corresponds with the actual dropping of each seed 202, rather than the expected dropping of each seed 202.” Ex. 1006, [0033].

177. As such, Wagers (Ex. 1004), or Wagers and Mitchell (Ex. 1005), in view of Wilkerson (Ex. 1006) renders claim 8 obvious.

D. Ground 4: Claims 9 and 10 of the '027 Patent are Obvious Over Wagers in view of Batcheller

178. Claims 9 and 10 depend from claim 1. As discussed above, each limitation of claim 1 is disclosed by Wagers (Ex. 1004) alone, or in view of Mitchell (Ex. 1005). Claim 9 further recites “providing a mixer in fluid communication with the substance receptacle and a substance flow path; and mixing the seed-applied substance prior to the selected type of the seed-applied substance being applied to the seed.” Claim 10 further recites “adjusting a mixture ratio of the seed-applied substance during operation of the planter.”

179. As addressed more fully in the claim charts attached as Appendix C, Batcheller (Ex. 1007) disclosed each of the limitations of dependent claims 9 and 10.

180. In summary, Batcheller disclosed a “nutrient system 1110” in figure 13 that “contains several types of chemicals, which may include fertilizers and pesticides, individual soil nutrients, and water, all of which can be added to the furrow or to the seed itself as required based on the soil conditions,” which according to Batcheller “may be separated by type and mixed together in the nutrient system 1100 as required to create the proper supplement to add to the soil.” Ex. 1007, at [0143].

181. As addressed more fully above and in the claim charts attached as Appendix C, Wagers disclosed “agricultural product reservoirs 116, 118” (shown in

fig. 1) that contain “liquid fertilizer or herbicide” and associated “spray units” that “are adjusted to provide a desired type and amount of the respective agricultural product? (further illustrated in fig. 4). Ex. 1004, [0028], [0040].

182. The mixing of compounds just prior to field application is common practice and has been since the dawn of agriculture. Given this long-standing practice and Wagers’ focus on providing “a desired type and amount of the respective agricultural product” based on seed type, as excerpted above, one of ordinary skill in the art would have been motivated to incorporate a mixer in the multi-row planter disclosed in Wagers. Such mixers were well known at the time as reflected in Batcheller, and could have been readily incorporated in the Wagers planter.

183. As such, Wagers (Ex. 1004), or Wagers and Mitchell (Ex. 1005), in view of Batcheller (Ex. 1007) renders claims 9 and 10 obvious.

E. Ground 5: Claim 17 of the ’027 Patent is Obvious Over Wagers in view of Memory

184. Claim 17 depends from claim 1. As discussed above, each limitation of claim 1 is disclosed by Wagers (Ex. 1004) alone, or in view of Mitchell (Ex. 1007). Claim 17 further recites “wherein the seed drop tube 20 comprises an air tube.”

185. As addressed more fully in the claim charts attached as Appendix C, Memory (Ex. 1008) disclosed each of the limitations of dependent claim 17.

186. In summary, Memory disclosed “air seeders” that “convey seeds from

the reservoir to the seed deposition outlets of the implement by means of a flow of air through conduits.” Ex. 1008, at 1:24-27. According to Memory, “the air flow is derived from a fan or air compressor, which is typically mounted on the implement and powered by the prime mover, normally a tractor.” *Id.* at 1:27-29. Such a system “conveys seeds in a flow of air carried by conduits to entrain the seeds with the air flow.” *Id.* at 2:66 – 3:5. Memory further disclosed “transport tubes” that “deliver coated seed to distributors 45 that operate to distribute the coated seeds to a plurality of delivery tubes connected to the seed deposition outlets 49 for depositing the coated seeds into the ground.” *Id.* at 4:48-51.

187. Seed drop tubes that use a flow of air to facilitate the discharge and planting of seeds, like those disclosed in Memory, were well known and have been used in agricultural planters since well before the 2015 priority date of the '027 Patent. One of ordinary skill in the art would have recognized that the multi-row planter of Wagers could have been readily equipped with any number of seed drop tube types including air tubes, brush tubes, as well as gravity tubes. Each of these types of seed drop tubes would have furthered the express goal in Wagers of maximizing planting precision.

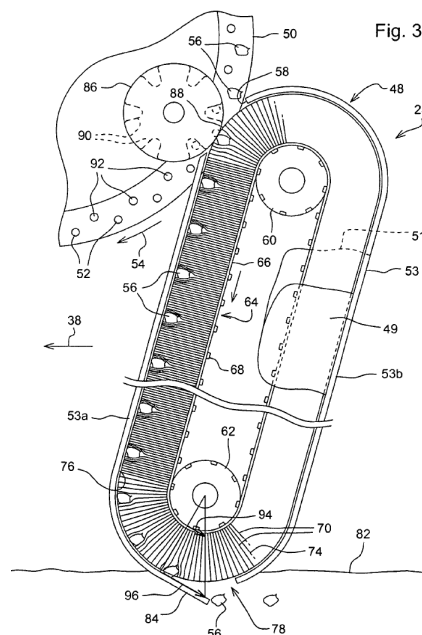
188. As such, Wagers (Ex. 1004), or Wagers and Mitchell (Ex. 1005), in view of Memory (Ex. 1008) renders claim 17 obvious.

F. Ground 6: Claims 18 and 19 of the '027 Patent are Obvious Over Wagers in view of Garner

189. Claims 18 and 19 depend from claim 1. As discussed above, each limitation of claim 1 is disclosed by Wagers (Ex. 1004) alone, or in view of Mitchell (Ex. 1005). Claim 18 further recites “wherein the seed drop tube comprises a brush tube.” Claim 19 further recites “wherein the seed drop tube comprises a seed accelerator.”

190. As addressed more fully in the claim charts attached as Appendix C, Garner (Ex. 1009) disclosed each of the limitations of dependent claims 18 and 19.

191. In summary, Garner disclosed a “seed delivery system” with “elongated bristles 70” driven by a “pair of pulleys 60, 62” and a “belt 64” as illustrated in Figure 3:



Ex. 1009, 3:40-54.

192. According to Garner, this seed delivery system “removes the seed from the seed meter by capturing the seed” and then “moves the seed down to a lower discharge point and accelerates the seed rearward to a horizontal velocity approximately equal to the forward travel 20 speed of the seeding machine such that the seed, when discharged, has a low or zero horizontal velocity relative to the ground.” Ex. 1009, 2:15-30. “The bristle distal ends thus cause the linear speed of the seeds to accelerate relative to the speed of the belt base member 66 and the housing as shown by the two arrows 94 and 96. The seeds are then propelled by the bristles over the ramp 84 and discharged through the lower opening 78 into the seed trench.” *Id.* at 4:27-33.

193. Brush-type seed drop tubes that by design accelerate seeds as they are discharged, like those disclosed in Garner, were well known and have been used in agricultural planters since well before the 2015 priority date of the '027 patent. As reflected in the similarity between the multi-row planters disclosed in Wages and Garner, a POSA would have recognized that the multi-row planter of Wagers could have been readily equipped with any number of seed drop tube types including brush tubes, air tubes, as well as gravity tubes. Each of these types of seed drop tubes would have furthered the express goal in Wagers of maximizing planting precision. Garner discloses the brush meter as a way of reducing variation, i.e. improving accuracy of seed delivery. Ex. 1009, *Abstract*, 1:64 to 2:11.

194. As such, Wagers (Ex. 1004), or Wagers and Mitchell (Ex. 1005), in view of Garner (Ex. 1009) renders claims 18 and 19 obvious.

G. Ground 7: Claims 1-19 of the '027 Patent Lack Enablement

195. In deciding whether a person having skill in the art would have to experiment unduly in order to make and use the invention, I understand several factors may be considered: (1) the quantity of experimentation necessary, (2) the amount of direction or guidance presented, (3) the presence or absence of working examples, (4) the nature of the invention, (5) the state of the prior art, (6) the relative skill of those in the art, (7) the predictability or unpredictability of the art, and (8) the breadth of the claims.

196. In my opinion, to the extent the Patent Owner attempts to narrowly construe the claims of the '027 Patent to require some form of “micro-dosing” and/or a degree of precision in the application of the claimed seed-applied substance, a person skilled in the art would have needed undue experimentation to implement such methods in light of the minimal nonspecific disclosure in the '027 specification. It is also my opinion that the claims of the '027 Patent are broad and utilize generic terminology which encompasses not only the prior art but also embodiments having more complexity. Given that, the claimed invention of the '027 Patent is not enabled.

197. It is my understanding that a claimed invention is not patentable under 35 U.S.C. 112 for lack of enablement if the specification does not contain a

sufficiently full and clear description of how to make and use the full scope of the claimed invention without undue experimentation. Factors that may be considered to determine whether there is undue experimentation include: (1) The breadth of the claims; (2) The nature of the invention; (3) The state of the prior art; (4) The level of one of ordinary skill; (5) The level of predictability in the art; (6) The amount of direction provided by the inventor; (7) The existence of working examples; and (8) The quantity of experimentation needed to make or use the invention based on the content of the disclosure.

198. Claims 1-19 each describe a “prescriptive seed treatment method” that includes a “planter” including “a seed drop tube” for “generating the combination of the seed and the selected type of the seed-applied substance at least in part by individually applying the desired application amount of the selected type of the seed-applied substance to each seed as it is being delivered to the soil.”

199. Dependent claim 8 includes the element of “a timing mechanism” for calculating “both delivery time of the selected type of the seed-applied substance from the substance receptacle through a substance flow path to the substance applicator and travel time of the seed through a seed flow path.”

200. As for the nature of the invention, according to the Cambridge Dictionary, the definition of “prescriptive” relates to providing rules or instructions as to what exactly must happen. In the art, prescriptive farming is used to provide

and account for site-specific (i.e., a defined geographic location in an agricultural field) parameters which affect the seed environment and determine the seed and treatment to apply to the field. Ex. 1010, 1:45-2:4. The '027 Patent provides no rules, directions, tolerances or guidance as to “generating the combination of the seed and the seed-applied substance at least in part by individually ...to each seed as it is being delivered to the soil.” To practice the full scope as claimed a “combination” “as it is being delivered to the soil” a POSA must create a situation where there is a spatial and temporal coincidence of the seed and the seed-applied substance. As such, there are a multitude of scenarios contemplated within the scope of claims 1-19 where a POSA needs to know the trajectory of the seed. This requires sensors in a structured configuration in conjunction with associated data processing hardware and computational algorithms.

201. The '027 Patent provides no guidance as to the kind of sensor to use to define a seed's trajectory through the seed drop tube, the location of the sensor, the nozzle, the placement and orientation of the nozzle, whether numerous sensors are required, the nozzle control system including the kind of valve or pump, or the metering device used. As such, a POSA could not use the full scope of the “prescriptive method” “seeds” to “generat[e] the combination of the seed and the selected type of the seed-applied substance at least in part by individually applying the desired application amount of the selected type of the seed-applied substance to

each seed as it is being delivered to the soil” for the reasons explained below. Further, he or she would be unable to use them without undue experimentation, and he or she would be forced to randomly produce numerous apparatuses or planters while testing numerous seeds to attempt to practice the full scope of the invention.

202. The art of developing contemporary prescriptive seed treatment technology and techniques often requires numerous years of trial and error as well as experience and training. Moreover, developing such technology is highly unpredictable given the variability in soil characteristics and seed characteristics, which requires substantial time, testing, and effort to devote for developing specific formulations and equipment to reliably deliver seeds to specific locations in a geographical area. Further, the operating environment of mobile agricultural equipment is unpredictable and harsh and requires robust system components and control systems that can compensate for a wide spectrum of vibration frequencies and amplitudes, severe dust and dirt accumulation and inherent variability in biological and natural entities such as seeds, soil and crop inputs. The prior art referenced below provides further evidence to these issues and to my knowledge was publicly available before the filing date of the ‘027 Patent. *See* Ex. 1030.

203. That is, claims 1-19 lack enablement for: (1) “generating the combination of the seed and ... the selected type of the seed-applied substance to each seed as it is being delivered to the soil;” and (2) “individually applying ... the

selected type of the seed-applied substance to each seed as it is being delivered to the soil.”

1. The ‘027 Patent Is Not Enabling For “Generating the Combination of the Seed and the ... Seed-Applied Substance to Each Seed as It is Being Delivered to the Soil”

204. Each of the claims 1-19 is invalid for lack of enablement because the specification of the ‘027 Patent does not enable a POSA to generate the combination of the seed and the seed-applied substance to each seed as it is being delivered to the soil. In other words, the ‘027 Patent does not enable a POSA to practice the full scope of the claimed invention based on its description of: (a) “seed;” and (b) “generating the combination” as “it is being delivered to the soil.” Below is an analysis that addresses factors for these limitations contributing to undue experimentation in practicing the full scope of the claims.

(a) The ‘027 Patent is Not Enabling for Seed

Breadth of the Claims & The Inventor’s Direction:

205. Claims 1-19 of the ‘027 patent are broad and the inventor does not give direction as to which seeds may or may not be suitable for use with the method of the prescriptive seed treatment; rather, the claims 1-19 apply to *any* seed.

206. The ’027 patent states: “the term ‘seed’ includes seeds of any type of plants, including row crops, cereals, grains, oilseeds, fruits, vegetables, turf, forage, ornamental, nuts, tobacco, plantation crops and the like.” Ex. 1001, 7:41-44.

207. Moreover, the '027 patent contemplates the full scope of the claims to encompass delivery of the generated seed and seed-applied substance to specific seed locations on a seed-by-seed basis. Ex. 1001, 21:63-22:6.

208. No specific planter is described for its implementation other than the method claims requiring a seed drop tube, a substance receptacle, and a substance applicator, all well known in the art. Ex. 1001, 7:25-40.

209. Therefore, a POSA would understand that from looking at the specification, the claimed method of generating the combination of the seed and the seed-applied substance would mean having to practice the method for *any* seed in order to practice the full scope of the claimed invention.

State of the Prior Art:

210. Planters and prescriptive seed treatment equipment often indicate which kind of seed is suitable for use for a particular device.

211. For example, Wagers discloses a planter suitable for corn, soybeans, wheat or the like. Ex. 1004, [0026].

212. Garner '856 discloses a metering member is intended for soybeans and other crops planted with a fairly close seed spacing. Ex. 1011, 10:6-8.

213. Thacker discloses vegetable seeds frequently bounce and roll when they drop to the soil; they may bounce and roll due to the forward motion of the machine, which introduces a significant error factor into the uniformity of the seed

spacing. As such, current vegetable seed planters must be operated at very low speeds (2MPH or less) to maintain good seed spacing. Ex. 1012, [0004]-[0006].

214. Further, Wendte '066 recognizes seeds vary considerably in size, weight and shape. Ex. 1013, 1:58-61. Further, seed meters suffer from a number of limitations including the limited speed at which they can accurately dispense seeds, and inability to handle different type seeds without making cumbersome and extensive part changes, and an inherent design complexity which may typically add to the cost, wear and maintenance problems of the mechanically operated seed dispensing mechanisms. Ex. 1013, 2:4-13. Wendte also discusses seed meters in the background section require cleanout before changing seed type particularly to avoid contamination from switching from one seed type to another. Ex. 1013, 1:21-34, 52-57.

The Quantity of Experimentation Needed:

215. To implement the method of claims 1-19, a POSA would have to consider many variables and create a planter capable of implementing the method to plant any seed to practice the full scope of the claims. In particular, a POSA would need to design a method knowing all elements of the process relating to “generating the combination of seed and seed-applied substance ...to the soil.” Again, beginning with the trajectory of the seed, a POSA would need to know how the particular seed falls (e.g., the initial and terminal velocity during travel to and

during treatment), the orientation it presents to the nozzle, the amount of seed-applied substance to be applied to the seed, etc.

216. Such a prescriptive seed treatment method must consider and reliably take into account the following seed variables in Table 1 to reliably deliver any seed to a seed location:

Table 1. Examples of Seed Parameters

General size	Turnip/onion to watermelon/pumpkin
Shape	Round to elliptical to amorphous
Density	Small, dense to large, light
Aerodynamic profile	Spherical to amorphous
Terminal velocity/drag coefficient	Dense small spheres to large light ellipsoids
Surface properties	Smooth and uniform to rough and variable

217. Moreover, additional variables including the ground spacing of seeds, the planting density of seeds, environmental conditions, and the actual ground speed of the planters, which typically operate between 5 and 10 mph affect how seeds are delivered to the soil at seed locations.

218. In considering these variables, pilot measurements of seed mass and variability were made with a Satorius Practum – 1S Balance (Figure 1) with a tolerance of +/- 0.1 mg. The measurements were undertaken with a limited set of seeds, relative to the spectrum of crop types stated in the '027 patent. Although the sampling is limited, the results conclusively establish a wide range of seed

characteristics.



Figure 1

219. Table 2 shows the results of the measurement analysis for a variety of seeds including the average mass, standard deviation, the standard deviation as a percentage of the average mass, and the mass relative to the smallest seed (i.e., King Midas Carrot).

Table 2. Seed measurements

Crop	Average mass (mg)	Standard Deviation (mg)	Deviation (% of mean)	Relative Mass (to King Midas Carrot)
King Midas Carrot	1.19	0.52	43.70	1
Beefsteak Tomato	2.1146	0.6566	31.05	2
Jewel Tone Pepper	7.68	1.93	25.13	6
Sweet Princess Watermelon	25.32	5.91	23.34	21
Lemon Cucumbers	25.94	6.78	26.14	22
Armenian Cucumber	36.81	7.51	20.40	31
Jack O' Lantern Pumpkin	138.15	26.01	18.83	116
Cinderella Pumpkin	212.85	54.85	25.77	179
Peaches & Cream Sweet Corn	226.63	16.48	7.27	190
Common Shelling Peas	228.04	37.94	16.64	192

Commercial Grain Corn	327.83	50.55	15.42	275
Trucker's Favorite Sweet Corn	345.72	56.07	16.22	291

220. Even with this limited list, in order to practice the full scope of the prescriptive seed treatment method of the '027 patent, a POSA would have to develop a planter capable of use with seeds ranging over a ratio of approximately 1:300 in average mass and between a 7 to 44% variation within a seed type and lot. Moreover, a tobacco seed (not explicitly measured in this experiment) has a reported mass of about 0.08 to 0.09 mg and there are about 11,000 - 12,000 seeds per gram. As noted above, there are about 3 corn seeds per gram. This is roughly a 4,000-fold range in mass between tobacco and corn seeds.

221. Claim 1 of the '027 patent is not limited to a single or a few inoperable embodiments. The list of inoperative seed types is extensive.

222. That is, the '027 patent states: "the term 'seed' includes seeds of any type of plants, including ... fruits, vegetables, turf, ... ornamental, nuts, ...plantation crops and the like." Ex. 1001, 7:41-44. Within this spectrum of seeds contemplated, there are notably many examples where no seeds are used in commercial production or the high crop density could not be possible for individual seed prescriptive treatment. For example, most tree, vine and bush fruits are propagated vegetatively and typically involve grafting of fruiting wood onto differing rootstock, not planting of seed. Strawberries, for example, are propagated

from runners, i.e., “daughters” from mature “mother plants”.

223. Vegetable seeds typically are small, light seeds and often seeded at high spatial rates: for example, commercial carrots may be seeded at rates up to 1.5 million seeds per acre; other leafy green vegetables are broadcast seeded and the ultimate location of the seed on the soil is not controlled to the extent of row crops (i.e., placed in a furrow or seedline); hence, location-based prescriptive aspects are less useful. Moreover, vegetable seeds are often seeded at lower speeds than 5mph rather than directly planted to achieve a defined spacing and crop density are instead thinned after emergence to achieve the desired plant density. *See e.g.* Ex. 1012, [0004]-[0006].

224. Similarly, turf seeds are typically planted by a broadcast seeder, releasing 1-5 million seed per acre. Ornamental plants would include flowers, planted as bulbs, tubers or cuttings or roses which are vegetatively propagated or rooted from cuttings. Nut crops, such as almonds, walnuts, pecans and pistachios are commercially propagated and planted as cuttings that are rooted or grafted onto rootstocks that have also been grown from rooted cuttings.

225. The term “plantation crops” generally refers to large areas planted to a single crop and typically fresh market crops requiring high labor input for cultivation and harvest, e.g., sugar cane, rubber trees, bananas, pineapple and similar crops, all of which are not propagated and planted as seed.

226. Mass and shape also make seeds more susceptible to changes in air resistance when they are light and would have difficulty taking advantage of gravitational forces for efficient, predictable, and accurate planting and movement through a planter to a seed location on a seed-by-seed location. Small seeds also lack surface area which makes application of effective amounts of seed-applied substance difficult. For example, in considering the embodiments requiring the use of seed sensors, small seeds such as lettuce, tomato, or carrot may not even be detected by a single sensor or even an array of spaced sensors. Further, just assuming a single seed type is used, a POSA cannot even be assured of a regular interval or distance between each seed as velocity can change, and trajectory can alter in correspondence with seed physical properties. These changes will affect the target area for the coincidence with emission or dispensing of the seed-applied substance.

Summary:

227. Given the above, it is unclear how a POSA would be able to use the same prescriptive seed treatment method claimed for any seed and “[generate] the combination of the seed and the selected type of the seed-applied substance...as it is being delivered to the soil,” without undue experimentation. The prior art devices recognize planters with specific seed types of comparable sizes (e.g., corn and soy, or similar vegetable seeds) and recognize planters are known to struggle with use

with widely variable characteristics. The inventors of the '027 patent provide little guidance as to how to develop a planter to use the claimed method and the claims. To practice their full scope, require the use of a planter capable of performing the method for any seed and generating the combination at each seed location. Finally, at least 10 variables related to seeds and delivery to seed locations (i.e., general size, shape, density, aerodynamic profile, terminal velocity, surface properties, ground spacing, planting density, planter ground speed, and environmental conditions) reliably need to be considered by a POSA when developing or designing a planter to carry out such a method. Moreover, given the substantial variability of the seeds contemplated to be used in the method of the '027 patent, significant and burdensome – in terms of cost, time, and resources – experimentation to evaluate the variables would be required for a POSA to practice the full scope of the claimed invention.

228. Further, the pilot measurements above in Table 2 also revealed that individual seeds, within a specific crop, cultivar, and seed lot have significant seed-to-seed variability in size. Notably, all seed types other than corn had a deviation within the seed lots of at least 18%, extending up to over 40% for King Midas Carrot seeds. Thus, these measurements show the unpredictability inherent in the art which requires extensive experimentation to establish practical confidence intervals to be able to implement a prescriptive seed treatment for just a single seed

type, let alone various seed types to implement in a prescriptive seed treatment method for *any* seed contemplated by the scope of claims 1-19 of the '027 Patent.

229. As discussed, to devise a planter to carry out the full scope of the method of claims 1-19 to “generate the combination ...[to deliver] to the soil” a POSA needs either a high degree of control or extensive sensing for detection of the seed. Control is necessary in order to ensure no variability in parameters; this is only feasible when one can adapt the environment to the process thereby reducing the variability such that everything does not need to be detected or sensed. The planting of seeds does not occur in an environment a POSA can control; therefore, a POSA needs to have sensors to sense the parameters and variations, on-board, high-speed data processing capability and control algorithms in order to attempt to control for variability in changes of things such as seed trajectory, seed presentation, velocity, etc.

230. Therefore, “generating the combination of [any] seed and the selected type of the seed-applied substance...as it is being delivered to the soil,” would require undue experimentation considering the factors above. For example, dependent claim 8 includes “a timing mechanism” for calculating “travel time of the seed through a seed flow path.” Yet, as discussed in detail below, no guidance is provided for a POSA to accomplish said “timing mechanism.”

(b) The ‘027 Patent is Not Enabling for “Generating the Combination ... As It is Being Delivered to the Soil”
Breadth of the Claims & The Inventor’s Direction:

231. Claims 1-19 of the ‘027 patent are broad and the inventor gives little direction as to how the combination is generated as it is being delivered to the soil.

232. First, the ‘027 patent explains “one or more controllers could communicate with the applicable other components of the planter and/or control them to generate the combination in many different ways depending on the particular embodiment.” Ex. 1001, 33:36-40.

233. The ‘027 patent then continues and lists a long list of examples of broad ways the controllers could generate the combination including using “one or more metering devices to cause the appropriate amount(s) of such seed-applied substances to be delivered through the substance flow path to the appropriate substance applicator(s),” using “any pumping and/or other substance delivery mechanisms,” using “timing mechanisms that can be used to synchronize the delivery of the seed.” Ex. 1001, 33:44-34:41.

234. The ‘027 patent, in the specification, provides no examples nor does it discuss what structure a “timing mechanism” of claim 8 could include. There are not even any “sensors” mentioned in the patent text except for sensing related to field properties as listed in Table 1, e.g., nitrogen deficiency, or calculating the combination of seed and seed-applied substance (“the seed-by-seed-applied-

substance combination selection process”). Ex. 1001, 28:42; 37:49. The functional connection between any sensors and the “timing mechanism” is not described explicitly or implicitly. In fact, in Figures 10 and 11, the “sensors” are shown to be distinct from the “timing mechanism”. Thus, the timing mechanism appears to be nothing more than a time delay and without “sensors” it is unclear how a POSA would be able to make and use the purported timing mechanism of claim 8 to “calculate and/or coordinate the delivery time of the seed-applied substance to one or more substance applicator(s) for one or more seeds at the appropriate point in the seed flow path.” Ex. 1001, 37:13-16.

235. Moreover the ‘027 patent contemplates the “substance applicator(s)” can include “many different types of spraying and/or applying technologies, including atomizers, jet nozzles, wheel nozzles, rotary spray heads” without describing specific configurations and include metering mechanisms including “valves, gates, orifices.” Ex. 1001, 12:42-52.

236. Further, as used in the ‘027 patent, the terms "substance" and/or "seed applied substance" include *any* composition applied to seeds prior to the seeds being planted. Ex. 1001, 7:45-48. Moreover, “desired application amount” is never discussed in the specification of the ‘027 patent. Yet the prosecution history indicates “pico” and “micro” amounts of seed applied substances are contemplated by the invention. Ex. 1002, 246. Patentee admitted in the Examiner interview on

March 28, 2022, that this nozzle requires a “special design.” *Id.* Yet, this element is not discussed in the specification. *Id.* The ‘027 patent merely states “the system provides for numerous configurations whereby the combination of seed and type and/or amount of seed-applied substance can be prescriptively selected based, at least in part, on the field, region, batch, row, and/or seed position” and can include “low rate, mid-rate and/or high rate” of seed applied substance without further direction. Ex. 1001, 13:15-20; 37:48-67.

237. Further, the only aspect of delivery that arguably provides some specificity to claims 1-19 is that the generation of the combination occurs “as it is being delivered” where the seed flow path includes a “seed drop tube.” Yet again the ‘027 Patent provides no guidance.

238. As the ‘027 Patent explains, “in lieu of or in addition to applying one or more of the seed-applied substances just prior to the seed entering, within, as the seed leaves, and/or otherwise proximate to one or more seed delivery tubes 40, the same can occur just prior to the seed entering, within, as the seed leaves, and/or otherwise proximate to any number of components within the seed flow path. For example, one or more of the seed-applied substance can be applied to the seed just prior to the seed entering, within, as the seed leaves and/or otherwise proximate to one or more seed hoppers 24, seed meters 26, and/or seed drop tubes 28.” Ex. 1001, 13:21-32.

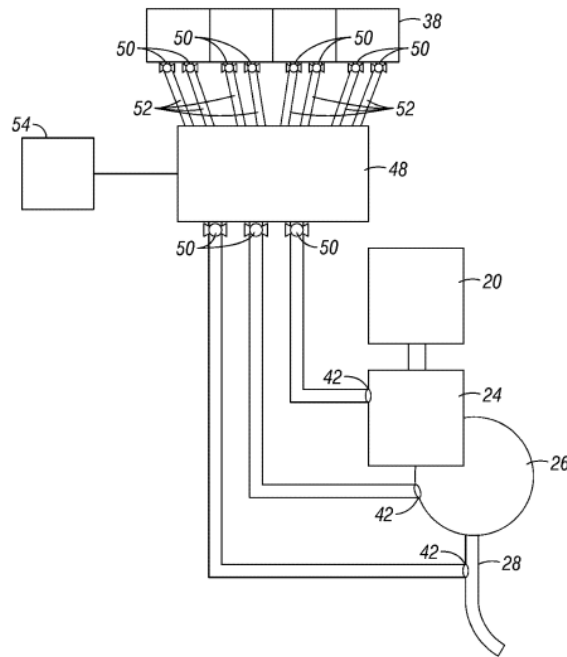


FIG. 5

239. Further, the '027 patent also gives little practical direction to how the substance applicators would avoid substance residue buildup or even clogging within the nozzle or applicator for the seed-applied substance. The disclosure shows the seed tube is open to the environment and that dust and dirt would intrude into the tube and enter the seed treatment environment. This is because the seed tube is in close proximity to the soil during planting and a large quantity of dust is generated during planting, even in normal conditions. The '027 patent recognizes and highlights this issue: "[b]ecause the brushes would typically be made of materials that could absorb and/or collect seed-applied substances and thus potentially become less effective with residue build up and/or be difficult to clean, substance applicators preferably would be situated such that the seed-applied

substances they dispense come in minimal, if any, contact with the brushes.” Ex. 1001, 14:26-35. This is again an embodiment professed by the ‘027 Patent, yet with no guidance as to where a POSA would even begin to situate the substance applicator nozzle. However, the Figures (e.g., Figures 8A-8C) show that the applicators come almost in direct contact with the brush tubes shown. The ‘027 Patent includes in Figure 5 above what appears to be flushing mechanisms to remove residue buildup from the seed tubes. Yet, there is no disclosure or guidance as to how a POSA could have any reasonable expectation of success to accomplish removing this residue without diluting future applications. Further, there is no guidance for a POSA to utilize this simplistic representation of a flushing mechanism without creating an environment for mud and clogging debris which is inevitable given the opening to the environment and dust. Thus, to practice the full scope of the claims a POSA would also have to be able to make and use the prescriptive seed method in planters both with and without the flushing mechanisms contemplated by the inventors.

State of the Prior Art:

240. Seed drop tubes were well known around the time of filing of the ‘027 patent to have difficulty in maintaining accurate and consistent seed spacing at planting speeds of greater than 5mph. Ex. 1011, 1:44-57.

241. In fact, the use of seed tubes to deliver the seeds to the seed furrow

have a negative effect on the uniformity of seed spacing because seeds descend through the seed tube by gravity often in a free-fall through the entire length of the seed tube and other metering devices. Ex. 1014, 1:41-54; Ex. 1015, pg. 57. Seeds may contact and bounce off the walls of the seed tube in relatively random intervals, which can lead to differences in the rates at which the seeds travel through the drop tube. Ex. 1014, 1:41-54. Later-discharged seeds from a seed meter are even known to pass an earlier-discharged seed as both are delivered to the soil. *Id.*

242. Thus, the lack of predictability of seeds falling through seed drop tubes has necessitated the use of sensors for accurate seed placement. Ex. 1016, [0004]. Even these sensors have a number of reliability concerns. For example, if the seed sensor is placed too high in the seed drop tube, the affects due to gravity (e.g., contact with the seed drop tube, bouncing within the seed drop tube) may still be unaccounted for when the seeds exit. Ex. 1017, 1:31-44. Second, optical sensors have difficulty counting seeds reliably because of the effect of sunlight as the seed exits the tube. Thus, other kinds of sensors needed to be developed to solve this problem. Ex. 1017, 1:31-44; 1:63-2:7.

243. With regard to seed applied substances, planters often apply seed applied substances to the seeds at such a position in the seed flow path to assure that the coating will be dried on the seed before it enters the planting tubes. Otherwise, if the material is not fully dry at this point, there is the possibility of

coating or caking the inside of the seed flow path, including seed drop tubes, especially where a manifold and relatively long runs of small diameter flexible tubing carry seed pneumatically between the planting drum and the actual furrow. *See e.g.*, Ex. 1018, 2:38-64.

244. One example in the prior art includes a nozzle so that seeds are sprayed just before they enter a drum and includes a blower system, operating through the rotating drum and the perforations therein, establishes a high air flow rate across the wetted seeds. Then, the seeds are further dried as they are picked up and rotated in the indents or seed pockets of the drum, acting partially as a metering device, so that they are substantially dry by the time they are dropped by gravity into the seed drop tubes for delivery in the furrow. Ex. 1018 at 3:29-52.

245. One notable consideration is the type of delivery of a particular seed applied substances to the seed. As previously mentioned, the '027 patent contemplates the use of *any* seed-applied substance to *any* seed in its prescription seed treatment method. In particular, the '027 patent contemplates the use of fungicides as a seed-applied substance for use in its "combinations" which "could be applied ... just prior to the seed entering, within, as the seed leaves, and/or otherwise proximate to ... seed drop tubes." Ex. 1001, 21:14-21. However, as of the filing of the '027 patent, a POSA would recognize that while the method of delivery could be acceptable for some chemicals such as insecticides, it was

definitely considered unacceptable for fungicide application because the method by which fungicides protect against disease requires *all soil that the seed will contact* (i.e., the furrow side walls) be sprayed with fungicide. Ex. 1019, pp. 14, 61, 75-76; *see also* Ex. 1005, pg. 1, ln. 32-43.

246. Further, various metering devices and timing mechanisms are known in the prior art to generate the combination of a seed and a seed applied substance. For example, some devices use the motor speed of the tractor or other speed-related parameters (e.g., rotational speed of a seed disc of a metering device) to apply a seed applied substance. Ex. 1018, 6:16-25; Ex. 1020, 2:4-28. Other devices include Wilkerson which uses a seed sensor to apply a seed applied substance. Ex. 1006, [0030]. However, the prior art has recognized this to be very complex and data intensive, requiring a controller with a significant amount of processor speed in order to improve reliability. Significant expense in terms of time, cost, and experimentation is needed to develop such a control algorithm. *See* Ex. 1020, 1:44-60.

The Quantity of Experimentation Needed:

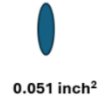
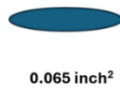
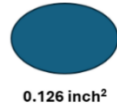
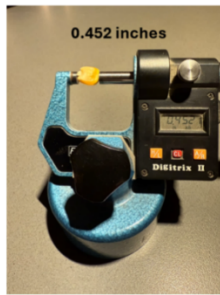
247. While the '027 patent may contain figures purporting to show “application...of the seed-applied substance to each seed as it is being delivered to the soil...,” these embodiments are oversimplified and inconsistent with the real world. Focusing on this aspect, the specification provides no parameters for where

or how to make the combination “as it is being delivered to the soil.”

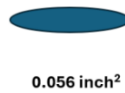
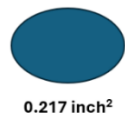
248. For example, the following pilot experiment was conducted on a limited range of commodity and specialty crop seeds (corn, pumpkins, and watermelon) to further illustrate the variability and unpredictability measured in seeds and substances and reveal amount of experimentation that would require in developing a substance applicator for a planter that would be capable of use with the prescriptive seed treatment methods of the ‘027 patent.

249. Physical measurements were taken of the seed dimensions and projected areas of the seeds were calculated for three orthogonal orientations during free fall that could occur with the delivery via a seed drop tube as claimed. Note that these three orientations represent a very small subset of the virtually infinite possibilities of the seed orientation. For simplicity, the seed applied substance applicator was assumed to be located in or immediately placed outside the exit of the seed drop tube. As can be seen from the images below, the same type of seed can present at least three different idealized orientations when falling. Each presentation will change the surface area presented to the nozzle while also creating detection issues for sensors spacing and type.

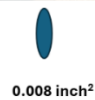
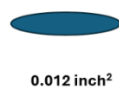
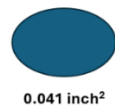
Field Corn



Pumpkin



Watermelon



250. Due to the non-spherical shape of many seeds, the area of the seed surface presented to a source of liquid spray being emitted perpendicular to the seed

travel varies greatly depending on seed orientation:

- Corn: 0.051 to 0.126 inch² or a 2.5-fold range
- Pumpkin: 0.033 to 0.217 inch² or a 6.8-fold range
- Watermelon: 0.008 to 0.041 inch² or a 5.3-fold range

251. Here, the projected surface area of the seed to which the sprayer can target can vary between 2.5 to 6.8 times in surface area for even the example seeds tested in the three orthogonal orientations.

252. Thus, to implement the method of claims 1-19, a POSA would have to consider not only the seed variables stated in Table 1, a POSA would have to consider the many variables involving the generation of the combination of seed applied substance and the treatment area of the seed to practice the full scope of the claims.

253. Such prescriptive seed treatment methods must also consider and reliably take into account developing an application system for the seed applied substance. Examples of typical experimental parameters a POSA would need to consider and address are shown in Tables 3-5 below:

Table 3. Substance parameters

Prescriptive dose mass	“pico” amounts / “micro” amounts / single small droplet to a seed up to ml amounts / saturation of seed surface
Viscosity (shear and extensional)	Low viscosity simple fluid to suspension/emulsion with complex liquid/solid mixtures
Surface tension (static and dynamic)	Volatile solvent to water based solutions
Volatility	High to low evaporation rates

Shear sensitivity	Conventional, shear-robust synthetic fertilizers / ag chemicals to shear-sensitive biological compounds
Solid loading	Single liquid substance to high mass loadings of solids in liquid solutions / emulsions / suspensions

Table 4. Spray delivery parameters

Median droplet size	Small, single droplets (micron range) to saturation sprays (100's of microns)
Droplet size spectrum	Disperse sizes / conventional spray to monodisperse / single droplet targeting
Droplet velocity	Low speed, (e.g., rotary atomizer) to high velocity ejection.
Spray nozzle emission pattern	Single droplet / stream to cone or fan pattern of varying diameter or size
Fluid pressure	High pressure for rapid ejection to low pressure / low shear to prevent damage to biological agents
Valve technique to control spray emission	Electrically actuated direct acting or pilot valve, pneumatically actuated or hydraulically actuated.
Spray emission structure	“Aimable” nozzle to track seed or fixed nozzle.
Orientation of multiple substance nozzles	Concurrent placement / potential interference of coincident spray droplet paths versus sequential placement / potential interference of deposition on wetted surfaces
Air assistance on spray emission	Use of air atomizing nozzle produces an air flow that potentially interferes with the air flow with seed
Use of electrostatic forces	Limits type of substances that can be used, preferential deposition on grounded planter surfaces rather than seed, potential charge build up on seeds in motion. Interference due to tribocharging of seeds or seed tubes.

Table 5. Design parameters of planter components to implement a prescriptive seed treatment.

A. Seed applied substance emitter, nozzle(s):
Flow rate capacity of nozzle(s) - (volume/mass of substance emitted per unit time)

• Pressure operating range of nozzle(s) – optimal and upper/lower bound
• Material (wear / clogging resistance)
• Atomization method – hydraulic pressure, air-assist, electrostatic, ultrasonic, rotary. .
• Flow control technique – pressure variation, variable orifice, metering pump, pulse width modulation
• Spray pattern, i.e., shape and spatial density of emitted spray: 2-d fan, symmetrical hollow cone, symmetrical solid cone, single droplet stream
B. Location of nozzle(s):
• Position relative to seed brush, plate or drop tube, sufficient time of travel from sensor to allow control system to react, non-excessive time that allows excessive variability in seed travel time
• Position relative to predicted / sensed seed location – high accuracy of successful treatment
• Orientation of nozzle(s) – achieving sufficient treatment time so that prescriptive dose is delivered
• Orientation of nozzle(s) – maintaining singulation of a flow of seeds to achieve individual treatment of seeds
• Independence of multiple nozzles – if multiple nozzles are used for different substances, avoiding interference in the spray trajectory and deposition from each nozzle to maintain desired prescription.
• Location relative to soil / exit of drop tube in order to prevent contamination from airborne dirt and effects of ambient air on spray trajectory. Consideration of drying time requirements before impaction with soil
C. Fluid control system:
• Method and system to initiate (trigger) and control the emission of the seed applied substance from the emitter, e.g., by mechanical or sensing means
• High cycle rate on/off (individual seed event) such that each seed can receive a unique prescription
• Capability to adjust the dispensed / deposited amount of seed applied substance, range of flow rate and flow duration to achieve dose transfer during seed treatment event duration.
• Flow metering actuator – valve (electrical, hydraulic, pneumatic) or metering pump (stepper motor control, linear actuator)
• Sequencing means for multiple nozzles for multiple substances
• Substance pumping / pressurization system – positive displacement pump with recirculation, centrifugal pump with dead-head control (pressure control method), gas-pressurized reservoirs for each substance
• Plumbing & flow configuration to achieve predictability of system response time and independence between seed events
• Capability for substances of varying viscosity, surface tension, density and fluid type (solution, pure fluid, emulsion, suspension, slurry, etc.)
• Embedded algorithms to compensate nozzle and flow control for varying substance physical properties to achieve prescribed dose of substance(s)
D. Process control system:

• Sequencing / prediction processor and control algorithm to supervise emission of seed applied substance, based on seed location sensor(s) to achieve prescriptive deposition of substance on individual seed in treatment arena
• Communication with seed sensor(s) to process sensor output to calculate arrival and dwell time in substance emission / treatment arena
• Compensation / sensing for differing seed movement properties
• Communication with spray nozzle control system to initiate, control and achieve substance emission from nozzle(s)
• Fault detection of sensor(s), nozzle(s) or flow control system(s)
• Power handling for sensor(s), fluid control/pumping components and actuators
• Interface with standard agricultural implement and vehicle systems, e.g., GPS, CAN bus, vehicle monitoring / reporting /navigation systems.

254. For example, typical agrochemical mix physical properties vary greatly. Below is a representation of a plurality of liquid formulations for water-based seed-applied substances, including typical agricultural surfactants and polymers used in formulations, which all have a density of approximately 1000 kg/m³. However, viscosity and surface tension vary widely by approximately 3 times as seen in columns 3 and 4 from the left. Ex. 1021, 98. Further, the table shows that atomization properties such as the Reynolds, Weber and Oh number vary significantly over the range of spray emissions from a simple circular orifice. A POSA would recognize immediately that extensive experimentation would be required to implement a system for application of seed-applied substance with varying physical properties.

Table 1 Physical Properties of Liquid Formulations and Dimensionless Flow Numbers for 70-kPa Liquid Supply Pressure and Two Orifice Sizes^a

Formulation	ρ (kg/m ³)	μ (mPa·s)	σ (N/m)	Orifice diameter = 0.508 mm				Orifice diameter = 1.194 mm			
				U (m/s)	Re	We	Oh $\times 10^{-3}$	U (m/s)	Re	We	Oh $\times 10^{-3}$
W	998.9	1.078	0.0723	6.621	3117	308	5.628	7.997	8848	1055	3.671
S	999.8	1.116	0.0263	6.414	2919	794	9.656	7.526	8050	2571	6.298
SPEO	999.6	1.395	0.0263	6.242	2272	752	12.07	6.745	5771	2065	7.874
STLC	1000.4	2.980	0.0278	6.230	1062	710	25.07	7.344	2944	2317	16.35
H	986.5	1.019	0.0338	6.621	3256	650	7.830	7.648	8840	2038	5.107
HPEO	988.2	1.317	0.0337	6.472	2467	624	10.13	6.939	6217	1686	6.605
HTLC	990.3	2.805	0.0337	6.681	1198	666	21.54	7.847	3308	2160	14.05

^a Physical properties were measured at 22°C. Jet velocities are for a steady-state condition integrated over a 10 s sample period.

255. Based on the Patentee’s characterizations that the “desired amount” could be in the range of “pico” and “micro” amounts (i.e., for “low-rate” applications), an experiment was conducted to establish an upper range (i.e., “high-rate”) of seed mass transfer a POSA would have to consider in order to practice the full scope of the claimed invention. In this context, pico is understood to be amounts defined as 10^{-12} as in picograms = 10^{-12} grams or picoliters = 10^{-12} liters and micro is understood to be amounts defined as 10^{-6} as in micrograms = 10^{-6} grams or microliters = 10^{-6} liters and milli is understood to be amounts 10^{-3} as in milligrams = 10^{-3} grams or milliliters = 10^{-3} liters.

256. The experiment here used example seeds and two representative fluids simulating a very limited range of conventional agrochemical tank mixes. The “holding capacity” of a liquid treated seed was estimated experimentally. Dry seeds were weighted, then dipped in the test solution and then reweighted to

determine the liquid mass transferred to the seeds. Five to ten individual seeds were tested for each of two simple test fluids: 2% solution of horticultural crop oil in water and 0.5% solution of Dyne-Amic agrochemical surfactant in water.



Seed Type	2% Crop Oil / 98% Water Tank Mix	0.5% Dyne-Amic Surfactant / 99.5% Water Tank Mix
	Average Mass Transfer (mg)	Average Mass Transfer (mg)
Pumpkin	32.64	18.02
Corn	27.32	23.36
Pea	36.68	19.8
Pepper	5.56	5.12
Watermelon	14.5	7.4

257. The results showed the typical seed mass transfer holding capacity was between 5.12 to 36.68 mg depending on the seed. Overall, there was a 7:1 range of average mass for this limited range of different seed types, and the type of liquid

mix (only two were tested to show the effect of fluid) affected capacity for a single type of seed. Thus, to practice the full scope of the claimed invention, a POSA would have to be able to develop a planter capable of performing a prescriptive seed treatment method which would be able to apply a desired amount between the range of “pico” or “micro” amounts up to at least 37 mg, representing 3 to 9 orders of magnitude difference.

258. This requirement affects the selection of a number of components. In particular, it affects the nozzle and the applicator’s control system that regulates and varies the amount of seed-applied substance to combine with the seed. For example, with a 7, 6, or even 5 fold range of mass to apply in roughly 10 msecs, the flow rate needs to be capable of varying by a factor of 7, 6, or 5. To accomplish this flow rate, a POSA understands the flow rate is related to the square root of pressure, i.e., $Q = A \times C \times \sqrt{2\Delta P/\rho}$, where Q is the mass flow rate, A is the cross sectional area of the nozzle, C is the orifice coefficient, P is the pressure, and ρ is the density of the seed applied substance. For a 7 fold range a POSA would need a 10 fold variation in pressure to alter the flow rate in a fixed period of seed treatment. This range of pressure is not possible in mobile agricultural fluid flow systems and not compatible with the atomization properties of nozzles used in mobile agricultural equipment. At the time of filing the ‘027 patent, technology for creating a wide range of dispensed spray volumes in a rapid time event was not

known.

259. Design, fabrication, and control of a dispensing system with 3-9 orders of magnitude range is extremely challenging and not found in industrial liquid dispensing systems in general and especially not in mobile field equipment for prescriptive seed treatment. Altering the fluid composition, as in creating a prescriptive treatment in response to field conditions, would affect the mass transfer characteristics and the performance of the seed-applying process. Creating and accomplishing a distinct and desired combination of seed and seed-applied substance would require a complex control system integrating models and control logic for seed type and rate and type of seed-applied substance. Further, assuring any functional reliability in the process would require adaptive control systems where the treated seed were evaluated, in real time, for the accomplishment of the seed and amount of seed-applied substance combination. The process and strategy for accomplishing the full scope contemplated by claims 1-19 is not taught in the '027 patent.

260. Moreover, a POSA would have to consider planting and environmental parameters as the combination is generated "as it is being delivered" to the soil, some of which are listed in the table below.

Table 6. Planting and environmental parameters

Ground speed of planter	3 - 15 mph and typical ranges for type of crops (specialty vs commodity)
Planting population rates	Potentially a 5- to 10-fold range or higher, corn to specialty crops. 30,000 seeds per acre to millions of seeds per acre.
Temperature	0 to 100 F. Typical agriculture design range
Relative humidity	10 to 100% Typical agriculture design range.
Vibration	Significant variability in magnitude and frequency. Harmonic frequencies of equipment and components.
Seed spacing	Determined by ground speed, row spacing and population rate
Seed handling	Brush, drop tube, air seeder

261. One notable issue with dispensing the seed-applied substances into the seed treatment arena is overspray of the substance from nozzles and the high likelihood of non-target deposition onto the seed tube walls. As discussed, the tight tolerances in temporal and spatial coincidence of the seed and the emitted “packet” or dose of substance require precise control of the spray emission process and the spray trajectory. Overspray must be avoided in order to exclusively treat the seeds. With typical agricultural spray nozzles and similar atomization and spraying nozzles, the creation and movement of the spray is affected by the physical properties of the liquid. With the multiple blends of substance discussed in the ‘027 patent, a control system would be required to adapt the substance emission to the

spray system and substance. For example, Cloeter showed that changes in the liquid composition of agricultural spray materials, dispensed through standard fan nozzles, typical of use in agriculture, significantly changed the velocity of the spray droplets and the pattern of distribution from the nozzles (figures below). Ex. 1022, pp. 4-6. Simply put, when the substance is changed, the droplet size and trajectory of the substance emitted from the nozzle changes, significantly affecting producing predictable and consistent spray across multiple types of seed applied substances. The system described in the '027 patent, with no compensation for the range of seed-applied substances, would result in significant non-target deposition in the treatment arena, including the seed tube walls. In other words, without a system for measurement and compensation of the substance physical properties, the application system could be affected by changes in the droplet velocity and could miss the critical time and space coincidence required to treat a moving seed with a moving mass of substance.

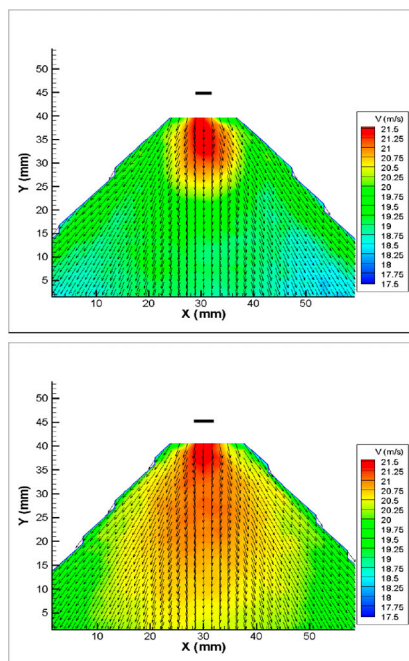


Figure 6. Velocity vectors with contour plot colored by velocity magnitude for 8002 nozzle with flow conditions same as Figure 5. Top plot, water only. Bottom plot, with 1000 ppm InterLock® emulsion.

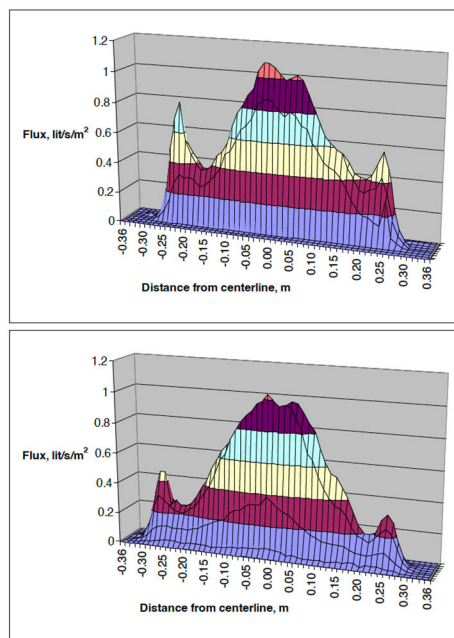


Figure 7. Patternation result for 8002 nozzle with flow conditions same as Figure 5. Top plot, water only. Bottom plot, with 1000 ppm InterLock® emulsion.

262. Additionally, interactions between the amounts and types of seed-applied substances further complicate the contamination issue. The volatility of the substance, combined with the characteristics of the co-flowing air stream would affect the drying time of the substance, both that successfully deposited on the seed and that non-target deposition on the walls of the seed treatment arena.

263. Knake recognized this issue in 1981 and invented a seed treatment system where the coating on the seed is dried before entering the seed tube, thereby keeping the seed tube uncontaminated. Knake states, “[t]he fluid material is applied to the seeds at such a position in the seed flow to assure that the coating will be dried on the seed before it enters the planting tubes. A particular drawback, if the material is not fully dry at this point, is the possibility of coating or caking the inside

of the conduits or planter tubes, particularly where a manifold and relatively long runs of small diameter flexible tubing carry seed pneumatically between the planting drum and the actual furrow. Furthermore, if a material is not promptly dried on the seed in the planting drum, the drum, itself, could be coated and plug the relatively small pockets or openings in the drum so that air will not flow around the seed and through the pockets to hold the seeds against gravity as they are turned from a picked-up position to a delivery position. Additionally, as mentioned before, loss of excessive amounts of relatively expensive treating material and unnecessary treatment of seeds is readily avoided by practice of the method of the present invention.” Ex. 1018, 2:45-64.

264. In addition to cross-contamination of seeds, waste of seed-applied substance and coating/contamination of the seed tube (i.e., treatment arena) walls and boundaries, the build-up of seed-applied substances on the walls of the seed tube would affect the underlying planting operation. In seed planting, the uniformity of seed spacing in the seed line is a critical performance metric and a critical factor in maintaining optimal yield in crops. University extension recommendations note the importance of making “sure seed drop tubes are clean” in planter performance. Ex. 1023.

265. Kocher reported that surface condition of the seed tube had a significant effect on seed spacing with tube wall surfaces exhibiting wear or

roughness causing reduced seed spacing uniformity. Ex. 1024. Further, the study found that the wear level on the seed tube and the type of seed (round versus flat) interacted to affect seed spacing with flat seeds in worn tubes creating the lowest seed spacing uniformity. *Id.* This study reveals that accumulation of seed-applied substance on the seed tubes, altering the surface condition, would not only affect the transfer of seed-applied substance but also affect the performance of the planter, as quantified by seed spacing uniformity. *Id.* This published result additionally confirms the essential requirement for sensing the seed trajectory, given that the wear and condition of the seed tube affect the trajectory. *Id.*

Summary:

266. The prescriptive seed method of claims 1-19 requires the use of a planter, in order to physically carryout the prescriptive treatment process of the claim. Creating such a planter further requires a planter system capable of delivering the “desired application” [dose and type of seed-applied substance] to the seed as it moves through the handling path in the planter as “it is being delivered to the soil.” Given there is no limitation on seed type or doses of substances, practicing this method requires a system to be not only able to handle a variety of seed types and substances, but also operational conditions (planting rates, ground speeds, etc.). Because the specification does not provide specific components or even characteristics of components (e.g. nozzles, pumps, etc.), practicing the

invention would require extensive design and selection of individual components.

267. To develop such a system, before work could even begin, a POSA would first need to determine a myriad of relevant parameters on which control could be exerted. These parameters include, *e.g.*, the kind of sensor to define a seed's trajectory through the seed drop tube, the location of the sensor, the accuracy, predictability, and repeatability of the sensor, the type, size and atomization method of the nozzle(s), the placement and orientation of the nozzle, the nozzle control system including the kind of valve or pump. Once an initial list of possible parameters was determined, it would then be necessary to actually test those parameters to see if sufficient control could even be exerted. Such testing would include the restructuring of large portions of the equipment to find successful and repeatable operation characteristics. Then, the test configurations would require field testing, in the range of expected agricultural field environments. Despite this complexity of implementation, the '027 patent states that "generating the combination" can be anywhere along the seed flow path. This complete lack of guidance regarding applicable parameters and their thresholds would require a POSA to use undue experimentation.

268. Further, no known planter device is capable of practicing the full scope of the claimed invention. Given the various number of parameters in Tables 3-5 to consider to develop such an applicator and number of ways to develop a

metering mechanism to generate the combination as claimed, it is unclear how a POSA would be able to practice the full scope of the claimed invention without undue experimentation.

269. Further, in a continuous flow of (individual) seeds in the seed tube or equivalent treatment arena, the antecedent condition of the treatment arena will depend on the accuracy and precision of all preceding seed treatment events. Specifically, any intended seed-applied substance that is not exclusively deposited on the target seed during the brief and highly spatialized prescriptive treatment will remain in the treatment arena and affect the treatment of all subsequent seed treatment events. Most likely, due to the challenges of exclusively treating individual seeds, seed-applied substances will accumulate in the treatment arena, with this accumulation consisting of substance that “missed” the target seed and deposited on the arena (e.g., seed tube) walls or substance that remained airborne as the target seed exited the treatment arena. The prior art has also known these issues related to the seed tube.

270. Thus, physically achieving the prescriptive treatment process as claimed would also include design and fabrication of a system capable of delivering the prescribed dose and type of seed-applied substance to the individual seed as it transits the seed handling pathway in the planter and as “it is being delivered to the soil.” Ex. 1001, claim 1. As no limitations on seeds or types and doses of

substances are stated in the claims or description, practicing the invention inherently requires the system be capable of functioning with a variety of seeds, substances and operational conditions (e.g., planting rates, ground speeds, etc.). As discussed previously, the specification of the '027 patent does not even enable a POSA to practice the full scope of the method to function with a single seed type. As the specification does not teach specific components or characteristics of the components (e.g., nozzles, pumps, mixers, etc.), practicing the invention with a variety of seeds, substances, and operational conditions would require extensive design and selection of individual components and excessive prototyping and experimentation to achieve the stated objectives of the invention.

271. Therefore, “generating the combination of [any] seed and the selected type of the seed-applied substance...as it is being delivered to the soil,” would require undue experimentation considering the factors above.

2. The '027 Patent is Not Enabled for “Individually Applying ... the Seed-Applied Substance to Each Seed As It Is Being Delivered to the Soil”

272. Each of the claims 1-19 is also invalid for lack of enablement because the specification of the '027 Patent does not enable a POSA to make and use the full scope of the claimed prescriptive seed treatment method which “individually appl[ies] ... the selected type of the seed-applied substance to each seed as it is being delivered to the soil.”

Breadth of the Claims & The Inventor's Direction:

273. As it reads in light of the specification, claims 1-19 are broad and even encompass applying an on-the-fly selection of an applied substance for each seed that falls through the seed drop tube. Moreover, the '027 patent specification states "the substance applicator 42 could ... quickly individually apply each of the relevant seed-applied substances from each of the relevant substance delivery tubes 52 as the seed traverses past the substance applicator 42." In fact, the Patentee has argued that such a term includes "a precise, seed-by-seed treatment, i.e., individual treatment of individual seeds." Ex. 1025, pp. 54-55. This suggestion is further evidenced by the '027 patent's disclosure stating controllers can use seed singulation, GPS and/or other means to determine the prescribed combination of seed and seed-applied substance(s) on a *seed-by-seed*, row-by-row, column-by-column, zone-by-zone, region-by-region, field-by-field and/or across multiple fields and/or farming operations. Thus, the full scope of the claims contemplates all of these possibilities. Ex. 1001, 36:59-65.

274. Notably, no seed sensors are disclosed to track the seeds as they travel through the seed flow path. In order to accurately "generat[e] the combination ... as it is being delivered to the soil" a POSA would need seed sensors, yet to the extent the patent discusses sensors, they have nothing to do with the location of the seed or the travel of the seed through the seed flow path so as to accomplish it being

delivered to the soil. For instance, the sole structure mentioned, as in dependent claim 8 of the '027 Patent, that arguably relates to this step is a timing mechanism. However, configuring such a timing mechanism could not be done without appropriately located sensors. The '027 Patent gives insufficient guidance if any as to how to configure the timing mechanism to account for the variation in seed spacing as the seeds fall through the seed drop tube. In fact, in a “exemplary embodiment,” the timing mechanism is synchronized with the delivery of the seed to the seed drop tube. Ex. 1001, 37:34-38. Thus, the timing mechanism presented in the '027 Patent would synchronize the generation of the combination as the seed begins to fall and as such would not be capable of accounting for the variability of the seed, its trajectory, or the seed orientation as it travels within the seed drop tube.

275. The '027 patent uses seed drop tubes, seed variability as the seeds travel through the seed drop tube make it nearly impossible to account for each seed individually.

276. The '027 patent purportedly illustrates an inflight treatment with various nozzle and fluid configurations in seed drop tubes (28). The seeds are shown uniformly spaced and falling in only two orientations. No orientation or seed position sensors are specified in the '027 patent.

277. The claims encompass seed-by-seed treatment of different seed types. For example, the scope of the claims cover treating a corn seed with one

selected substance and a soybean seed with a different selected substance immediately following thereafter.

State of the Prior Art:

278. Wagers recognizes there are optimum planting characteristics (vacuum level, population rate, coulter down pressure and the like) for each of the differing seeds. Further, the vacuum applied through a seed disk for a first seed type having a first shape and size is insufficient for a second larger seed type with a second shape and size. Ex. 1004, [0007].

279. Wilkerson discloses a sensor operable to detect when an object passes a first location as the object moves to a second location. The system can also include a fluid dispenser operable to dispense fluid at the second location. In addition, the system can include a control unit in communication with the sensor and the fluid dispenser. Ex. 1006, [0013].

280. Grimm discloses the systems disclosed by Wilkerson recognizes individual seed timing is very complex and data intensive, thereby requiring a controller with a significant amount of processor speed. Ex. 1020, 1:44-57

281. In fact, substance application planters known prior to the filing of the '027 Patent included a single seed sensor, which was only operable as a seed counter and for seed spacing rather than a timing sensor to determine spray application. Ex. 1016, [0004]; Ex. 1017, 1:18-23. The present John Deere Exact

Shot Planter, debuted in 2023, still drops individual seed into the furrow, and subsequently provides a pulsed large shot of substance (i.e., 0.2 mL) to the seed in the furrow because sensor technology was not in existence at the time of filing the '027 to reliably perform timing of individual application. Ex. 1026, at pp. 1-2. Nor was the fluid dispensing technology in existence to allow treatment exclusively to the seed.

282. Both Garner '894 and Wendte '802 disclose systems utilizing seed drop tubes that allow the planting of different seed varieties. However, both systems recognize that mixing of seeds *will occur* when switching between the seed types, so the devices cannot account for planting different seed types at a seed-per-seed level. Ex. 1027, 3:56-62; Ex. 1028, 1:57-2:4. That is, prescriptive planting devices are still designed at the area level in mind. No known device is capable of switching between seeds at a seed-per-seed level.

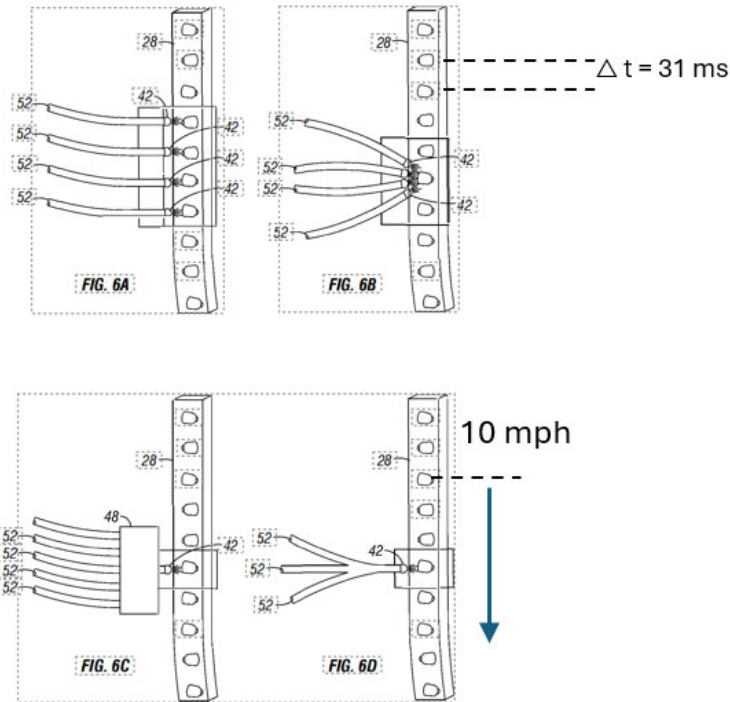
283. There are no known sprayers to treat individual small seeds such as tomato, tobacco, lettuce, etc. because they are too small to treat due to the speed of tractor (see Thacker) volume and seed sensor issues. Ex. 1012, [0004]-[0006].

284. Applying a discrete pulse of chemical to each seed requires knowledge of when each seed lands in the furrow, so that the valve can be actuated. Ex. 1019, pp. 59-60. Additionally, a high-frequency on/off fluid valve with a response time less than 5 ms is required to accommodate the planting speeds and

seeding rates currently employed by producers. Ex. 1019, pp. 59-60. Existing technologies could be used to overcome the challenges associated with seed-specific chemical application. These include seed sensors for detecting the presence of falling seeds, and high-speed fluid valves with response times less than 3 msec. *Id.*

Quantity of Experimentation Needed:

285. In analyzing the feasibility of the prescriptive seed treatment of claims 1-19 of “individually applying,” a system was analyzed using field corn, pumpkin, and watermelon seeds assuming a planter ground speed of 10 mph, a planting density of 38,000 seeds per acre, and a 30-inch row spacing. Thus, these assumptions would necessitate a planting speed of 32 seeds per second or 0.031 seconds per seed, and a spray orientation along the thickness of the seed.



286. Given the above assumptions, the time for seed treatment for each of corn, pumpkin, and watermelon seeds would be as follows:

Field corn – 0.182 inches		1.03 ms
Pumpkin – 0.103 inches		0.58 ms
Watermelon – 0.053 inches		0.30 ms

287. Thus, only accounting for these three varieties of seeds, at typical planting rates and with a range of seeds, to achieve a desired individual dose on

each seed, the liquid delivery system must have a dynamic range of ~ 3- to 7-fold depending on seed size and orientation, treatment delivery times must be on the order of 1 ms or less, and the system cycle time must be on the order of 30 Hz.

288. Furthermore, such a prescriptive seed treatment method must consider and reliably take into account all of the other typical operational and experimental parameters a POSA would need to consider in Tables 1-6. *See also*, Ex. 1029, 118, 126.

289. Even more so, because the full scope of the claims contemplates a seed-by-seed level generation of a combination by individually applying to each seed, not only timing but also dose control (of the high speed and range) must be present. Further, the generation of the combination would be further complicated and a POSA would have to have a planter that not only takes into account the individual combination treatments for different type of seeds, but also take into account all of the parameters in Tables 1-6 for each individual seed on a seed by seed basis.

Summary:

290. Such a prescriptive treatment method would have required undue experimentation given the lack of working examples, the lack of direction provided by the inventor, the complexity of prescriptive treatment planters, and the prior art around the time of the filing of the '027 patent provides strong evidence that such

a “seed-by-seed treatment” would be nearly impractical if not impossible to practice the full scope of the claimed invention.

291. In summary, to accomplish applying seed-applied substances to each individual seed, a POSA needs either: 1) a high degree of control; or 2) high fidelity in terms of sensing to determine (a) where the seed is; and (b) where the substance droplet(s) is. Looking first at the seed, a POSA would consider two general ways to obtain that information: 1) a system of complex sensors, since the orientation of the seed may and will vary and, as such, one would need to measure each time one is dropped in light of various variables which complicate and cause variation (e.g., bumps while driving planter, the symmetry of the seed, and airflow around the seed and seed-applied substance); and 2) maintaining a high degree of control over the motion of the seed via the seed drop tube and ways to control the seed motion (e.g., narrow seed tubes, guides, etc.).

292. Thus, in order to accurately “individually apply ... the seed applied substance to each seed ... as it is being delivered to the soil” a POSA would need seed sensors, yet to the extent the patent discusses sensors, they have nothing to do with the location of the seed or the travel of the seed through the seed flow path so as to accomplish it being delivered to the soil. For instance, the sole structure mentioned in claim 8 of the '027 Patent that relates to this step is a timing mechanism. However, configuring such a precise timing mechanism could not be

done without a multitude of appropriately located sensors resulting in undue experimentation. The '027 patent gives very little, if any, guidance as to how to configure the timing mechanism to account for the variation in seed spacing as the seeds fall through the seed drop tube. In fact, in a “exemplary embodiment,” the timing mechanism is synchronized with the delivery of the seed to the seed drop tube. Ex. 1001, 37:34-38. Thus, the timing mechanism presented in the '027 patent would synchronize the generation of the combination as the seed begins to fall and would not be capable to account for the variability of the seed as it travels within the seed drop tube.

293. Contrary to the figures shown in the '027 patent, it is unclear what technology existed at the time of filing of the '027 patent that would allow seeds to maintain such regular intervals and orientations through seed drop tubes. This would be required to apply the seed substance consistently and accurately. Such teaching is certainly not in the '027 patent.

294. Further, because the '027 patent uses seed drop tubes, seed variability as the seeds travel through the seed drop tube make it nearly impossible to account for each seed individually.

295. For example, because of the variability in seed spacing as seeds fall through the tube, sensors would need to be placed at the exit of the tube, just prior to where application occurs. Natural conditions involved, such as unevenness of the

ground is a large contributor in the variability and unpredictability of the process.

296. Moreover, the timing involved from the sensor to the spray application would require not only extremely precise timing but would require extremely fast processing. Such rapid processing in an agricultural planter had not and could not be achieved at the time of filing of the '027 Patent and would require a unique system to minimize the time for the electrical communication between the sensor system, an onboard processor, and the spray actuator control.

297. The '027 patent does not suggest it had possession of that capability particularly because no location of the “one or more controllers 54” is discussed and moreover describes being “preferably located and/or be capable of being operated within the cabin of the tractor 12.” Ex. 1001, 34:59-59; 35:59-65

298. Second, because the claims encompass seed-by-seed treatment, the claims also encompass seed-by-seed treatment of different seed types. For example, the scope of the claims cover treating a corn seed with one selected substance and a soybean seed with a different selected substance immediately following thereafter. However, the prior art around the time of the filing of the '027 patent suggests that this level of granularity is not known to be possible. For example, both Garner '894 and Wendte '802 disclose systems utilizing seed drop tubes that allow the planting of different seed varieties. *See* Ex. 1027, 3:56-62; Ex. 1028, 1:57-2:4. However, both systems recognize that mixing of seeds will occur when switching

between the seed types, so the devices cannot account for planting different seed types at a seed-per-seed level. That is, prescriptive planting devices are still designed at the field area level in mind.

299. Moreover, these prior art devices included detailed description of their metering devices to be capable of reliably switching seed types even for area-by-area planting. No specific seed meter is disclosed in the '027 patent which would be required for the prescriptive method to apply an individual treatment for a different seed type at the seed-per-seed level. For example, the '027 patent suggests that any known seed meter to one of ordinary skill in the art would suffice. 10:4-22.

300. Considering the mechanism for dispensing the seed-applied substance, as discussed earlier, there are two sources of significant challenge in practicing the claims of the invention. The issues of seed variability have been discussed. Similarly, the range of rates or “dose” quantity of the substance and the range of substance characteristics has been illustrated. Accomplishing the simultaneous and coincident impact of the seed and the mass of substance for each seed on a seed-by-seed basis requires spray and atomization technology that also did not exist at the time of filing.

301. Further, the extent of experimentation required is significantly beyond the time additive and multiplicative effects of the range of seed

characteristics, the range of prescriptive dose (amount) of seed-applied substance to be applied and the range of characteristics of potential seed-applied substance mixtures. Establishing confidence and predictability in the experimental results requires not merely the conduct of a single experiment with one combination of seed, seed orientation, dose of substance and type of substance but rather the replication of each experiment for the requisite number of times to establish the statistical confidence interval and confidence in the results. These requisite numbers of replications are influenced by the inherent variability in the test parameters, for example required to design a field-worthy system, the variability in seed size in a single lot of seeds. These numbers of replications depend on the desired level of confidence in the results and can range from dozens to hundreds of individual replications of an experiment for a single combination of seed, dose and type of seed-applied substance. Overlaying this level of experimentation is the necessity to conduct the replicated experiments over a range of field operating conditions with vibration ,temperature, soil condition, planter adjustments and all other operating conditions expected in the harsh agricultural field environment.

302. As a result, the ‘027 patent lacks the necessary disclosure of the features to enable a person skilled in the art to practice the full scope of the claimed prescriptive seed treatment method which “individually apply[ies] ... the selected type of the seed-applied substance to each seed as it is being delivered to the soil,”

without undue experimentation. Therefore, claims 1-19 lack enablement.

VIII. CONCLUSION

303. For the reasons provided above, it is my opinion that the identified claims of the '027 Patent are anticipated by Wagers and/or obvious over Wagers in view of Mitchell. In addition, it is my opinion that: claim 8 is obvious over Wagers in view of Wilkerson and/or over Wagers and Mitchell in view of Wilkerson. It is my further opinion that claims 9 and 10 are obvious over Wagers and Batcheller and/or over Wagers and Mitchell in view of Batcheller. It is also my opinion that claim 17 is obvious over Wagers in view of Memory and/or Wagers and Mitchell in view of Memory. Finally, it is my opinion that claims 18 and 19 are obvious over Wagers in view of Garner and/or over Wagers and Mitchell in view of Garner. I also have reached the opinion that the claims of the '027 patent lack enablement. Should further information become available to me as this matter proceeds, I may revise my opinions.

304. I recognize this Declaration may be used as evidence in the above-captioned proceeding. I accordingly agree to appear for cross-examination within the scope of this Declaration at a convenient time and place within the United States, should the same be requested.

I hereby declare under penalty of perjury that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true, and further that these statements were made with 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.



Durham Kenimer Giles, Ph.D.

30 June 2025

Dated

APPENDIX A

Durham Kenimer (Ken) Giles
Professor Emeritus
Biological and Agricultural Engineering
University of California, Davis
Fellow, American Society of Biological & Agricultural Engineers
Fellow, National Academy of Inventors

Education

B.S. (Magna Cum Laude) Agricultural Engineering, University of Georgia, 1979.
M.S. Agricultural Engineering, University of Georgia, 1983.
Ph.D. Ag. Engineering, Minor in Mechanical Engineering, Clemson University, 1987.

Academic Career

1979-1983 Research Engineer, Particulate Engineering Lab., Driftmier Engineering Center.
1983-1987 Research Assistant, Agricultural Engineering Department, Clemson University.
1987-2019 Assistant Professor, Associate Professor and Professor, Biological & Agricultural Engineering Department, Univ. of Calif., Davis.
2013-2019 Vice Chair, Biological & Agricultural Engineering Department, Univ. of Calif., Davis.
2019 – Professor Emeritus, Biological & Agricultural Engineering Department, Univ. of Calif., Davis.

Selected Awards

1996 Outstanding Paper Award, American Society of Agricultural Engineers.
1997 Engineer of the Year, CA/NV Society of Agricultural Engineers
1997 AE-50 Award for Outstanding Product Design, American Society of Agricultural Engineers.
1998 Outstanding Paper Award, American Society of Agricultural Engineers.
1999 Engineering Concept of the Year Award, American Society of Agricultural Engineers.
2003 Outstanding Paper Award, American Society of Agricultural & Biological Engineers.
2004 Outstanding Paper Award, American Society of Agricultural & Biological Engineers.
2004 AE-50 Award for Outstanding Product Design, American Society of Agricultural & Biological Engineers.
2005 Outstanding Paper Award, American Society of Agricultural & Biological Engineers.
2007 Outstanding Paper Award, American Society of Agricultural & Biological Engineers.
2008 AE-50 Award for Outstanding Product Design, American Society of Agricultural & Biological Engineers.
2012 AE-50 Award for Outstanding Product Design, American Society of Agricultural & Biological Engineers.
2013 Elected to Fellow in American Society of Biological and Agricultural Engineers.
2015 Jerome Case Gold Medal Award for Exceptional and Meritorious Engineering Achievement - American Society of Agricultural & Biological Engineers.
2017 Alumni of Distinction Award – University of Georgia Graduate School.
2018 Elected to Fellow in National Academy of Inventors.

Editorships

Division Editor (emeritus) for *Transactions of the American Society of Agricultural Engineers* and *Applied Engineering in Agriculture* (ASABE).

Associate Editor (emeritus) for *Transactions of the American Society of Agricultural Engineers* and *Applied Engineering in Agriculture* (ASABE).

Board of Directors (emeritus) – *Institute for Liquid Atomization and Spraying Systems*.

Editorial Board (emeritus) for *Atomization & Sprays*.

Research Proposal Review Panel Manager - United State Department of Agriculture, Small Business Innovation Program (multiple years).

Teaching (University of California, Davis) 1987 - 2021

EBS 200 Research Methods in Biological & Agricultural Engineering

ABT 233 Advanced Pest Control Methods – Spray Application of Agrochemicals

EBS 170A Engineering Design and Professional Responsibilities

EBS 170B Engineering Design: Design

EBS 170BL Engineering Design: Design Lab

EBS 170C Engineering Design: Evaluation

EBS 170CL Engineering Design: Evaluation Lab

(The EBS 170 A, B, BL, C and CL course series comprises the Capstone (Senior) Design Experience for the UC Davis Biological Systems Engineering undergraduate engineering program.)

Teaching (Tokyo University of Agriculture & Technology) 2014-present

Technical Writing and Ethics in Engineering and Science. Guest Professor.

Professional Practice

Consulting to industry, commerce, non-profit organizations and government in the areas of:

Litigation support and testimony – product liability

Litigation support and testimony – intellectual property

Research & development – products

Research & development – processes

Education – product use and market introduction

Regulatory affairs – regulation of agrochemical application

Related Certifications

United States Federal Aviation Administration Licenses:

Single Engine Land Airplane: Private Pilot, Instrument Pilot and Commercial Pilot Rated with High Performance & Complex Airplane Endorsements.

Unmanned Aerial Systems, Remote Pilot.

California Department of Pesticide Regulation Licenses:

Agricultural Pesticide Applicator Pilot (JPC - Journeyman): Manned and Unmanned Aircraft

Qualified Pesticide Applicator License (QAL): Ground-based Applicator / Supervisor

Selected Refereed Publications

- Giles, D.K. 2024. Remotely-piloted aircraft for field crop and orchard insecticide application: review of California studies. *Aspects of Applied Biology* 148: 1-3.
- Giles, D.K. 2022. Dynamic flow control for agricultural chemical application. *Aspects of Applied Biology* 147.
- Li, X., Giles, D.K., Andaloro, J.T., Long, R., Lang, E.B., Watson, L.J., Qandah, I. 2021. Comparison of UAV and fixed-wing aerial application for alfalfa insect pest control: evaluating efficacy, residues, and spray quality. *Pest Management Science*. 77(11):4980-4992.
- Li, X., Giles, D.K., Neiderholzer, F.J., Andaloro, J.T., Lang, E.B., Watson, L.J. 2020. Evaluation of an unmanned aerial vehicle as a new method of pesticide application for almond crop production. *Pest Management Science*. 3 August 2020. DOI 10.1002/ps.6052
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- Giles, D.K. 2019. Remotely-piloted aircraft for agricultural spraying: Multiple season results in commercial scale applications. STP1619 on 39th Symposium on Pesticide Formulation and Delivery Systems: Innovative Formulation, Application and Adjuvant Technologies for Agriculture. American Society for Testing and Materials. 1-8.
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Depositions and Testimony 2021-2025 (Client Underlined)

Depositions:

State of California, et al. v. Alpine Helicopter Service, Inc. & Joel Dozhier, et al. STK-CV-UCC-2020-0009229 (Consolidated with STK-CV-UEJ-2016-4746; STK-CV-UBT-2020-7717). Superior Court of California, County of San Joaquin. 2021.

Calyxt, Inc. v. Morris Ag Air & Sons, Inc., et al. CV-20-01221-PHX-DLR. U.S. District Court, District of Arizona. 2023.

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Coordination Proceeding Special Title (Rule 3.550) Paraquat Cases. JCCP No. 5031 MS 5031. Superior Court of California, County of Contra Costa. 2023. (Client: Syngenta Crop Protection, LLC.)

Wirtgen America, Inc. v. Caterpillar, Inc. C.A. No. 1:17-cv-00770-JDW. U.S. District Court, District of Delaware. 2023.

Brenda Behm, Christopher Behm, Cottonwood Ranch, LLC v. Lance Schade, George Schade, George Shade Trust, L&K Farms, Inc, Schade Farms, Inc. 1:22-CV-01013-MAM. U.S. District Court, District of South Dakota, Northern Division. 2024.

Trial Testimony:

State of California, et al. v. Alpine Helicopter Service, Inc. & Joel Dozhier, et al. STK-CV-UCC-2020-0009229 (Consolidated with STK-CV-UEJ-2016-4746; STK-CV-UBT-2020-7717). Superior Court of California, County of San Joaquin. 2021.

State of California, et al. v. Alpine Helicopter Service, Inc. & Joel Dozhier, et al. STK-CV-UCC-2020-0009229 (Consolidated with STK-CV-UEJ-2016-4746; STK-CV-UBT-2020-7717) / Penalty Phase. Superior Court of California, County of San Joaquin. 2022.

Brenda Behm, Christopher Behm, Cottonwood Ranch, LLC v. Lance Schade, George Schade, George Shade Trust, L&K Farms, Inc, Schade Farms, Inc. 1:22-CV-01013-MAM. U.S. District Court, District of South Dakota, Northern Division. 2024.

APPENDIX B

EXHIBIT LIST

Exhibit No.	Description
1001	U.S. Patent No. 12,102,027 to Smith et al., entitled “System and Method for Prescriptive Seed Treatment,” filed June 23, 2015
1002	Selected Excerpts of the File History of the ’027 Patent
1003	Declaration of Durham K. Giles, Ph.D.
1004	Wagers et al., “Multi-Seed Planter Control System and Method for the Same,” US2014/0277959, published on September 18, 2014 (“Wagers”)
1005	Mitchell, “Antismut Grain and Soil Treating Process and Apparatus,” U.S. Patent No. 1,409,564, issued on March 14, 1922
1006	Wilkerson et al., “Systems and Methods for Fluid Dispensing,” US2004/0231575, published on November 25, 2004 (“Wilkerson”)
1007	Batcheller et al., “Method and System for Optimizing Planting Operations,” US2014/0379228, published on December 25, 2014 (“Batcheller”)
1008	Memory et al., “Method and Apparatus for Coating Seeds,” U.S. Patent No. 6,155,185, issued on December 5, 2000 (“Memory”)
1009	Garner et al., “Seeding Machine with Seed Delivery System,” U.S. Patent No. 8,850,995, issued on October 7, 2014 (“Garner”)
1010	Bender et al., “Multiple-Type Seed Dispensing System,” U.S. Patent No. 5,915,313, issued on June 29, 1999 (“Bender”)
1011	Garner et al., “Planting Unit for a Seeding Machine Having Blocking Member to Control Hand-Off of Seed From a Seed Meter to a Seed Delivery System,” U.S. Patent No. 8,671,856, issued on March 18, 2014 (“Garner ‘856”)
1012	Thacker, “Vegetable Seed Planter,” U.S. Patent App. Pub. No. 2016/0174458, published on June 23, 2016 (“Thacker”)

1013	Wendte, “Method and Apparatus for an Agricultural Implement Seed Meter,” U.S. Patent No. 7,854,066, issued on December 21, 2010 (“Wendte ‘066”)
1014	Sauder et al., “Apparatus and Method for Controlled Delivery of Seeds to an Open Furrow,” U.S. Patent No. 6,681,706, issued on January 27, 2004 (“Sauder ‘706”)
1015	Celik, “Effects of Various Planters on Emergence and Seed Distribution Uniformity of Sunflower,” Applied Engineering in Agriculture (2007) (“Celik”)
1016	Liu et al., “Seed Sensory System and Method for Improved Seed Count and Seed Spacing,” U.S. Patent App. Pub. No. 2010/0116974, published on May 13, 2010 (“Liu”)
1017	Sauder et al., “Seed Tube Egress-Mounted Seed Sensor,” U.S. Patent No. 8,631,749, issued on January 21, 2014 (“Sauder ‘749”)
1018	Knake, “Apparatus for Spray-Treating Seeds During Planting,” U.S. Patent No. 4,356,934, issued on November 2, 1982 (“Knake”)
1019	Hancock, John H., “Design and Evaluation of a Seed-Specific Applicator for In-Furrow Chemical Application,” University of Tennessee, 2003 (“Hancock”)
1020	Grimm et al., “System and Method for Spraying Seeds Dispensed From a Planter,” U.S. Patent No. 9,226,442, issued on January 5, 2016 (“Grimm”)
1021	Downey et al., “Pulsed-Jet Microspray Applications for High Spatial Resolution of Deposition on Biological Targets,” Atomization and Sprays, Vol. 14, pp. 93-109 (2004) (“Downey”)
1022	Cloeter et al., “Planar Laser Induced Fluorescence (PLIF) Flow Visualization applied to Agricultural Spray Nozzles with Sheet Disintegration; Influence of an Oil-in-Water Emulsion,” ILASS-Americas 22nd Annual Conference on Liquid Atomization and Spray Systems, Cincinnati, OH (2010) (“Cloeter”)

1023	Nielsen, “Don’t Let the Planter Hold Back Your Corn Yields,” Purdue University, published January 4, 1996 (“Nielsen”)
1024	Kocher et al., “Corn Seed Spacing Uniformity as Affected by Seed Tube Condition,” Biological Systems Engineering: Papers and Publications (2011) (“Kocher”)
1025	Selected Excerpts of the File History of Eur. Patent App. No. 3967120, filed on June 23, 2015
1026	“John Deere Debuts New Planting Technology & Electric Excavator During CES 2023 Keynote,” John Deere, published on January 5, 2023
1027	Garner et al., “Seeding Machine for Planting Multiple Seed Varieties and Prescription for Multiple Varieties Seeding Machine,” U.S. Patent No. 8,942,894, issued on January 27, 2015 (“Garner ‘894”)
1028	Wendte et al., “Multiple Seed-Type Planter with On-Row Selector Assembly,” U.S. Patent No. 9,648,802, issued on May 16, 2017 (“Wendte ‘802”)
1029	Giles, D. Ken et al., “Liquid Property and Nozzle Effects on Flight Time of Pulsed Jet Spray.” <i>Atomization and Sprays</i> , vol. 14, no. 2 (2004) (“Giles”)
1030	Declaration of Sylvia D. Hall-Ellis, PhD

APPENDIX C

US 12,102,027	Wagers (claims 1-4, 6, 7, 11, 13-16)
<u>Claim 1.</u> A prescriptive seed treatment method comprising the steps of:	[0008] "...the present subject matter can provide a solution to this problem, such as by a method of automatic planting of two or more seed types with a planter. The method monitors a <i>planter location</i> on a <i>prescription map</i> of a field, <i>selects a seed type based on the monitored planter location on the prescription map, and then dynamically changes one or more of the planter characteristics based on at least the selected seed type.</i> ... Dynamic changing of the planter characteristics ensures that each of a variety of seed types are handled and planted according to the characteristics of the seed (and optionally other characteristics of the field or prescription map). <i>Some of the planter characteristics that are dynamically changed during operation of the planter include, but are not limited to, vacuum level, population rate, coulter down pressure, agricultural product selection and application rate or the like.</i>" [0053] "In another example one or more of the row units, for instance each of the row units 114 includes its own position sensor Such as a GPS position sensor. The <i>planter location 104 is monitored on a prescription map</i>, such as the prescription map 300 shown in FIG.3 of an agricultural field. The <i>planter 104 includes one or more remotely adjustable planting characteristics</i>, for instance the characteristics shown and described herein including, but not limited to, <i>seed selection, vacuum level, coulter down-pressure, population rate, agricultural product type and rate and the like.</i>" [0063] "For instance as the <i>planter location</i> is updated with the <i>planter</i> moving through a field and from Zone to Zone the multi-seed control system 400 shown in FIG. 4 <i>continuously updates the position of the planter 104 and accordingly adjusts the dynamic characteristics of one or more of the row units 114 within corresponding Zones based on the selected seed type and other characteristics associated with the particular Zone.</i>"

providing:

- a planter,
- a seed drop tube,
- a substance receptacle,
- a substance applicator,
- a seed, and
- a seed-applied substance;

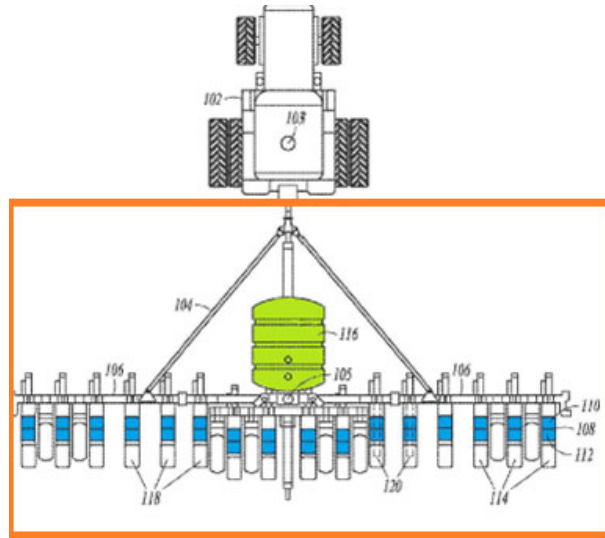


FIG. 1

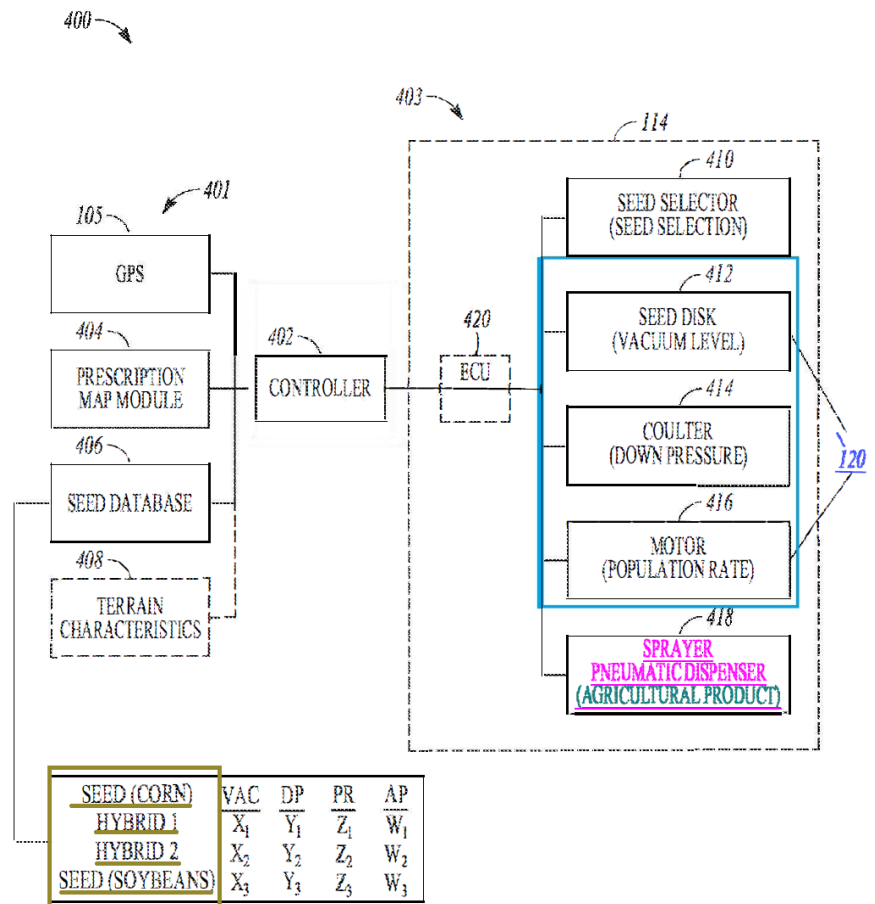


FIG. 4

[0026] “Referring again to FIG. 1, the multi-seed planter 104 as shown includes a plurality of features configured to plant

differing varieties of a seed or differing seeds. For instance the multi-seed planter 104 includes a seed hopper 108.”

[0028] “In another example, the multi-seed planter 104 includes one or more agricultural product reservoirs 116, 118. For instance, in one example a liquid fertilizer or herbicide is provided in the agricultural product reservoir 116. In one example the agricultural product reservoir 116 is distributed throughout the row units 114 for instance to corresponding spray units associated with each of the one or more row units 114 or associated with two or more row units 114.”

[0028] “As will be described herein the multi-seed planter 104, for instance a control system associated with the multi-seed planter 104 is configured to *select one of a plurality of seed types for instance provided within the seed hopper 108 and accordingly dispense the seed from one or more of the row units 114* according to the position of the multi-seed planter 104 within an agricultural field, for instance an agricultural field with indexed zones having prescriptions for particular seed types and planter characteristics.”

[0029] “Referring now to FIG. 2 another example of a multi-seed planter 200 is provided. ... In one example, *each of the first and second sets of row units 202, 204 includes separate components for each of the respective row units (e.g., coulters, seed metering systems including seed wheels, seed hoppers and the like).*”

[0033] “In one example, the seed type prescribed in each of the Zones 302 correspondingly determines one or more planter characteristics of the multi-hybrid planter 104 including for instance one or more remotely adjustable planting characteristics of one or more of the row units 114 previously shown in FIG. 1 including, but not limited to, population rate of the selected seed type, planter vacuum level for a seed disk, row unit down-pressure of one or more of the row unit coulters, and the selection of one or more agricultural products and the rate of application of the one or more agricultural products.”

[0036] “In one example, the controller 402 provides instructions to each of the features of the row unit 114 for instance including the features of the seed metering system 120 as well as other features such as the coulter (corresponding to a coulter down pressure) and one or more agricultural product dispensers such as a sprayer or a pneumatic dispenser 418.”

[0040] “In one example a seed selector 410 is operated to accordingly feed the selected seed to the seed metering system 120 (e.g., including the seed disk driven by a motor such as a hydraulic motor, the vacuum fan). The seed disk 412 accordingly adjusts its vacuum level according to the seed type selected based on instructions from the controller 402. The vacuum level is adjusted in one example to reliably hold each of the seeds along the seed disk (e.g., based on the respective size, shape, and weight of the seed) *for planting according to a population rate for instance a population rate determined by a rotational speed provided by the motor 416*. In another example the population rate controlled by the motor 416 is also determined by the controller 402 by way of the prescription provided in the seed database 406. In still another example, the *controller 402 controls a down-pressure of the coulter 414 according to the seed type being planted*. The coulter pressure is in one example adjusted upwardly or downwardly to provide a desired depth for planting of the selected seed.”

[0050] Referring now to FIG. 5E one example of an agricultural product dispenser 418 Such as one or more of a sprayer or pneumatic system for respective liquid or granular fertilizer, herbicide, insecticide or the like is provided.

[0088] “controlling the population rate of the one or more seed metering systems includes *individually controlling the population rate of the one or more seed metering systems* of the corresponding row units”

[0089] “dynamically changing one or more remotely adjustable planting characteristics includes *controlling a planter vacuum level and corresponding retention force of*

the selected seed type along respective seed disks of the one or more seed metering systems”

[0090] “dynamically changing one or more remotely adjustable planting characteristics includes *controlling a row unit down pressure of one or more row unit coulters* based on the selected seed type and the *planter location*”

[0116] “wherein the prescription map module includes a *seed type prescription map having a plurality of indexed locations distributed over the seed type prescription map, each of the indexed locations corresponding to one seed type of two or more seed types*”

One of ordinary skill in the art would understand that multi-seed planters, liked those disclosed in Wagers, that include seed metering systems and depth-setting coulters for placing seeds at prescribed distances and soil depth, would necessarily have seed drop tubes below the seed metering wheels for placing the seeds at the rate set by the metering wheel in the furrow set by the coulters. Seed drop tubes are a well understood and necessary component ubiquitous in all such multi-seed planters and have been used in planters since the advent of mechanized agriculture over a century ago (see, e.g., Mitchell – U.S. Patent No. 1,409,564 – issued March 14, 1922). The planting precision disclosed in Wagers, as excerpted above, requires the use of seed drop tubes, which are a necessary component of the multi-seed planters disclosed therein.

calculating a location within a field where the seed will be delivered to the soil by the planter

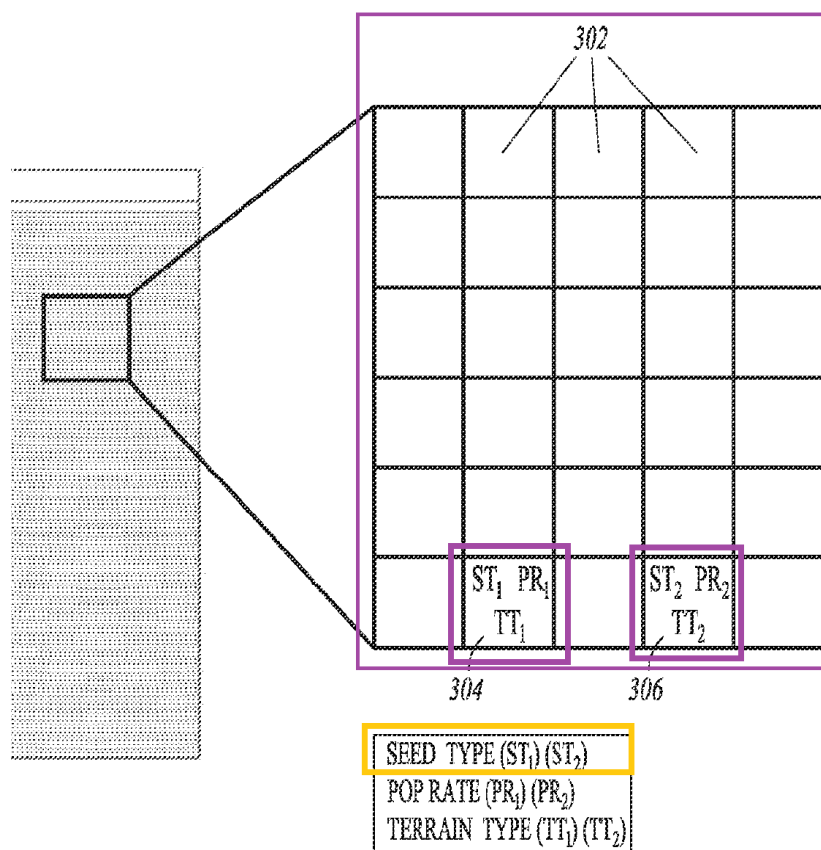


FIG. 3

[0032] As further shown in FIG. 3, the first and second Zones 304,306 are provided as demonstrative examples. As previously described the plurality of Zones 302 include prescriptions for seed selection for each of the respective Zones 302. Additionally in other examples the Zones 302 (as shown with the demonstrative first and second Zones 304, 306) include additional prescription characteristics to further enhance the characteristics of the planter to optimally plant a seed (e.g., with one or more agricultural products, at a particular planting depth, according to an optimal population rate and the like). For instance as shown in FIG. 3 the first and second Zones 304,306 include a plurality of characteristics determined by one or more of the seed type, the terrain type or the like for the prescription map 300. For instance in the first Zone 304 the seeds type, population rate and terrain type is specified. For instance as shown in FIG. 3 the first Zone 304 has a seed type (ST), a

specified population rate (PR) and a specified terrain type (TT). In one example, each of these characteristics are specified for the particular Zone 304 according to the optimum seed type for that Zone as well as the terrain characteristics and the desired population rate (with one or more of the characteristics optionally chosen or weighted according to the seed type selected). In a similar manner the second Zone 306 has its own respective characteristics for instance seed type, population rate and terrain type (ST, PR and TT). Each of the Zones 302, for instance of the entire prescription map 300, are mapped with one or more characteristics corresponding to at least seed type and optionally one or more other characteristics, such as terrain type or population rate. Each of these one or more indexed values are used by the control system to select a seed type and dynamically adjust one or more planter characteristics to provide optimal planting of the selected seed type.

[0039] “In one example the location of the planter 104 for instance determined with the GPS antenna 105 cooperates with the prescription map module 404 to accordingly determine a seed type to be dispensed by one or more of the row units 114. As further shown in FIG. 4 in one example *the seed type selected by way of cooperation between the GPS antenna 105 and the prescription map module 404* corresponds to a seed type contained within the seed database 406.”

[0041] “The multi-seed control system 400 is thereby able to optimally plant a plurality of seed types for instance one or more hybrids within the same field according to information indexed to the Zones 302 of the prescription map 300. The prescription map 300 provides indicates the seed type to be planted in each of one or more Zones and accordingly the seed type (optionally in combination with one or more characteristics) is used to adjust one or more of the planting characteristics of one or more of the row units 114 to achieve optimal planting of each of the seed types.”

[0053] “At 602, the method 600 includes *monitoring a planter location* for instance the location of the planter 104 (and optionally each or one or more of the row units 114) by

way of one or more GPS antennas 105. In one example as shown in FIG. 1 a GPS antenna 105 is associated with a central portion of the planter 104. In another example one or more of the row units, for instance each of the row units 114 includes its own position sensor such as a GPS position sensor. The planter location 104 is monitored on a prescription map, such as the prescription map 300 shown in FIG.3 of an agricultural field.

selecting, based at least in part on a condition, a combination of the seed and the seed-applied substance by selecting a type of seed-applied substance and

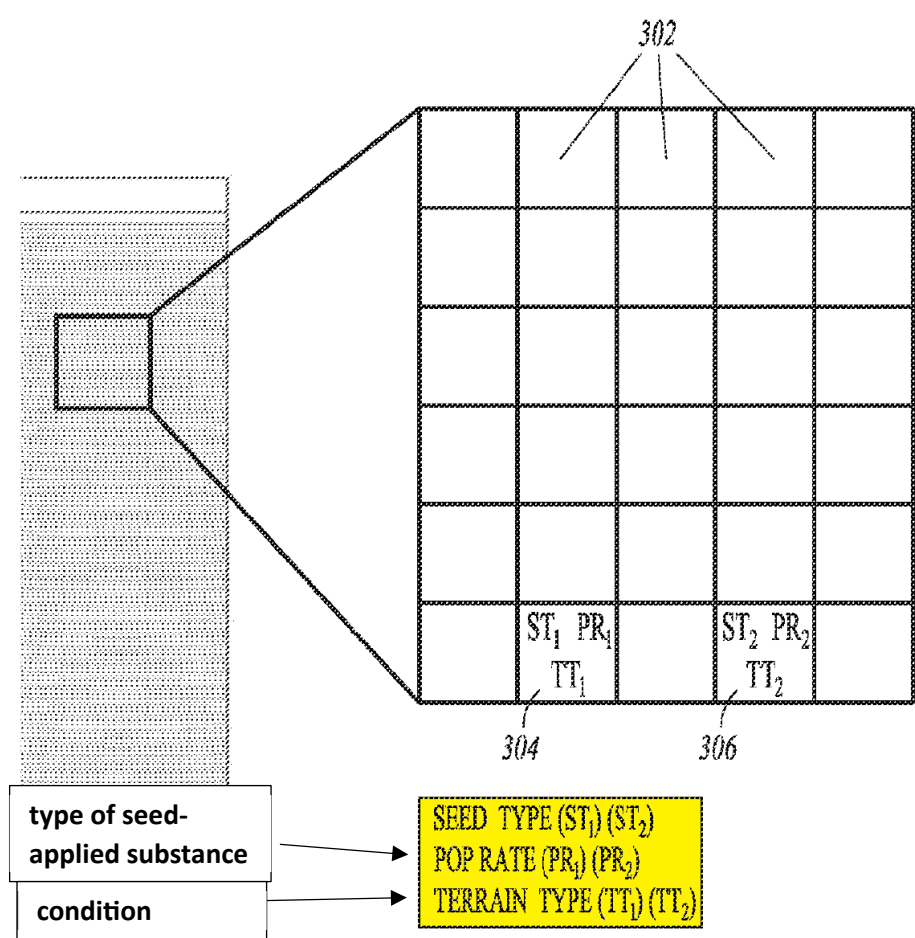


FIG. 3

[0008] “The method monitors a planter location on a prescription map of a field, selects a seed type based on the monitored planter location on the prescription map, and then dynamically changes one or more of the planter characteristics based on at least the selected seed type.”

[0028] “a control system associated with the multi-seed planter 104 is configured to select one of a plurality of seed

types for instance provided within the seed hopper 108 and accordingly dispense the seed from one or more of the row units 114 according to the position of the multi-seed planter 104 within an agricultural field, for instance *an agricultural field with indexed zones having prescriptions for particular seed types and planter characteristics*”

[0028] “The agricultural product reservoirs 118 are configured to provide the agricultural product contemporaneously with dispensing and planting of seeds.”

[0032] As further shown in FIG. 3, the first and second Zones 304,306 are provided as demonstrative examples. As previously described the plurality of Zones 302 include prescriptions for seed selection for each of the respective Zones 302. Additionally *in other examples the Zones 302 (as shown with the demonstrative first and second Zones 304, 306) include additional prescription characteristics to further enhance the characteristics of the planter to optimally plant a seed (e.g., with one or more agricultural products, at a particular planting depth, according to an optimal population rate and the like)*. For instance as shown in FIG. 3 the first and second Zones 304,306 include a plurality of characteristics determined by one or more of the seed type, the terrain type or the like for the prescription map 300. For instance in the first Zone 304 the seeds type, population rate and terrain type is specified. For instance as shown *in FIG. 3 the first Zone 304 has a seed type (ST), a specified population rate (PR) and a specified terrain type (TT)*.

[0033] “the seed type prescribed in each of the Zones 302 correspondingly determines one or more *planter characteristics* of the multi-hybrid planter 104 including for instance ... the *selection of one or more agricultural products and the rate of application of the one or more agricultural products*”

[0040] “provide *a desired type and amount of the respective agricultural product based on the seed selected and optionally one or more of the terrain characteristics* for instance provided by the terrain characteristic module 408

	<u><i>corresponding to one or more sensors or terrain characteristics associated with the plurality of Zones</i></u> (e.g., the Zones 302) in the prescription map 300.” [0062] “dynamically changing one or more of the remotely adjustable <u><i>planting characteristics</i></u> further includes <u><i>selecting an agricultural product (e.g., one or more of a liquid or granular product) for application according to the monitored planter location 104 on the prescription map</i></u>” [0067] “In one example the terrain characteristics 408 are determined with one or more sensors provided on the planter 200 or optionally provided with a leading vehicle 102. The terrain characteristics 408 include but are not limited to the <u><i>moisture content of the soil, accelerometer data corresponding to the roughness of the terrain, the grade of the terrain or the like.</i></u>”
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calculating a desired application amount of the selected type of the seed-applied substance to be applied to and carried by the seed to the soil

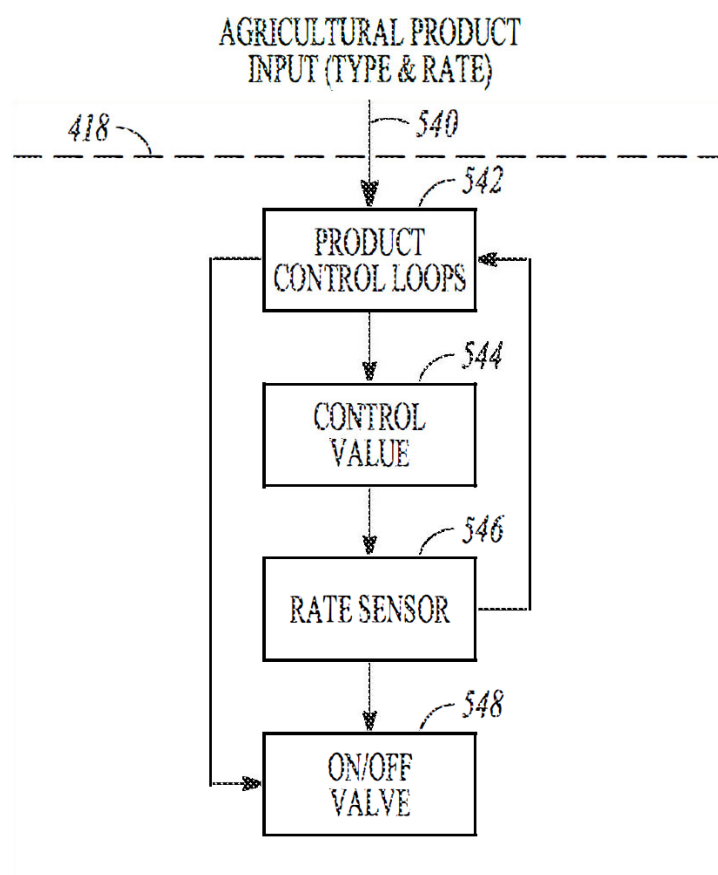


FIG. 5E

[0028] “The agricultural product reservoirs 118 are configured to **provide the agricultural product contemporaneously with dispensing and planting of seeds.**”

[0033] “the seed type prescribed in each of the Zones 302 correspondingly determines one or more planter characteristics of the multi-hybrid planter 104 including for instance ... the **selection of one or more agricultural products and the rate of application of the one or more agricultural products**”

[0040] “In a similar manner one or more of the sprayer or pneumatic dispenser 418 for liquid and granular agricultural products 418 are **adjusted to provide a desired type and amount of the respective agricultural product based on the seed selected and optionally one or more of the terrain**

characteristics for instance provided by the terrain characteristic module”

[0050] “In one example a rate sensor 546 is provided on the output side of the control valve 544 to accordingly measure the opening of the control valve 544 and the actual dispensation rate (e.g., as a flow meter) from the agricultural product dispenser 418. The output from the rate sensor 546 is communicated to the valve controller 542 to achieve a desired target rate and type of agricultural product dispensation by feedback control.”

[0051] “in one example the control valve 544 is used to apply a particular rate of an agricultural product with the respective row unit 114”

generating the combination of the seed and the selected type of the seed-applied substance at least in part by individually applying the desired application amount of the selected type of the seed-applied substance to each seed as it is being delivered to the soil and

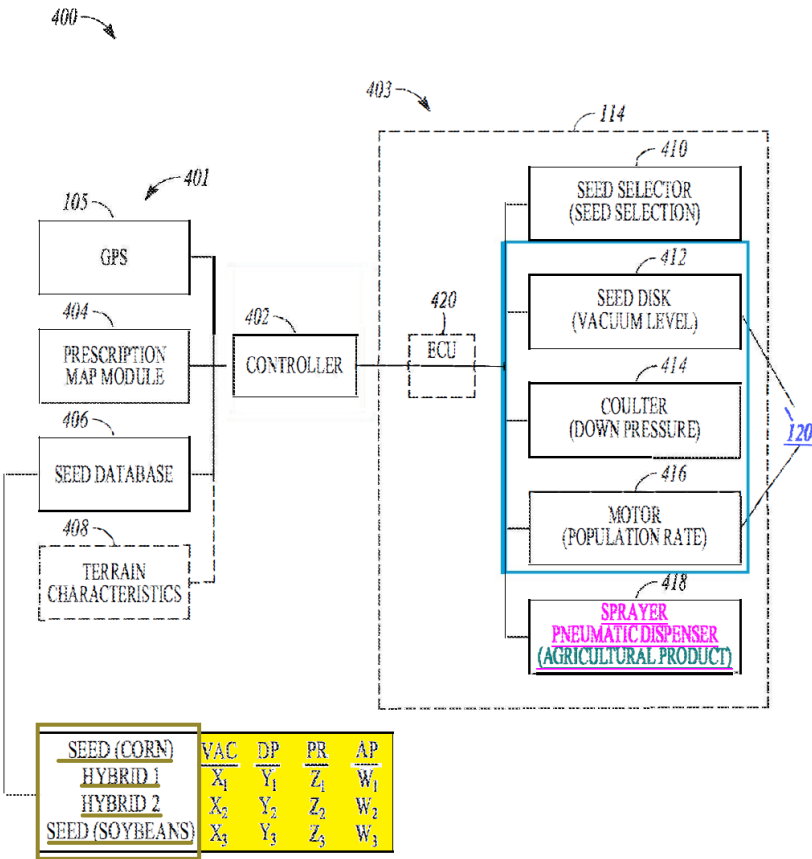


FIG. 4

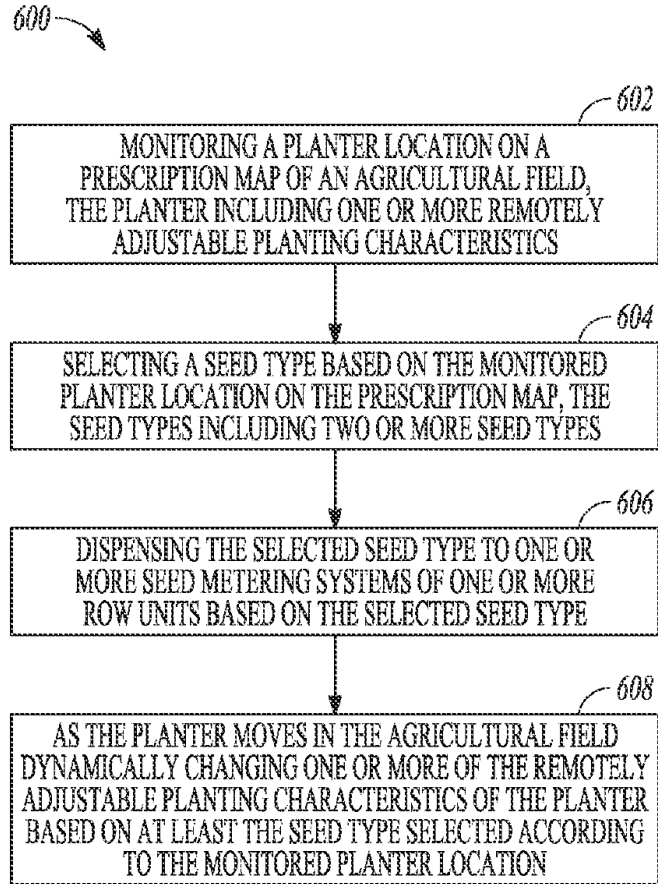


FIG. 6

[0028] “The agricultural product reservoirs 118 are configured to provide the agricultural product contemporaneously with dispensing and planting of seeds.”

[0040] “In one example a seed selector 410 is operated to accordingly feed the selected seed to the seed metering system 120 (e.g., including the seed disk driven by a motor such as a hydraulic motor, the vacuum fan). The seed disk 412 accordingly adjusts its vacuum level according to the seed type selected based on instructions from the controller 402. The vacuum level is adjusted in one example to reliably hold each of the seeds along the seed disk (e.g., based on the respective size, shape, and weight of the seed) for planting according to a population rate for instance a population rate determined by a rotational speed provided by the motor 416. In another example the population rate controlled by the motor 416 is also determined by the controller 402 by way of

the prescription provided in the seed database 406. In still another example, the controller 402 controls a down-pressure of the coulter 414 according to the seed type being planted. The coulter pressure is in one example adjusted upwardly or downwardly to provide a desired depth for planting of the selected seed. In a similar manner one or more of the for liquid and granular agricultural products are adjusted to provide a desired type and amount of the respective agricultural product based on the seed selected and optionally one or more of the terrain characteristics for instance provided by the terrain characteristic module...”

[0051] “in one example the control valve 544 is used to apply a particular rate of an agricultural product with the respective row unit 114”

[0060] In another example dynamically changing one or more remotely adjustable planting characteristics includes controlling a planter vacuum level for instance of the seed disk 412. Accordingly the retention force of the selected seed type provided by the controller 402 is adjusted for one or more of the seed metering systems 120 associated with respective row units 114 for instance as shown in FIG. 4. In one example specified vacuum levels are associated with each of one or more hybrids or each of a differing seed types and the controller 402 changes the vacuum level for instance of one or more of the seed disks 412 is based on the selected seed type.

[0061] In another example dynamically changing one of the remotely adjustable planting characteristics includes controlling a row unit down-pressure of one or more of the row unit coulters 414. In one example the row unit down-pressure is adjusted based on the selected seed type (to accordingly provide a desired planting depth) and the planter location on the prescription map 404 for instance determined with the GPS antenna 105 (or antennas associated with one or more of the row units 114).

As excerpted above, Wagers discloses the metering of individual seeds and applying an agricultural product or substance contemporaneously with the dispensing of the seed.

One of ordinary skill in the art would understand this to necessarily disclose application of the substance to the individual seed just prior to placement in the ground.

delivering the combination of the seed and the selected type of the seed-applied substance to the soil at the calculated location within the field for planting

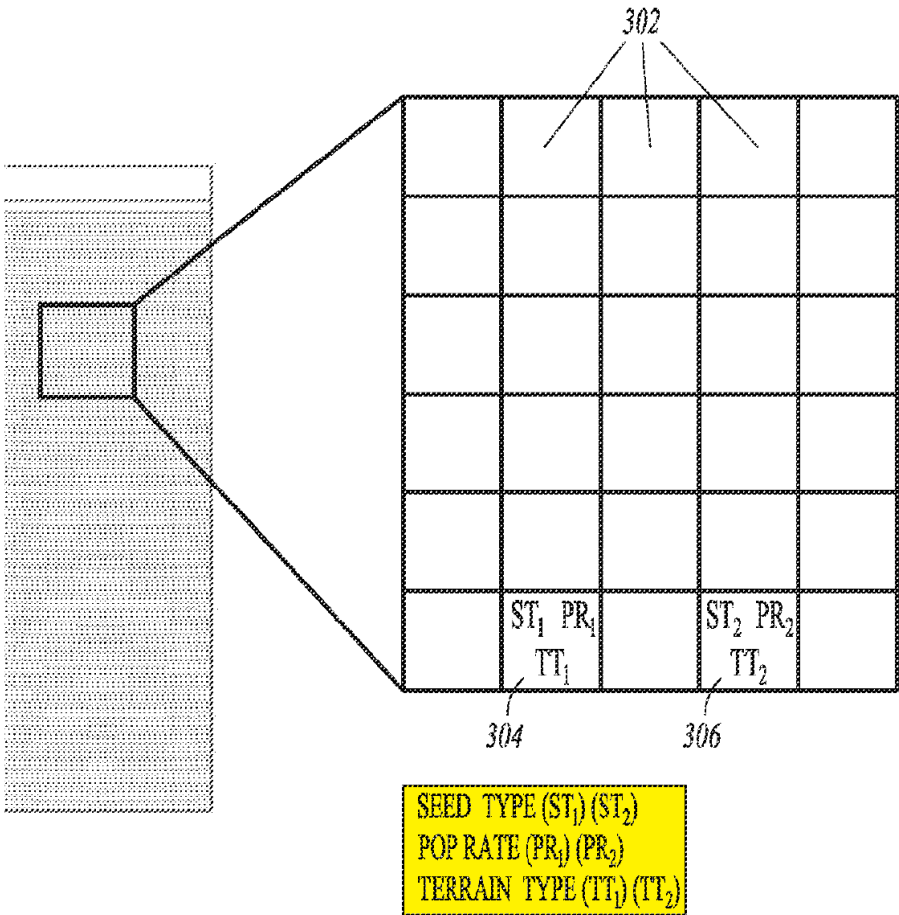


FIG. 3

[0028] “The agricultural product reservoirs 118 are configured to ***provide the agricultural product contemporaneously with dispensing and planting of seeds***”

[0033] “***the seed type prescribed in each of the Zones 302*** correspondingly determines one or more ***planter*** characteristics of the multi-hybrid ***planter 104*** including for instance ... the ***selection of one or more agricultural products and the rate of application of the one or more agricultural products***”

[0041] Accordingly with multi-seed control system 400 provided in FIG. 4 ***one or more of the characteristics of the***

	<i>planter</i> for instance a plurality of remotely adjustable planting characteristics are adjusted for one or more of the row units 114 <i>according to the seed type selected and optionally according to one or more other characteristics, for instance terrain characteristics and the like.</i> The multi-seed control system 400 is thereby able to optimally plant a plurality of seed types for instance one or more hybrids within the same field according to information indexed to the Zones 302 of the prescription map 303. <u>The prescription map 300 provides indicates the seed type to be planted in each of one or more Zones</u> and accordingly the seed type (optionally in combination with one or more characteristics) is used to adjust one or more of the planting characteristics of one or more of the row units 114
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wherein the type of the seed-applied substance, and the desired application amount of the selected type of the seed-applied substance can vary as the planter changes locations within the field.

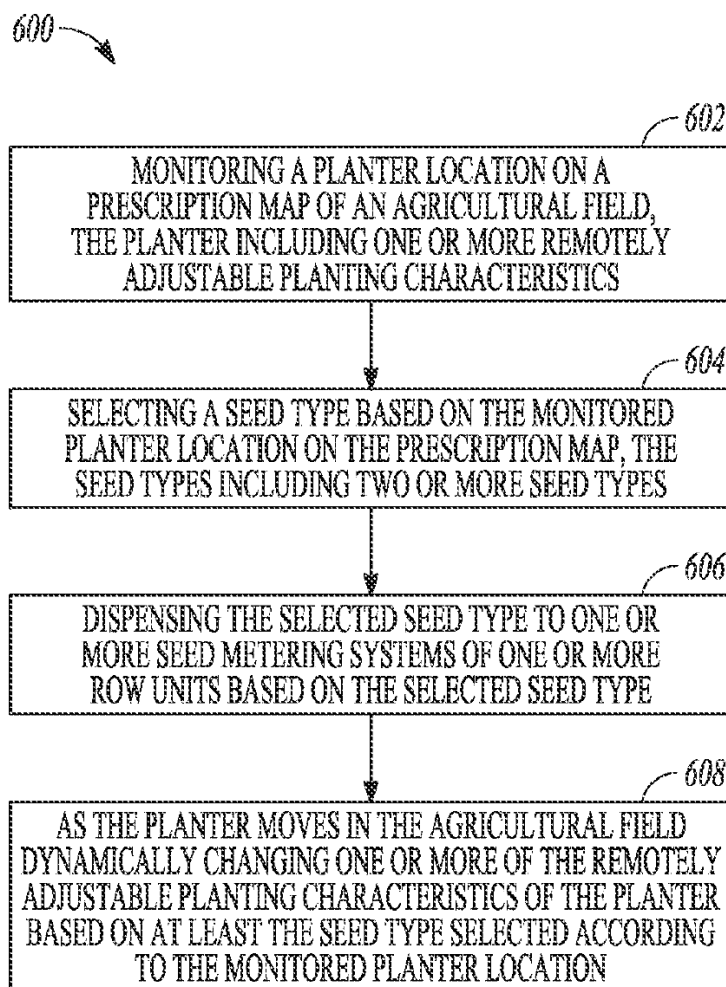


FIG. 6

[0040] “In a similar manner one or more of the *sprayer or pneumatic dispenser 418* for liquid and granular agricultural products 418 are adjusted to provide a desired type and amount of the respective agricultural product based on the seed selected and optionally one or more of the terrain characteristics [408] for instance provided by the terrain characteristic module”

[0062] “dynamically changing one or more of the remotely adjustable planting characteristics further includes selecting an agricultural product (e.g., one or more of a liquid or granular product) for application according to the monitored planter location 104 on the prescription map”

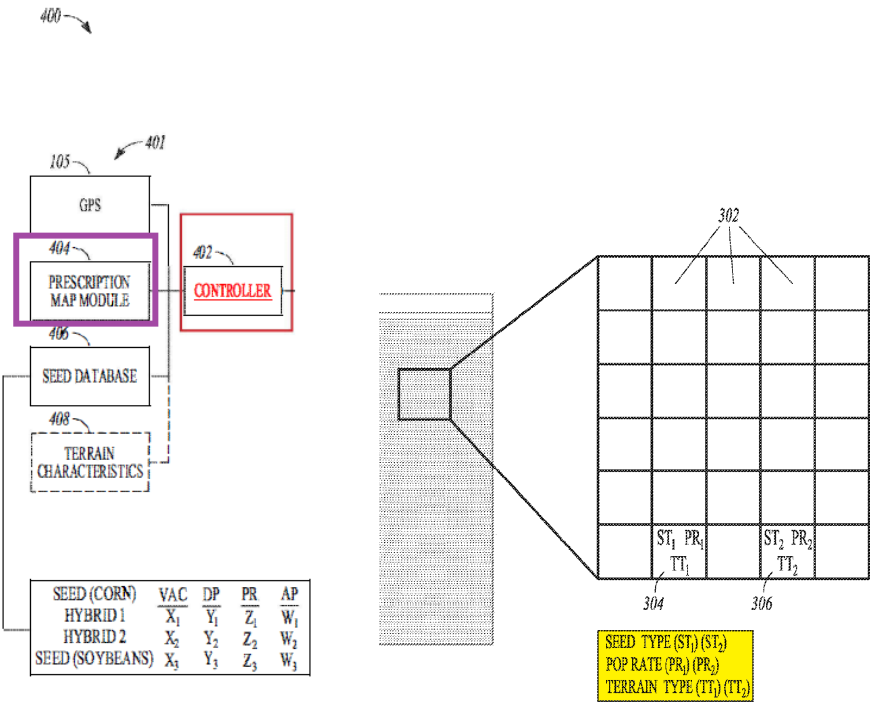
<u>Claim 2.</u> The method of claim 1 wherein the step of selecting, based at least in part on the condition, the combination of seed and seed-applied substance further comprises selecting a seed type.	[0008] “The method monitors a planter location on a prescription map of a field, <i>selects a seed type based on the monitored planter location on the prescription map</i>, and then dynamically <i>changes one or more of the planter characteristics based on at least the selected seed type.</i>” [0028] “a control system associated with the multi-seed planter 104 is configured to select one of a plurality of seed types for instance provided within the seed hopper 108 and accordingly dispense the seed from one or more of the row units 114 according to the position of the multi-seed planter 104 within an agricultural field, for instance an agricultural field with indexed zones <i>having prescriptions for particular seed types and planter characteristics</i>” [0039] “The controller 402 accordingly <i>sends instructions to one or more of the row units 114 corresponding to the seed type selected for the particular Zone</i> of the field including one or more row units 114. [0040] the controller 402 based on the seed type selected and the according prescription for each of the seeds adjusts one or more characteristics of the one or more row units 114. In one example a seed selector 410 is operated to accordingly feed the selected seed to the seed metering system 120 (e.g., including the seed disk driven by a motor such as a hydraulic motor, the vacuum fan).”
<u>Claim 3.</u> The method of claim 1 wherein the combination of seed and the selected type of the seed-applied substance varies based at least in part on one of the following: a type of the seed, the type of the seed-applied substance, and an application rate of the seed-applied substance.	[0008] “The method monitors a <i>planter location</i> on a prescription map of a field, <i>selects a seed type based on the monitored planter location on the prescription map</i>, and then dynamically <i>changes one or more of the planter characteristics based on at least the selected seed type.</i>” [0033] “In one example, the seed type prescribed in each of the Zones 302 correspondingly determines one or more <i>planter</i> characteristics of the multi-hybrid <i>planter 104</i> including for instance <i>one or more remotely adjustable planting characteristics of one or more of the row units 114 previously shown in FIG. 1</i> including, but not limited to, population rate of the selected seed type, <i>planter</i> vacuum level for a seed disk, row unit down-pressure of one or more of the row unit <i>coulters</i>, and <i>the selection of one or more</i>

agricultural products and the rate of application of the one or more agricultural products.”

[0037] “In a similar example, characteristics regarding another type of seed, such as Soybeans are also provided. In one example *the seed database 406 accordingly associates one or more planter characteristics such as* seed disk vacuum level, *coulter* down-pressure, population rate (corresponding to operation of hydraulic motor configured to rotate the seed disk) and *agricultural product dispensation with each of the types of seeds.”*

[0040] “In a similar manner one or more of the *sprayer or pneumatic dispenser 418* for liquid and granular agricultural products 418 are *adjusted to provide a desired type and amount of the respective agricultural product based on the seed selected and optionally one or more of the terrain characteristics* for instance provided by the terrain characteristic module”

Claim 4. The method of claim 1 wherein a **controller** can be used to calculate the **location** where the seed will be delivered to the soil, select, based at least in part on the condition, the combination of seed and seed-applied substance to plant at the **location**, generate the combination of the seed and the selected type of the seed-applied substance, or plant the combination of seed and the selected type of the seed-applied substance.



[0032] As further shown in FIG. 3, the first and second Zones 304,306 are provided as demonstrative examples. As

previously described the plurality of Zones 302 include prescriptions for seed selection for each of the respective Zones 302. Additionally *in other examples the Zones 302 (as shown with the demonstrative first and second Zones 304, 306) include additional prescription characteristics to further enhance the characteristics of the planter to optimally plant a seed (e.g., with one or more agricultural products, at a particular planting depth, according to an optimal population rate and the like)*. For instance as shown in FIG. 3 the first and second Zones 304,306 include a plurality of characteristics determined by one or more of the seed type, the terrain type or the like for the prescription map 300. For instance in the first Zone 304 the seeds type, population rate and terrain type is specified. For instance as shown *in FIG. 3 the first Zone 304 has a seed type (ST), a specified population rate (PR) and a specified terrain type (TT)*.

[0036] “In one example, the *controller 402* provides instructions to each of the features of the row unit 114 for instance including the features of the *seed metering system 120* as well as other features such as the *coulter* (corresponding to a *coulter* down pressure) and one or more agricultural product dispensers such as a *sprayer* or a *pneumatic dispenser 418*.”

[0039] “As will be described herein the *controller 402* receives the inputs 401. In one example the *location of the planter 104 for instance determined with the GPS antenna 105 cooperates with the prescription map module 404 to accordingly determine a seed type to be dispensed by one or more of the row units 114*. As further shown in FIG. 4 in one example *the seed type selected by way of cooperation between the GPS antenna 105 and the prescription map module 404* corresponds to a seed type contained within the seed database 406.”

[0039] “The *controller 402* accordingly sends instructions to one or more of the row units 114 *corresponding to the seed type selected for the particular Zone of the field* including one or more row units 114.”

	[0040] “the <u>controller 402</u> based on the seed type selected and the according prescription for each of the seeds <i>adjusts one or more characteristics of the one or more row units 114. In one example a seed selector 410 is operated to accordingly feed the selected seed to the <u>seed metering system 120</u></i> (e.g., including the seed disk driven by a motor such as a hydraulic motor, the vacuum fan). The <i>seed disk 412 accordingly adjusts its vacuum level according to the seed type selected based on instructions from the <u>controller 402</u>.</i> The vacuum level is adjusted in one example to reliably hold each of the seeds along the seed disk (e.g., based on the respective size, shape, and weight of the seed) for planting according to a population rate for instance a population rate determined by a rotational speed provided by the motor 416. In another example <i>the population rate controlled by the motor 416 is also determined by the <u>controller 402</u></i> by way of the prescription provided in the seed database 406. In still another example, <i>the <u>controller 402</u> controls a down-pressure of the <u>coulter 414</u></i> according to the seed type being planted. The <u>coulter</u> pressure is in one example adjusted upwardly or downwardly to provide a desired depth for planting of the selected seed. In a similar manner <i>one or more of the sprayer or pneumatic dispenser 418 for liquid and granular agricultural products 418 are adjusted to provide a desired type and amount of the respective agricultural product</i> based on the seed selected and optionally one or more of the terrain characteristics for instance provided by the terrain characteristic module 408 corresponding to one or more sensors or terrain characteristics associated with the plurality of Zones (e.g., the Zones 302) in the prescription map 300.”
<u>Claim 6.</u> The method of claim 1 wherein the <u>substance applicator</u> comprises a <u>nozzle</u> to spray the selected type of the seed-applied substance onto the seed as	[0028] “In one example the agricultural product reservoir 116 is distributed throughout the row units 114 for instance to corresponding <u>spray units</u> associated with each of the one or more row units 114 or associated with two or more row units 114.”

the seed is delivered to the soil.	[0028] “The agricultural product reservoirs 118 are configured to provide the agricultural product contemporaneously with dispensing and planting of seeds.” [0036] “In one example, the controller 402 provides instructions to each of the features of the row unit 114 for instance including the features of the seed metering system 120 as well as other features such as the coulter (corresponding to a coulter down pressure) and one or more <u>agricultural product dispensers such as a sprayer or a pneumatic dispenser 418.</u>” [0050] “Optionally, each of one or more <i>agricultural product dispensers</i> (at either of the reservoirs 116, 118 or at the dispensing devices such as <i>spouts, nozzles or sprayers</i>) includes an agricultural product control loop of the type or similar to that shown in FIG. 5E.” As excerpted above for claim 1, Wagers discloses the metering of individual seeds and applying an agricultural product or substance contemporaneously with the dispensing of the seed. One of ordinary skill in the art would understand this to necessarily disclose application of the substance to the individual seed just prior to placement in the ground, that is, “contemporaneously”.
<u>Claim 7.</u> The method of claim 1 wherein the step of generating the combination of the seed and the selected type of the seed-applied substance further comprises: providing a metering device; and metering an amount of the selected type of the seed-applied substance from the substance receptacle through a substance flow	[0050] “In one example a <i>rate sensor 546</i> is provided on the output side of the <u>control valve 544</u> to accordingly <i>measure the opening of the control valve 544 and the actual dispensation rate</i> (e.g., as a flow meter) from the agricultural product dispenser 418. The output from the rate sensor 546 is communicated <u>to the valve controller 542 to achieve a desired target rate and type of agricultural product dispensation by feedback control.</u>”

path to the substance applicator with the metering device.	
<u>Claim 11.</u> The method of claim 1 wherein the substance applicator is associated with at least one of: a. a mixer in fluid communication with the substance receptacle and a substance flow path; b. a seed hopper configured to receive the seed from a seed receptacle; c. a seed meter configured to receive the seed from the seed hopper and further transfer it through a seed flow path; and d. the seed drop tube.	[0028] “In one example the <i>agricultural product reservoir 116</i> is distributed throughout the row units 114 for instance to corresponding <i>spray units associated with each of the one or more row units 114</i> or associated with two or more row units 114.” [0028] “The <i>agricultural product reservoirs 118</i> are configured to provide the agricultural product <i>contemporaneously with dispensing</i> and planting of seeds” [0029] “As further shown in FIG. 2 the first and second sets of row units 202, 204 (each of the individual row units associated with the sets) is spaced apart according to a row unit set lateral offset 206 (lateral offset herein). In one example, <i>each of the first and second sets of row units 202, 204 includes separate components for each of the respective row units (e.g., coulters, seed metering systems including seed wheels, seed hoppers and the like).</i>” [0036] “For instance, the <u>seed metering system 120</u> of the exemplary row unit 114 includes in one example one or more of a seed disk 412 and a motor, such as a hydraulic motor associated with the seed disk 412. In one example, the controller 402 provides instructions to <i>each of the features of the row unit 114 for instance including</i> the features of the <u>seed metering system 120</u> as well as other features such as the <u>coulter</u> (corresponding to a <u>coulter</u> down pressure) and <i>one or more agricultural product dispensers such as a sprayer or a pneumatic dispenser 418</i>. In one example the controller 402 communicates with the row unit 114 by way of an electronic control unit 420 associated with the individual row unit. The optional electronic control unit 420 receives control signals from the controller 402, interprets them and accordingly provides separate control signals (e.g., instructions) to each of the components.”
<u>Claim 13.</u> The method of claim 1 wherein the	[0051] “As further shown in FIG. 5E, in one example a shutoff valve 548 is associated with the agricultural product

desired application amount of the selected type of the seed-applied substance to be applied to the seed is either: always the same amount of seed-applied substance; or only either one specific amount of seed-applied substance or no amount of the seed-applied substance.	dispenser 418. In one example the valve controller 542 further operates the shutoff valve 548 to accordingly shut off the flow of one or more of liquid or granular agricultural product to the respective row unit 114. Accordingly in one example <i>the control valve 544 is used to apply a particular rate of an agricultural product with the respective row unit 114 while the shutoff valve 548 is used to toggle between application or an interruption of application of the agricultural product at the rate provided by the control valve 544.</i> One of ordinary skill in the art would understand it was and is a common agricultural practice to apply an agricultural product at a fixed rate throughout a given field if the relevant conditions within the field are uniform or, alternatively to alternate between no application and a fixed application if, as an example, one variety of seed is planted on part of a field and another variety is planted in another part of the field. Thus, it would have been obvious to use the shutoff valve of Wagers to apply an agricultural product in such a manner.
<u>Claim 14.</u> The method of claim 1, wherein the type of the seed-applied substance and the desired application amount of the selected type of the seed-applied substance can vary as the planter changes location within the field by changing the type, number or amount of one or more of the seed-applied substances applied to the seed when generating the combination of the seed and the seed-applied substance.	[0040] “In a similar manner one or more of the sprayer or pneumatic dispenser 418 for liquid and granular agricultural products <i>418 are adjusted to provide a desired type and amount of the respective agricultural product based on</i> the seed selected and optionally <i>one or more of the terrain characteristics</i> [408] for instance provided by the terrain characteristic module” [0062] “dynamically changing one or more of the remotely adjustable planting characteristics further includes <i>selecting an agricultural product (e.g., one or more of a liquid or granular product) for application according to the monitored <u>planter location</u> 104 on the prescription map</i>”
<u>Claim 15.</u> The method of claim 1, wherein the	[0040] “In a similar manner one or more of the sprayer or pneumatic dispenser 418 for liquid and granular agricultural

combination of seed and the selected type of the seed-applied substance can vary based at least in part upon a seed-applied substance type, a number of seed-applied substances, or the desired application amount of one or more of the selected type of seed-applied substance.

products 418 *are adjusted to provide a desired type and amount of the respective agricultural product based on* the seed selected and optionally *one or more of the terrain characteristics* [408] for instance provided by the terrain characteristic module”

[0062] “dynamically changing one or more of the remotely adjustable planting characteristics further includes *selecting an agricultural product (e.g., one or more of a liquid or granular product) for application according to the monitored planter location 104 on the prescription map*”

Claim 16. The method of claim 1, wherein the combination of seed and the selected type of the seed-applied substance can vary based at least in part upon a seed type.

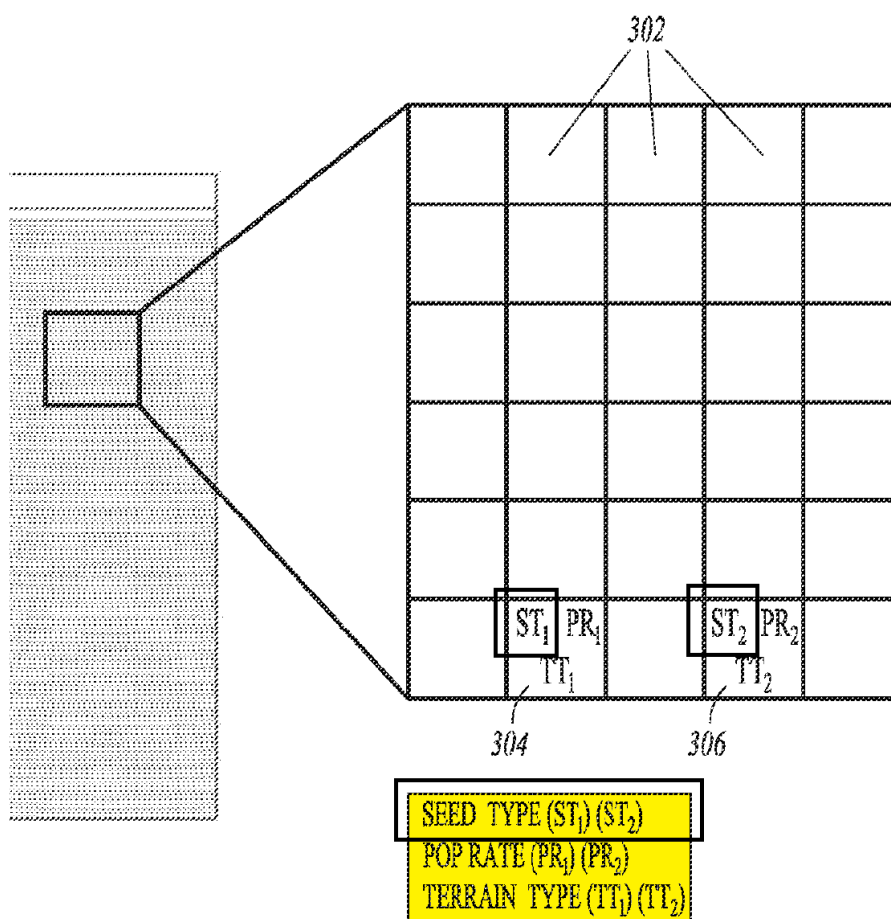


FIG. 3

[0008] “The method monitors a planter location on a prescription map of a field, *selects a seed type based on the monitored planter location on the prescription map, and*

	<i>then dynamically changes one or more of the <u>planter</u> characteristics based on at least the selected seed type. ...</i> Dynamic changing of the planter characteristics ensures that each of a variety of seed types are handled and planted according to the characteristics of the seed (and optionally other characteristics of the field or prescription map). <i>Some of the <u>planter</u> characteristics that are dynamically changed during operation of the <u>planter</u> include</i>, but are not limited to, vacuum level, population rate, <i><u>coulter</u></i> down pressure, <i>agricultural product selection and application rate</i> or the like.” [0037] “In one example the seed database 406 accordingly <i>associates one or more <u>planter</u> characteristics such as</i> seed disk vacuum level, <i><u>coulter</u></i> down-pressure, population rate (corresponding to operation of hydraulic motor configured to rotate the seed disk) and <i>agricultural product dispensation with each of the types of seeds.</i>” [0040] “In a similar manner one or more of the sprayer or pneumatic dispenser 418 for liquid and granular agricultural products 418 <i>are adjusted to provide a desired type and amount of the respective agricultural product based on the seed selected</i> and optionally one or more of the terrain characteristics for instance provided by the terrain characteristic module”
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US 12,102,027	Wagers + Mitchell (claims 1-7, 11-16)
<u>Claim 1.</u> A prescriptive seed treatment method comprising the steps of:	<u>Wagers:</u> [0008] "...the present subject matter can provide a solution to this problem, such as by a method of automatic planting of two or more seed types with a planter. The method monitors a <i>planter location</i> on a <i>prescription map</i> of a field, <i>selects a seed type based on the monitored planter location on the prescription map, and then dynamically changes one or more of the planter characteristics based on at least the selected seed type.</i> ... Dynamic changing of the planter characteristics ensures that each of a variety of seed types are handled and planted according to the characteristics of the seed (and optionally other characteristics of the field or prescription map). <i>Some of the planter characteristics that are dynamically changed during operation of the planter include, but are not limited to, vacuum level, population rate, coulter down pressure, agricultural product selection and application rate or the like.</i>" [0053] "In another example one or more of the row units, for instance each of the row units 114 includes its own position sensor Such as a GPS position sensor. The <i>planter location 104 is monitored on a prescription map</i>, such as the prescription map 300 shown in FIG.3 of an agricultural field. The <i>planter 104 includes one or more remotely adjustable planting characteristics</i>, for instance the characteristics shown and described herein including, but not limited to, <i>seed selection, vacuum level, coulter down-pressure, population rate, agricultural product type and rate and the like.</i>" [0063] "For instance as the <i>planter location</i> is updated with the <i>planter</i> moving through a field and from Zone to Zone the multi-seed control system 400 shown in FIG. 4 <i>continuously updates the position of the planter 104 and accordingly adjusts the dynamic characteristics of one or more of the row units 114 within corresponding Zones based on the selected seed type and other characteristics associated with the particular Zone.</i>"

providing:

- a planter,
- a seed drop tube,
- a substance receptacle,
- a substance applicator,
- a seed, and
- a seed-applied substance;

Wagers:

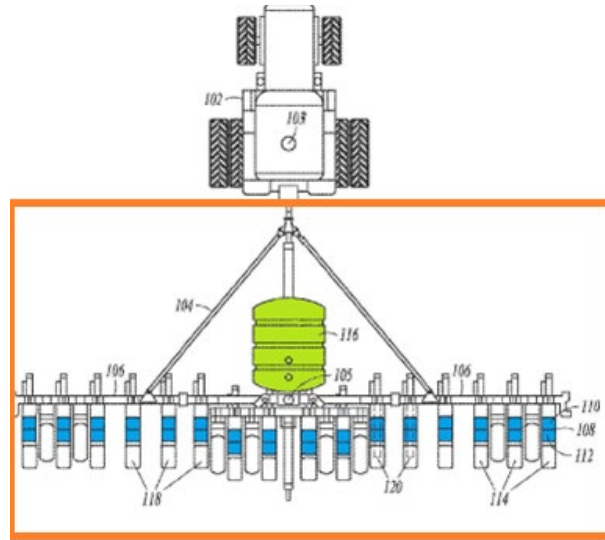


FIG. 1

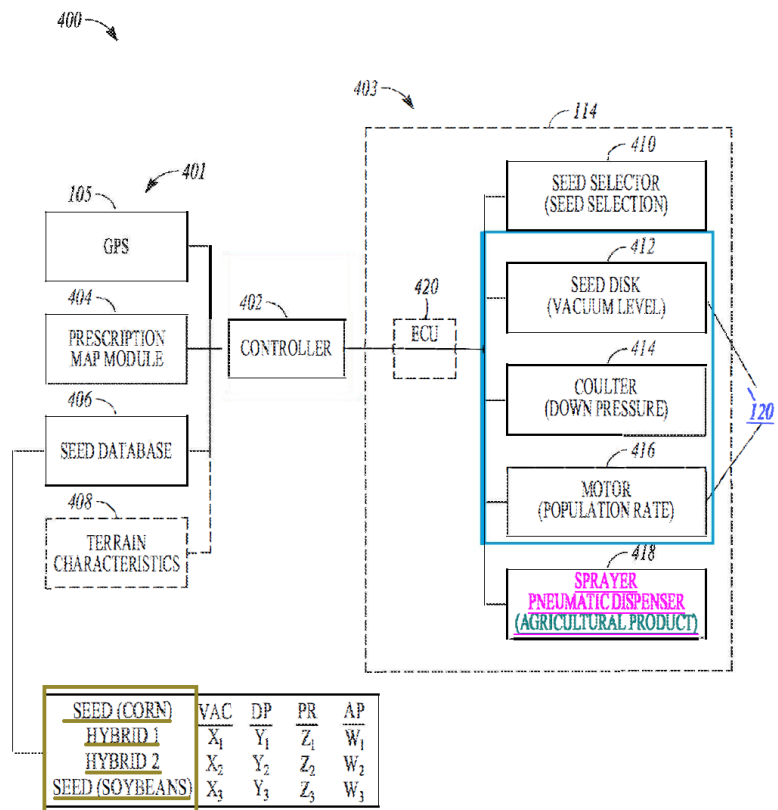


FIG. 4

[0026] “Referring again to FIG. 1, the multi-seed planter 104 as shown includes a plurality of features configured to plant

differing varieties of a seed or differing seeds. For instance the multi-seed planter 104 includes a seed hopper 108.”

[0028] “In another example, the multi-seed planter 104 includes one or more agricultural product reservoirs 116, 118. For instance, in one example a liquid fertilizer or herbicide is provided in the agricultural product reservoir 116. In one example the agricultural product reservoir 116 is distributed throughout the row units 114 for instance to corresponding spray units associated with each of the one or more row units 114 or associated with two or more row units 114.”

[0028] “As will be described herein the multi-seed planter 104, for instance a control system associated with the multi-seed planter 104 is configured to *select one of a plurality of seed types for instance provided within the seed hopper 108 and accordingly dispense the seed from one or more of the row units 114* according to the position of the multi-seed planter 104 within an agricultural field, for instance an agricultural field with indexed zones having prescriptions for particular seed types and planter characteristics.”

[0029] “Referring now to FIG. 2 another example of a multi-seed planter 200 is provided. ... In one example, *each of the first and second sets of row units 202, 204 includes separate components for each of the respective row units (e.g., coulters, seed metering systems including seed wheels, seed hoppers and the like).*”

[0033] “In one example, the seed type prescribed in each of the Zones 302 correspondingly determines one or more planter characteristics of the multi-hybrid planter 104 including for instance one or more remotely adjustable planting characteristics of one or more of the row units 114 previously shown in FIG. 1 including, but not limited to, population rate of the selected seed type, planter vacuum level for a seed disk, row unit down-pressure of one or more of the row unit coulters, and the selection of one or more agricultural products and the rate of application of the one or more agricultural products.”

[0036] “In one example, the controller 402 provides instructions to each of the features of the row unit 114 for instance including the features of the seed metering system 120 as well as other features such as the coulter (corresponding to a coulter down pressure) and one or more agricultural product dispensers such as a sprayer or a pneumatic dispenser 418.”

[0040] “In one example a seed selector 410 is operated to accordingly feed the selected seed to the seed metering system 120 (e.g., including the seed disk driven by a motor such as a hydraulic motor, the vacuum fan). The seed disk 412 accordingly adjusts its vacuum level according to the seed type selected based on instructions from the controller 402. The vacuum level is adjusted in one example to reliably hold each of the seeds along the seed disk (e.g., based on the respective size, shape, and weight of the seed) *for planting according to a population rate for instance a population rate determined by a rotational speed provided by the motor 416*. In another example the population rate controlled by the motor 416 is also determined by the controller 402 by way of the prescription provided in the seed database 406. In still another example, the *controller 402 controls a down-pressure of the coulter 414 according to the seed type being planted*. The coulter pressure is in one example adjusted upwardly or downwardly to provide a desired depth for planting of the selected seed.”

[0050] Referring now to FIG. 5E one example of an agricultural product dispenser 418 Such as one or more of a sprayer or pneumatic system for respective liquid or granular fertilizer, herbicide, insecticide or the like is provided.

[0088] “controlling the population rate of the one or more seed metering systems includes *individually controlling the population rate of the one or more seed metering systems* of the corresponding row units”

[0089] “dynamically changing one or more remotely adjustable planting characteristics includes *controlling a planter vacuum level and corresponding retention force of*

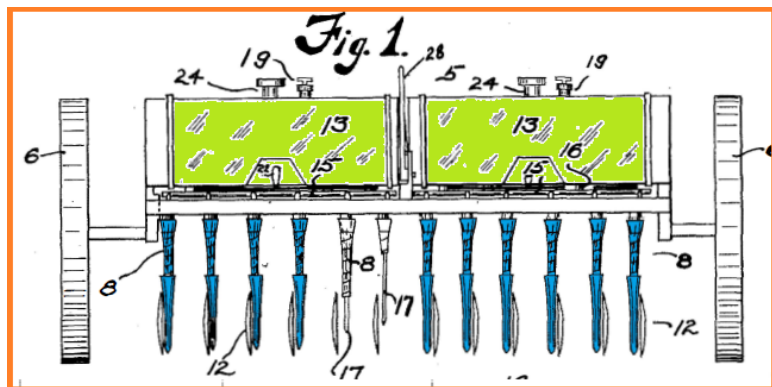
the selected seed type along respective seed disks of the one or more seed metering systems”

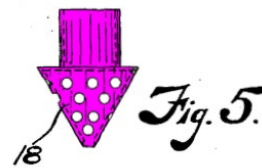
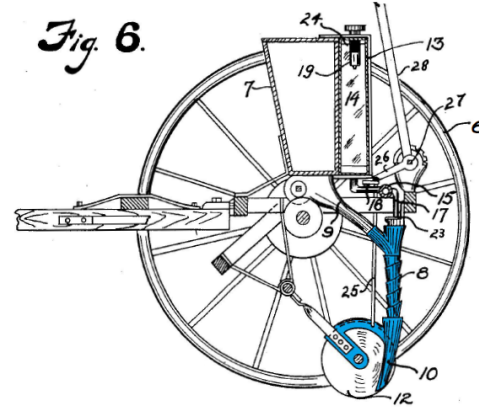
[0090] “dynamically changing one or more remotely adjustable planting characteristics includes *controlling a row unit down pressure of one or more row unit coulters* based on the selected seed type and the *planter location*”

[0116] “wherein the prescription map module includes a *seed type prescription map having a plurality of indexed locations distributed over the seed type prescription map, each of the indexed locations corresponding to one seed type of two or more seed types*”

One of ordinary skill in the art would understand that multi-seed planters, liked those disclosed in Wagers, that include seed metering systems and depth-setting coulters for placing seeds at prescribed distances and soil depth, would necessarily have seed drop tubes below the seed metering wheels for placing the seeds at the rate set by the metering wheel in the furrow set by the coulters. Seed drop tubes are a well understood and necessary component ubiquitous in all such multi-seed planters and have been used in planters since the advent of mechanized agriculture over a century ago (see, e.g., Mitchell – U.S. Patent No. 1,409,564 – issued March 14, 1922). The planting precision disclosed in Wagers, as excerpted above, requires the use of seed drop tubes, which are a necessary component of the multi-seed planters disclosed therein.

Mitchell:





Further, Mitchell discloses:

(Page 2, lines 8-19) “Let the numeral 5 designate an ordinary **grain drill** or **seeder**, considered in its entirety, the same being mounted on ground wheels, 6, and provided with a grain box, 7, and **hollow teeth**, 8, which are connected as shown at 9 with the box whereby the **seed grain** passes from the box into the **hollow teeth** and thence into the earth, the points 10 of the teeth coming in contact with the soil, discs 12 being employed for covering the **grain** as it is deposited. This is a **grain drill** or **seeder** of ordinary construction.”

(Page 2, lines 36-47) “Leading downwardly from the **conduit**, 15, is a number of **spouts**, 17, which pass through the **hollow teeth**, 8; of the **seeder** and are relatively small, whereby they do not interfere with the passage of the grain through the said teeth. The **lower extremity of each of these spouts is equipped with a spray nozzle**, 18, which is located just above the point 10 of the tooth, so that **the liquid as it issues from the nozzle is deposited upon the grain** and the soil or earth in which it is planted, simultaneously.”

(Page 2, lines 54-64) “Then, as the machine is driven across the field, **the grain** passes through the **hollow teeth** of the drill simultaneously with the **passage of the liquid** through the **spouts** 17 of my attachment, and consequently, **as the seed is**

	<i>about to enter the- earth at the lower extremities 10 of the hollow teeth, the liquid is applied to the grain and also to the earth, thus giving the seed and earth at the same time a treatment with the anti-smut liquid compound.”</i> (Page 2, lines 101-105) “The herein described seeding process, consisting in dropping <i>seed</i> and simultaneously <i>spraying the seed as it falls</i> and the soil into which it falls with an <i>anti-smut liquid</i>.” (Page 2, lines 121-124) “spraying means within the lower ends of said <i>hollow teeth</i> for <i>spraying the seed with said liquid as it is conducted to the earth by the teeth</i>” (Page 3, lines 3-6) “The method of treating seed while being planted, consisting in <i>spraying with a liquid fungicide, the seed while in transit from a source of supply to the ground.</i>” (Page 3, lines 11-12) “means for <i>spraying the seed while in motion</i> with a <i>liquid fungicide</i>” <u>Motivation to Combine:</u> It is well understood that seed drop tubes, which provide for the release of seed at or near the ground, thereby allow much greater precision in seed placement, which is one of the goals of Wagers. Seed drop tubes are ubiquitous features of in-row planters, including multi-row planters, seed drills, air seeders, and the like, for well over a century if not longer as reflected in Mitchell, which issued as a patent in 1922. Incorporating a seed drop tube like that of Mitchell in the multi-row planter disclosed in Wagers would have been straightforward. Indeed, given the widespread use of seed drop tubes, to the extent the planter disclosed in Wagers does not expressly or inherently include a seed drop tube, it would have been a standard bolt-on part widely available at the time.
calculating <i>a location within a field</i> where <i>the seed will be delivered</i> to the soil by the planter	<u>Wagers:</u>

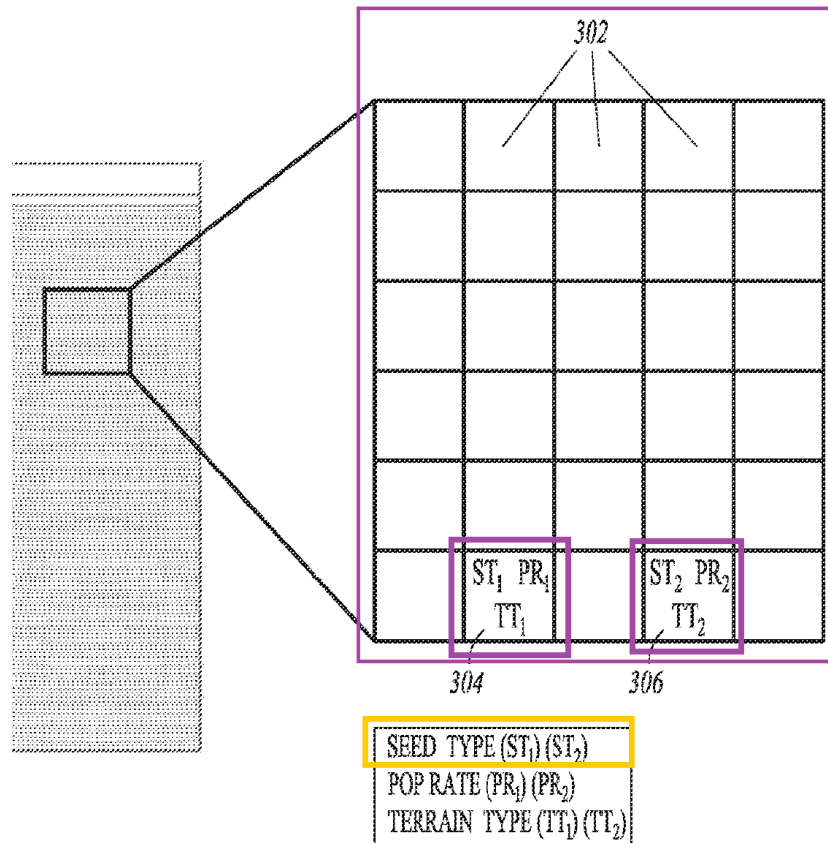


FIG. 3

[0032] As further shown in FIG. 3, the first and second Zones 304,306 are provided as demonstrative examples. As previously described the plurality of Zones 302 include prescriptions for seed selection for each of the respective Zones 302. Additionally in other examples the Zones 302 (as shown with the demonstrative first and second Zones 304, 306) include additional prescription characteristics to further enhance the characteristics of the planter to optimally plant a seed (e.g., with one or more agricultural products, at a particular planting depth, according to an optimal population rate and the like). For instance as shown in FIG. 3 the first and second Zones 304,306 include a plurality of characteristics determined by one or more of the seed type, the terrain type or the like for the prescription map 300. For instance in the first Zone 304 the seeds type, population rate and terrain type is specified. For instance as shown in FIG. 3 the first Zone 304 has a seed type (ST), a

specified population rate (PR) and a specified terrain type (TT). In one example, each of these characteristics are specified for the particular Zone 304 according to the optimum seed type for that Zone as well as the terrain characteristics and the desired population rate (with one or more of the characteristics optionally chosen or weighted according to the seed type selected). In a similar manner the second Zone 306 has its own respective characteristics for instance seed type, population rate and terrain type (ST, PR and TT). Each of the Zones 302, for instance of the entire prescription map 300, are mapped with one or more characteristics corresponding to at least seed type and optionally one or more other characteristics, such as terrain type or population rate. Each of these one or more indexed values are used by the control system to select a seed type and dynamically adjust one or more planter characteristics to provide optimal planting of the selected seed type

[0039] “In one example the location of the planter 104 for instance determined with the GPS antenna 105 cooperates with the prescription map module 404 *to accordingly determine a seed type to be dispensed* by one or more of the row units 114. As further shown in FIG. 4 in one example *the seed type selected by way of cooperation between the GPS antenna 105 and the prescription map module 404* corresponds to a seed type contained within the seed database 406.”

[0041] “The multi-seed control system 400 is thereby able to optimally plant a plurality of seed types for instance one or more hybrids within the same field according to information indexed to the Zones 302 of the prescription map 300. The prescription map 300 provides indicates the seed type to be planted in each of one or more Zones and accordingly the seed type (optionally in combination with one or more characteristics) is used to adjust one or more of the planting characteristics of one or more of the row units 114 to achieve optimal planting of each of the seed types.”

[0053] “At 602, the method 600 includes *monitoring a planter location* for instance the location of the planter 104 (and optionally each or one or more of the row units 114) *by*

way of one or more GPS antennas 105. In one example as shown in FIG. 1 a GPS antenna 105 is associated with a central portion of the planter 104. In another example one or more of the row units, for instance each of the row units 114 includes its own position sensor such as a GPS position sensor. The planter location 104 is monitored on a prescription map, such as the prescription map 300 shown in FIG.3 of an agricultural field.

selecting, based at least in part on a condition, a combination of the seed and the seed-applied substance by selecting a type of seed-applied substance and

Wagers:

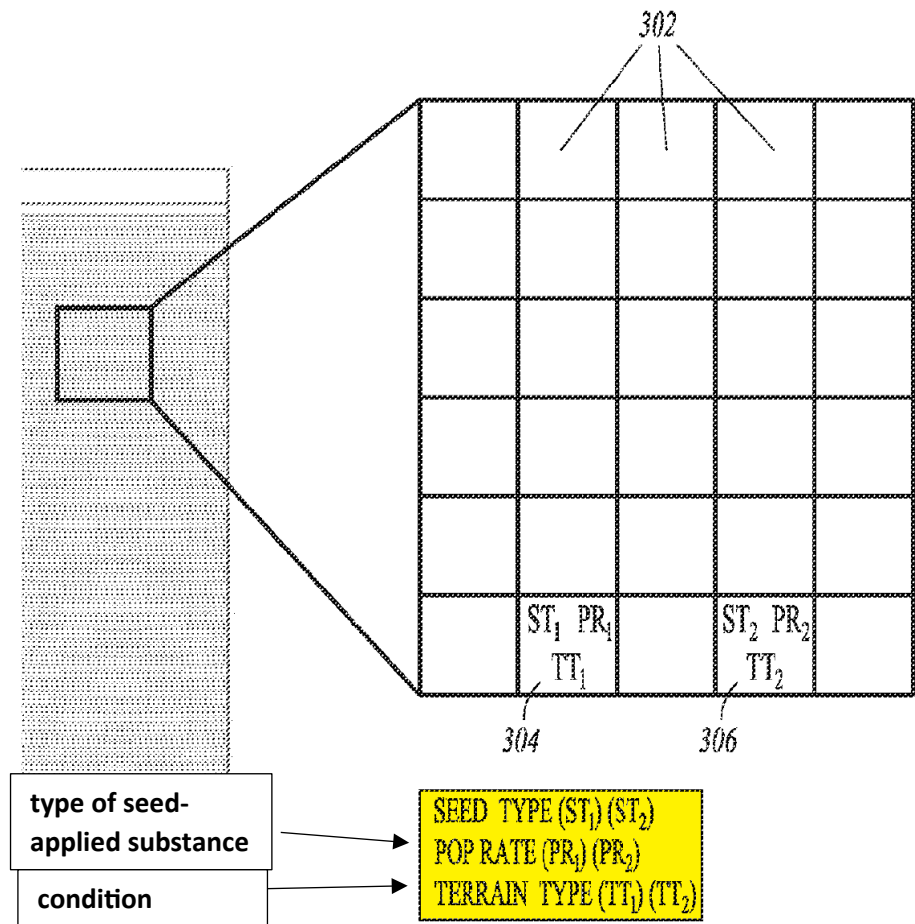


FIG. 3

[0008] “The method monitors a planter location on a prescription map of a field, selects a seed type based on the monitored planter location on the prescription map, and then dynamically changes one or more of the planter characteristics based on at least the selected seed type.”

[0028] “a control system associated with the multi-seed planter 104 is configured to select one of a plurality of seed types for instance provided within the seed hopper 108 and accordingly dispense the seed from one or more of the row units 114 according to the position of the multi-seed planter 104 within an agricultural field, for instance *an agricultural field with indexed zones having prescriptions for particular seed types and planter characteristics*”

[0028] “The agricultural product reservoirs 118 are configured to provide the agricultural product contemporaneously with dispensing and planting of seeds.”

[0032] As further shown in FIG. 3, the first and second Zones 304,306 are provided as demonstrative examples. As previously described the plurality of Zones 302 include prescriptions for seed selection for each of the respective Zones 302. Additionally *in other examples the Zones 302 (as shown with the demonstrative first and second Zones 304, 306) include additional prescription characteristics to further enhance the characteristics of the planter to optimally plant a seed (e.g., with one or more agricultural products, at a particular planting depth, according to an optimal population rate and the like)*. For instance as shown in FIG. 3 the first and second Zones 304,306 include a plurality of characteristics determined by one or more of the seed type, the terrain type or the like for the prescription map 300. For instance in the first Zone 304 the seeds type, population rate and terrain type is specified. For instance as shown *in FIG. 3 the first Zone 304 has a seed type (ST), a specified population rate (PR) and a specified terrain type (TT)*.

[0033] “the seed type prescribed in each of the Zones 302 correspondingly determines one or more *planter characteristics* of the multi-hybrid planter 104 including for instance ... the *selection of one or more agricultural products and the rate of application of the one or more agricultural products*”

[0040] “provide *a desired type and amount of the respective agricultural product based on the seed selected and*

	<i>optionally one or more of the <u>terrain characteristics</u> for instance provided by the terrain characteristic module 408 <u>corresponding to one or more sensors or terrain characteristics associated with the plurality of Zones</u> (e.g., the Zones 302) in the prescription map 300.”</i> [0062] “dynamically changing one or more of the remotely adjustable <u>planting characteristics</u> further includes <u>selecting an agricultural product (e.g., one or more of a liquid or granular product) for application according to the monitored planter location 104 on the prescription map</u>” [0067] “In one example the terrain characteristics 408 are determined with one or more sensors provided on the planter 200 or optionally provided with a leading vehicle 102. The terrain characteristics 408 include but are not limited to the <u>moisture content of the soil, accelerometer data corresponding to the roughness of the terrain, the grade of the terrain or the like.</u>”
calculating a desired application amount of the selected type of the seed-applied substance to be applied to and carried by the seed to the soil	<u>Wagers:</u>

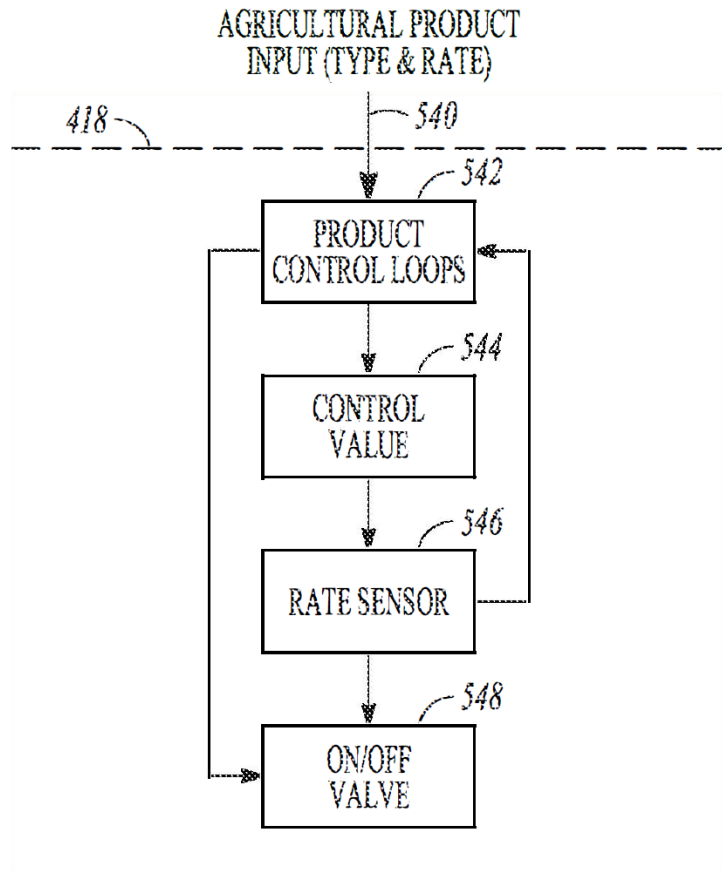


FIG. 5E

[0028] “The agricultural product reservoirs 118 are configured to **provide the agricultural product contemporaneously with dispensing and planting of seeds.**”

[0033] “the seed type prescribed in each of the Zones 302 correspondingly determines one or more planter characteristics of the multi-hybrid planter 104 including for instance ... the **selection of one or more agricultural products and the rate of application of the one or more agricultural products**”

[0040] “In a similar manner one or more of the sprayer or pneumatic dispenser 418 for liquid and granular agricultural products 418 are **adjusted to provide a desired type and amount of the respective agricultural product based on the seed selected and optionally one or more of the terrain**

characteristics for instance provided by the terrain characteristic module”

[0050] “In one example a rate sensor 546 is provided on the output side of the control valve 544 to accordingly measure the opening of the control valve 544 and the actual dispensation rate (e.g., as a flow meter) from the agricultural product dispenser 418. The output from the rate sensor 546 is communicated to the valve controller 542 to achieve a desired target rate and type of agricultural product dispensation by feedback control.”

[0051] “in one example the control valve 544 is used to apply a particular rate of an agricultural product with the respective row unit 114”

generating the combination of the seed and the selected type of the seed-applied substance at least in part by individually applying the desired application amount of the selected type of the seed-applied substance to each seed as it is being delivered to the soil and

Wagers:

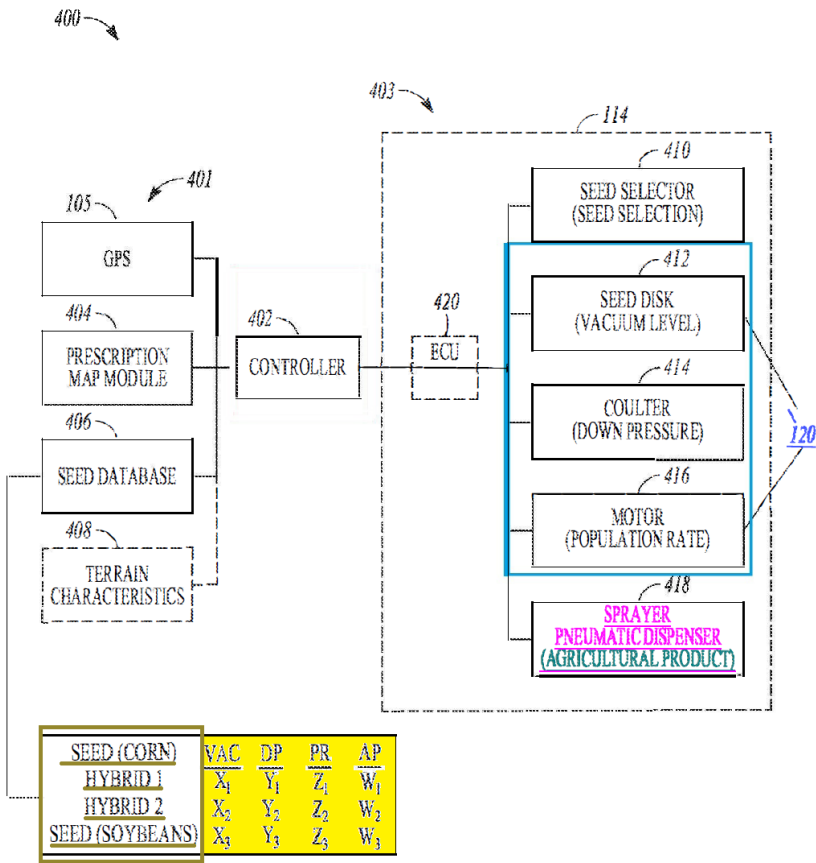


FIG. 4

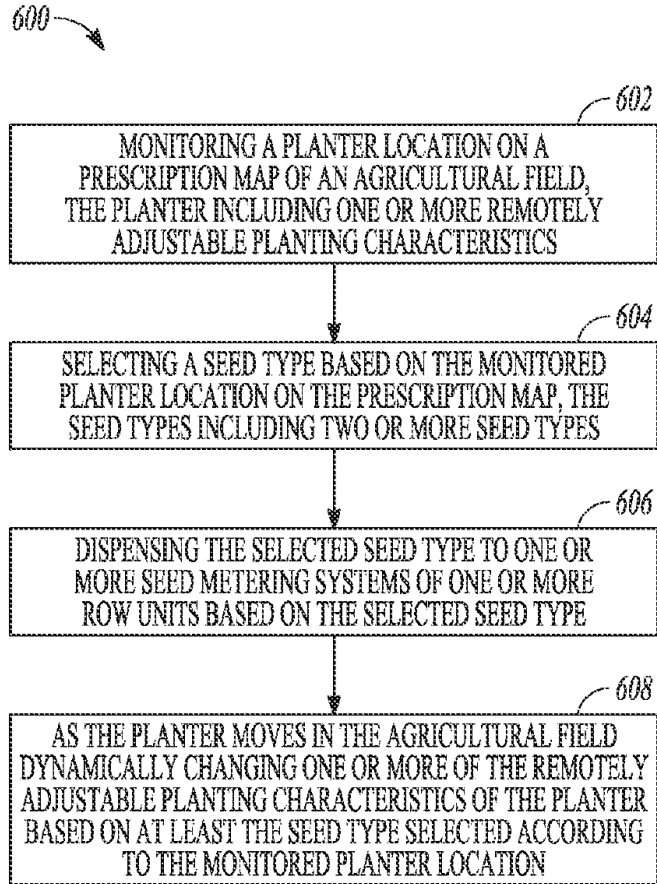


FIG. 6

[0028] “*The agricultural product reservoirs 118 are configured to provide the agricultural product contemporaneously with dispensing and planting of seeds.*”

[0040] “In one example a seed selector 410 is operated to accordingly feed the selected seed to the seed metering system 120 (e.g., including the seed disk driven by a motor such as a hydraulic motor, the vacuum fan). The seed disk 412 accordingly adjusts its vacuum level according to the seed type selected based on instructions from the controller 402. The vacuum level is adjusted in one example to reliably hold each of the seeds along the seed disk (e.g., based on the respective size, shape, and weight of the seed) for planting according to a population rate for instance a population rate determined by a rotational speed provided by the motor 416. In another example the population rate controlled by the motor 416 is also determined by the controller 402 by way of

the prescription provided in the seed database 406. In still another example, the controller 402 controls a down-pressure of the coulter 414 according to the seed type being planted. The coulter pressure is in one example adjusted upwardly or downwardly to provide a desired depth for planting of the selected seed. In a similar manner one or more of the for liquid and granular agricultural products are adjusted to provide a desired type and amount of the respective agricultural product based on the seed selected and optionally one or more of the terrain characteristics for instance provided by the terrain characteristic module...”

[0051] “in one example the control valve 544 is used to apply a particular rate of an agricultural product with the respective row unit 114”

[0060] In another example dynamically changing one or more remotely adjustable planting characteristics includes controlling a planter vacuum level for instance of the seed disk 412. Accordingly the retention force of the selected seed type provided by the controller 402 is adjusted for one or more of the seed metering systems 120 associated with respective row units 114 for instance as shown in FIG. 4. In one example specified vacuum levels are associated with each of one or more hybrids or each of a differing seed types and the controller 402 changes the vacuum level for instance of one or more of the seed disks 412 is based on the selected seed type.

[0061] In another example dynamically changing one of the remotely adjustable planting characteristics includes controlling a row unit down-pressure of one or more of the row unit coulters 414. In one example the row unit down-pressure is adjusted based on the selected seed type (to accordingly provide a desired planting depth) and the planter location on the prescription map 404 for instance determined with the GPS antenna 105 (or antennas associated with one or more of the row units 114).

As excerpted above, Wagers discloses the metering of individual seeds and applying an agricultural product or substance contemporaneously with the dispensing of the seed.

One of ordinary skill in the art would understand this to necessarily disclose application of the substance to the individual seed just prior to placement in the ground.

Mitchell:



Further, Mitchell discloses:

(Page 2, lines 36-47) “Leading downwardly from the conduit, 15, is a number of spouts, 17, which pass through the hollow teeth, 8; of the seeder and are relatively small, whereby they do not interfere with the passage of the grain through the said teeth. The *lower extremity of each of these spouts is equipped with a spray nozzle, 18, which is located just above the point 10 of the tooth, so that the liquid as it issues from the nozzle is deposited upon the grain* and the soil or earth in which it is planted, simultaneously.”

(Page 2, lines 54-64) “Then, as the machine is driven across the field, the grain passes through the *hollow teeth* of the drill simultaneously with the passage of the liquid through the *spouts 17* of my attachment, and consequently, *as the seed is about to enter the- earth at the lower extremities 10 of the hollow teeth, the liquid is applied to the grain* and also to the earth, thus giving the seed and earth at the same time a treatment with the anti-smut liquid compound.”

	(Page 2, lines 101-105) “The herein described seeding process, consisting in dropping seed and simultaneously <i>spraying the seed as it falls</i> and the soil into which it falls with an anti-smut liquid.” (Page 2, lines 121-124) “spraying means within the lower ends of said <i>hollow teeth</i> for <i>spraying the seed with said liquid as it is conducted to the earth by the teeth</i>” (Page 3, lines 3-6) “The method of treating seed while being planted, consisting in <i>spraying with a liquid fungicide, the seed while in transit from a source of supply to the ground.</i>” (Page 3, lines 11-12) “means for <i>spraying the seed while in motion</i> with a liquid fungicide” <u>Motivation to Combine:</u> As excerpted above, Wagers discloses the metering and planting of individual seeds and the application of an agricultural substance contemporaneous with the dispensing of the seed. It was well understood at the time that there were numerous well-known means for applying substance to individual seeds during planting, all of which are readily incorporated in the multi-row planter disclosed in Wagers, and all of which are consistent with and would further the express objective of Wagers to improve planting precision. One such example is the hollow teeth and spray nozzle configuration of Mitchell, which provides for the spray of seed while in transit to the ground. One would have been motivated to incorporate the spray nozzle configuration of Mitchell because of the precision it affords. Incorporating such a configuration in the multi-row planter disclosed in Wagers would have been straightforward. As excerpted below for claims 6 and 11, Wagers discloses spray nozzles that are associated with the individual row units, which include “coulters, seed metering systems including seed wheels, seed hoppers and the like.” [0028]-[0029].
delivering the combination of the seed and the selected type of the seed-applied	<u>Wagers:</u>

substance to the soil at the calculated location within the field for planting

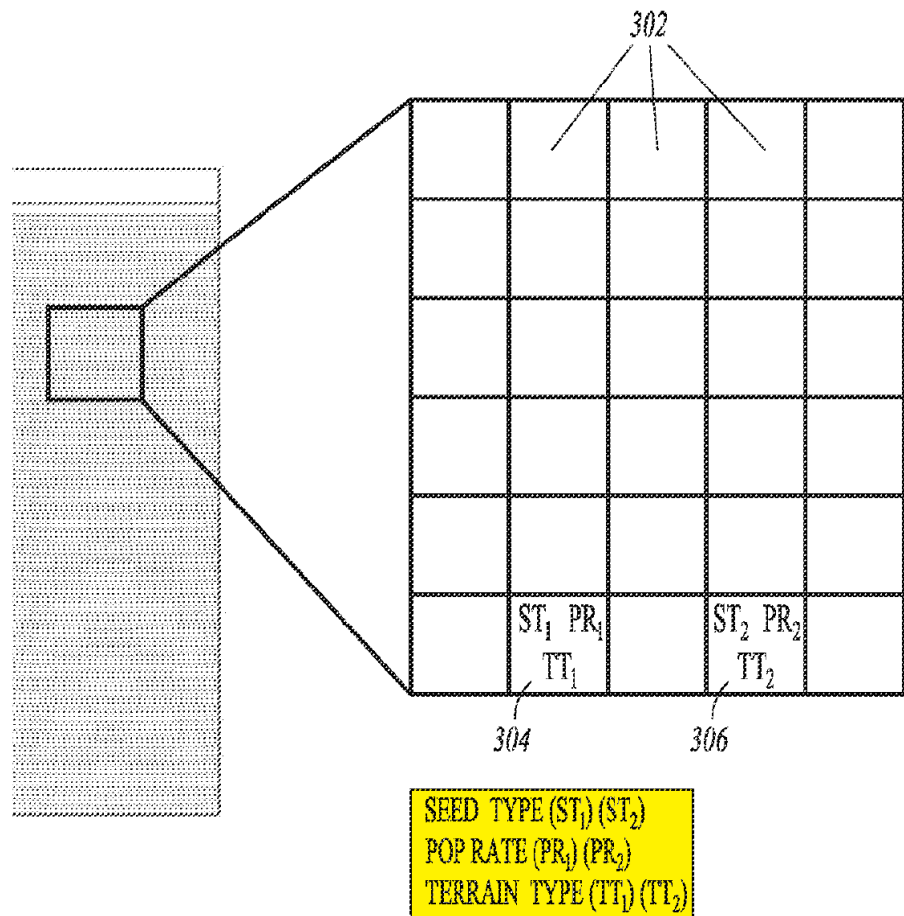


FIG. 3

[0028] “The agricultural product reservoirs 118 are configured to ***provide the agricultural product contemporaneously with dispensing and planting of seeds***”

[0033] “***the seed type prescribed in each of the Zones 302*** correspondingly determines one or more ***planter*** characteristics of the multi-hybrid ***planter 104*** including for instance ... the ***selection of one or more agricultural products and the rate of application of the one or more agricultural products***”

[0041] Accordingly with multi-seed control system 400 provided in FIG. 4 ***one or more of the characteristics of the planter*** for instance a plurality of remotely adjustable planting characteristics are adjusted for one or more of the row units 114 ***according to the seed type selected and optionally according to one or more other characteristics, for instance***

	<i>terrain characteristics and the like.</i> The multi-seed control system 400 is thereby able to optimally plant a plurality of seed types for instance one or more hybrids within the same field according to information indexed to the Zones 302 of the prescription map 303. <u>The prescription map 300 provides indicates the seed type to be planted in each of one or more Zones</u> and accordingly the seed type (optionally in combination with one or more characteristics) is used to adjust one or more of the planting characteristics of one or more of the row units 114
wherein the type of the seed-applied substance, and the desired application amount of the selected type of the seed-applied substance can vary as the planter changes locations within the field.	<u>Wagers:</u> <pre> graph TD 600 --> 602 602 --> 604 604 --> 606 606 --> 608 </pre> 600 602 MONITORING A PLANTER LOCATION ON A PRESCRIPTION MAP OF AN AGRICULTURAL FIELD, THE PLANTER INCLUDING ONE OR MORE REMOTELY ADJUSTABLE PLANTING CHARACTERISTICS 604 SELECTING A SEED TYPE BASED ON THE MONITORED PLANTER LOCATION ON THE PRESCRIPTION MAP, THE SEED TYPES INCLUDING TWO OR MORE SEED TYPES 606 DISPENSING THE SELECTED SEED TYPE TO ONE OR MORE SEED METERING SYSTEMS OF ONE OR MORE ROW UNITS BASED ON THE SELECTED SEED TYPE 608 AS THE PLANTER MOVES IN THE AGRICULTURAL FIELD DYNAMICALLY CHANGING ONE OR MORE OF THE REMOTELY ADJUSTABLE PLANTING CHARACTERISTICS OF THE PLANTER BASED ON AT LEAST THE SEED TYPE SELECTED ACCORDING TO THE MONITORED PLANTER LOCATION FIG. 6

	[0040] “In a similar manner one or more of the <i>sprayer or pneumatic dispenser 418</i> for <u><i>liquid and granular agricultural products 418 are adjusted to provide a desired type and amount of the respective agricultural product based on</i></u> the seed selected and optionally one or more of the terrain characteristics [408] for instance provided by the terrain characteristic module” [0062] “dynamically changing one or more of the remotely adjustable planting characteristics further includes <u><i>selecting an agricultural product (e.g., one or more of a liquid or granular product) for application according to the monitored planter location 104 on the prescription map</i></u>”
<u>Claim 2.</u> The method of claim 1 wherein the step of selecting, based at least in part on the condition, the combination of seed and seed-applied substance further comprises selecting a seed type.	<u>Wagers:</u> [0008] “The method monitors a planter location on a prescription map of a field, <i>selects a seed type based on the monitored planter location on the prescription map</i>, and then dynamically <i>changes one or more of the planter characteristics based on at least the selected seed type.</i>” [0028] “a control system associated with the multi-seed planter 104 is configured to select one of a plurality of seed types for instance provided within the seed hopper 108 and accordingly dispense the seed from one or more of the row units 114 according to the position of the multi-seed planter 104 within an agricultural field, for instance an agricultural field with indexed zones <i>having prescriptions for particular seed types and planter characteristics</i>” [0039] “The controller 402 accordingly <i>sends instructions to one or more of the row units 114 corresponding to the seed type selected for the particular Zone</i> of the field including one or more row units 114. [0040] the controller 402 based on the seed type selected and the according prescription for each of the seeds adjusts one or more characteristics of the one or more row units 114. In one example a seed selector 410 is operated to accordingly feed the selected seed to the seed metering system 120 (e.g., including the seed disk driven by a motor such as a hydraulic motor, the vacuum fan).”

<u>Claim 3.</u> The method of claim 1 wherein the combination of seed and the selected type of the seed-applied substance varies based at least in part on one of the following: a type of the seed, the type of the seed-applied substance, and an application rate of the seed-applied substance.	<u>Wagers:</u> [0008] “The method monitors a <i>planter location</i> on a prescription map of a field, <i>selects a seed type based on the monitored planter location on the prescription map</i>, and then <i>dynamically changes one or more of the planter characteristics based on at least the selected seed type.</i>” [0033] “In one example, the seed type prescribed in each of the Zones 302 correspondingly determines one or more <i>planter</i> characteristics of the multi-hybrid <i>planter 104</i> including for instance <i>one or more remotely adjustable planting characteristics of one or more of the row units 114 previously shown in FIG. 1 including</i>, but not limited to, population rate of the selected seed type, <i>planter</i> vacuum level for a seed disk, row unit down-pressure of one or more of the row unit <i>coulters</i>, and <i>the selection of one or more agricultural products and the rate of application of the one or more agricultural products.</i>” [0037] “In a similar example, characteristics regarding another type of seed, such as Soybeans are also provided. In one example <i>the seed database 406 accordingly associates one or more planter characteristics such as</i> seed disk vacuum level, <i>coulter</i> down-pressure, population rate (corresponding to operation of hydraulic motor configured to rotate the seed disk) and <i>agricultural product dispensation with each of the types of seeds.</i>” [0040] “In a similar manner one or more of the <i>sprayer or pneumatic dispenser 418</i> for liquid and granular agricultural products 418 are <i>adjusted to provide a desired type and amount of the respective agricultural product based on the seed selected and optionally one or more of the terrain characteristics</i> for instance provided by the terrain characteristic module”
<u>Claim 4.</u> The method of claim 1 wherein a <i>controller</i> can be used to calculate the <i>location</i> where the seed will be	<u>Wagers</u>

delivered to the soil, select, based at least in part on the condition, the combination of seed and seed-applied substance to plant at the location, generate the combination of the seed and the selected type of the seed-applied substance, or plant the combination of seed and the selected type of the seed-applied substance.

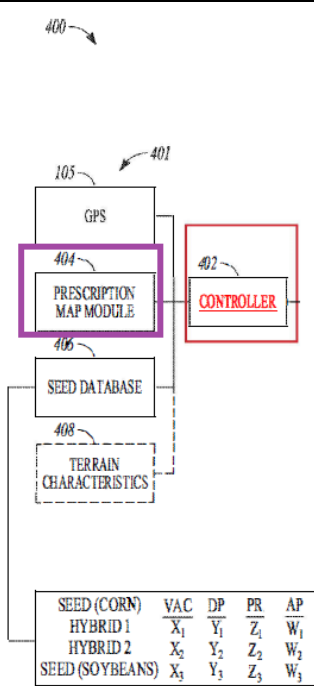


FIG. 4

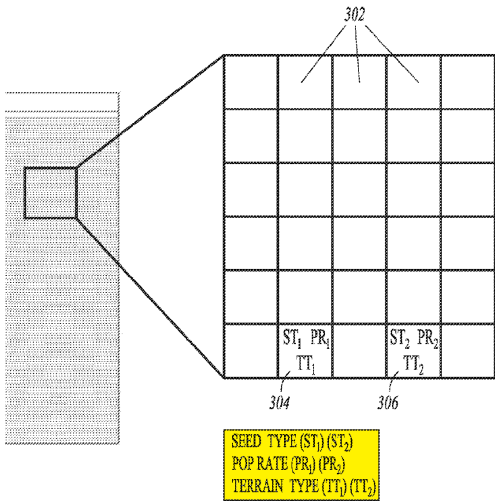


FIG. 3

[0032] As further shown in FIG. 3, the first and second Zones 304,306 are provided as demonstrative examples. As previously described the plurality of Zones 302 include prescriptions for seed selection for each of the respective Zones 302. Additionally *in other examples the Zones 302 (as shown with the demonstrative first and second Zones 304, 306) include additional prescription characteristics to further enhance the characteristics of the planter to optimally plant a seed (e.g., with one or more agricultural*

products, at a particular planting depth, according to an optimal population rate and the like). For instance as shown in FIG. 3 the first and second Zones 304,306 include a plurality of characteristics determined by one or more of the seed type, the terrain type or the like for the prescription map 300. For instance in the first Zone 304 the seeds type, population rate and terrain type is specified. For instance as shown in FIG. 3 the first Zone 304 has a seed type (ST), a specified population rate (PR) and a specified terrain type (TT).

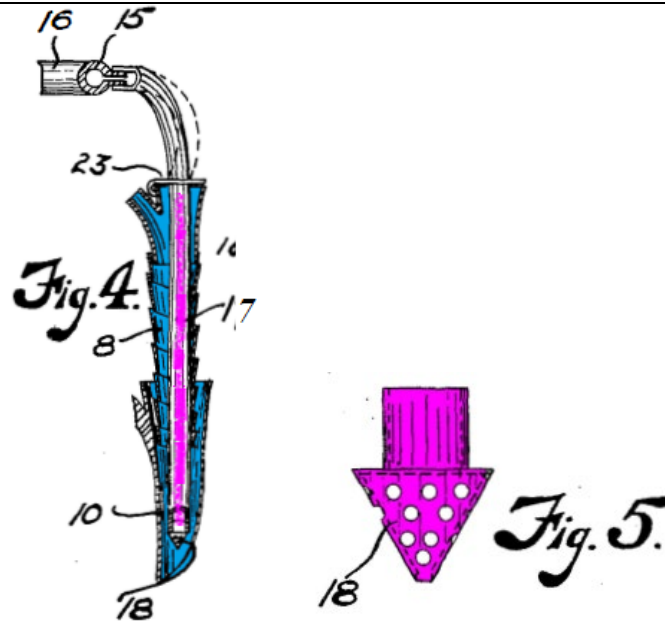
[0036] “In one example, the controller 402 provides instructions to each of the features of the row unit 114 for instance including the features of the seed metering system 120 as well as other features such as the coulter (corresponding to a coulter down pressure) and one or more agricultural product dispensers such as a sprayer or a pneumatic dispenser 418.”

[0039] “As will be described herein the controller 402 receives the inputs 401. In one example the location of the planter 104 for instance determined with the GPS antenna 105 cooperates with the prescription map module 404 to accordingly determine a seed type to be dispensed by one or more of the row units 114. As further shown in FIG. 4 in one example the seed type selected by way of cooperation between the GPS antenna 105 and the prescription map module 404 corresponds to a seed type contained within the seed database 406.”

[0039] “The controller 402 accordingly sends instructions to one or more of the row units 114 corresponding to the seed type selected for the particular Zone of the field including one or more row units 114.”

[0040] “the controller 402 based on the seed type selected and the according prescription for each of the seeds adjusts one or more characteristics of the one or more row units 114. In one example a seed selector 410 is operated to accordingly feed the selected seed to the seed metering system 120 (e.g., including the seed disk driven by a motor such as a hydraulic motor, the vacuum fan). The seed disk

	<i>412 accordingly adjusts its vacuum level according to the seed type selected based on instructions from the <u>controller 402</u>. The vacuum level is adjusted in one example to reliably hold each of the seeds along the seed disk (e.g., based on the respective size, shape, and weight of the seed) for planting according to a population rate for instance a population rate determined by a rotational speed provided by the motor 416. In another example <i>the population rate controlled by the motor 416 is also determined by the <u>controller 402</u></i> by way of the prescription provided in the seed database 406. In still another example, <i>the <u>controller 402</u> controls a down-pressure of the <u>coulter</u> 414</i> according to the seed type being planted. The <u>coulter</u> pressure is in one example adjusted upwardly or downwardly to provide a desired depth for planting of the selected seed. In a similar manner <i>one or more of the sprayer or pneumatic dispenser 418 for liquid and granular agricultural products 418 are adjusted to provide a desired type and amount of the respective agricultural product</i> based on the seed selected and optionally one or more of the terrain characteristics for instance provided by the terrain characteristic module 408 corresponding to one or more sensors or terrain characteristics associated with the plurality of Zones (e.g., the Zones 302) in the prescription map 300.”</i>
<u>Claim 5.</u> The method of claim 1 wherein the selected type of the seed-applied substance is applied to the seed proximate to the <i>seed drop tube</i>.	<u>Mitchell:</u>



(Page 2, lines 36-47) “Leading downwardly from the conduit, 15, is a number of *spouts*, 17, which pass through the *hollow teeth*, 8; of the seeder and are relatively small, whereby they do not interfere with the passage of the grain through the said teeth. The *lower extremity of each of these spouts is equipped with a spray nozzle, 18, which is located just above the point 10 of the tooth*, so that the liquid as it issues from the nozzle is deposited upon the grain and the soil or earth in which it is planted, simultaneously.”

Given the shape of the tip of the hollow teeth 8 (seed drop tube) where the tip is in contact with the ground, as depicted in Fig. 4 above, one of ordinary skill in the art would understand that the anti-smut substance of Mitchell is necessarily applied to the seed both within hollow teeth 8 and just beyond (proximate to) the hollow teeth 8.

Motivation to Combine:

It is well understood to a person having ordinary skill in the art that seed drop tubes, which provide for the release of seed at or near the ground, thereby allow much greater precision in seed placement, which is one of the goals of Wagers. Seed drop tubes have been ubiquitous features of in-row planters, including multi-row planters, seed drills, air seeders, and the like, for well over a century if not longer as reflected in

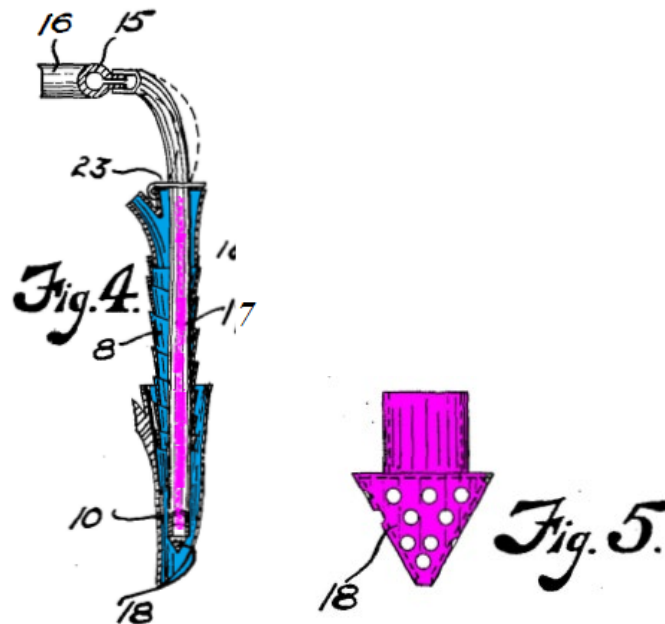
	Mitchell, which issued as a patent in 1922. Incorporating a seed drop tube like that of Mitchell in the multi-row planter disclosed in Wagers would have been straightforward. Indeed, given the widespread use of seed drop tubes, to the extent the planter disclosed in Wagers does not expressly or inherently include a seed drop tube, it would have been a standard bolt-on part widely available at the time. As excerpted above for claim 1, Wagers discloses the metering and planting of individual seeds and the application of an agricultural substance contemporaneous with the dispensing of the seed. It was well understood at the time that there were numerous well-known means for applying substance to individual seeds during planting, all of which are readily incorporated in the multi-row planter disclosed in Wagers, and all of which are consistent with and would further the express objective of Wagers to improve planting precision. One such example is the hollow teeth and spray nozzle configuration of Mitchell, which provides for the spray of seed while in transit to the ground. One would have been motivated to incorporate the spray nozzle configuration of Mitchell because of the precision it affords. Incorporating such a configuration in the multi-row planter disclosed in Wagers would have been straightforward. As excerpted below for claims 6 and 11, Wagers discloses spray nozzles that are associated with the individual row units, which include “coulters, seed metering systems including seed wheels, seed hoppers and the like.” [0028]-[0029].
Claim 6. The method of claim 1 wherein the <u>substance applicator</u> comprises a <u>nozzle</u> to spray the selected type of the seed-applied substance onto the seed as the seed is delivered to the soil.	<u>Wagers:</u> [0028] “In one example the agricultural product reservoir 116 is distributed throughout the row units 114 for instance to corresponding <u>spray units</u> associated with each of the one or more row units 114 or associated with two or more row units 114.” [0028] “The agricultural product reservoirs 118 are configured to provide the agricultural product contemporaneously with dispensing and planting of seeds.”

[0036] “In one example, the controller 402 provides instructions to each of the features of the row unit 114 for instance including the features of the seed metering system 120 as well as other features such as the coulter (corresponding to a coulter down pressure) and one or more agricultural product dispensers such as a sprayer or a pneumatic dispenser 418.”

[0050] “Optionally, each of one or more *agricultural product dispensers* (at either of the reservoirs 116, 118 or at the dispensing devices such as *spouts, nozzles or sprayers*) includes an agricultural product control loop of the type or similar to that shown in FIG. 5E.”

As excerpted above for claim 1, Wagers discloses the metering of individual seeds and applying an agricultural product or substance contemporaneously with the dispensing of the seed. One of ordinary skill in the art would understand this to necessarily disclose application of the substance to the individual seed just prior to placement in the ground.

Mitchell:



Further, Mitchell discloses:

(Page 2, lines 36-47) “Leading downwardly from the conduit, 15, is a number of *spouts*, 17, which pass through the *hollow teeth*, 8; of the seeder and are relatively small, whereby they

do not interfere with the passage of the grain through the said teeth. The *lower extremity of each of these spouts is equipped with a spray nozzle, 18, which is located just above the point 10 of the tooth*, so that the liquid as it issues from the nozzle is deposited upon the grain and the soil or earth in which it is planted, simultaneously.”

(Page 2, lines 54-64) “Then, as the machine is driven across the field, the grain passes through the *hollow teeth* of the drill simultaneously with the passage of the liquid through the *spouts* 17 of my attachment, and consequently, *as the seed is about to enter the- earth at the lower extremities 10 of the hollow teeth, the liquid is applied to the grain* and also to the earth, thus giving the seed and earth at the same time a treatment with the anti-smut liquid compound.”

(Page 2, lines 101-105) “The herein described seeding process, consisting in dropping seed and simultaneously *spraying the seed as it falls* and the soil into which it falls with an anti-smut liquid.”

(Page 2, lines 121-124) “spraying means within the lower ends of said *hollow teeth* for *spraying the seed with said liquid as it is conducted to the earth by the teeth*”

(Page 3, lines 3-6) “The method of treating seed while being planted, consisting in *spraying with a liquid fungicide, the seed while in transit from a source of supply to the ground.*”

(Page 3, lines 11-12) “means for *spraying the seed while in motion* with a liquid fungicide”

Motivation to Combine:

As excerpted above, Wagers discloses the metering and planting of individual seeds and the application of an agricultural substance contemporaneous with the dispensing of the seed. It was well understood at the time that there were numerous well-known means for applying substance to individual seeds during planting, all of which are readily incorporated in the multi-row planter disclosed in Wagers, and all of which are consistent with and would further the express objective of Wagers to improve planting precision. One such example is the hollow teeth and spray nozzle

	configuration of Mitchell, which provides for the spray of seed while in transit to the ground. One would have been motivated to incorporate the spray nozzle configuration of Mitchell because of the precision it affords. Incorporating such a configuration in the multi-row planter disclosed in Wagers would have been straightforward. As excerpted above (and below for claim 11), Wagers discloses spray nozzles that are associated with the individual row units, which include “coulters, seed metering systems including seed wheels, seed hoppers and the like.” [0028]-[0029].
<u>Claim 7.</u> The method of claim 1 wherein the step of generating the combination of the seed and the selected type of the seed-applied substance further comprises: providing a metering device; and metering an amount of the selected type of the seed-applied substance from the substance receptacle through a substance flow path to the substance applicator with the metering device.	<u>Wagers:</u> [0050] “In one example a <i>rate sensor 546</i> is provided on the output side of the <i>control valve 544</i> to accordingly <i>measure the opening of the control valve 544 and the actual dispensation rate</i> (e.g., as a flow meter) from the agricultural product dispenser 418. The output from the rate sensor 546 is communicated <i>to the valve controller 542 to achieve a desired target rate and type of agricultural product dispensation by feedback control.</i>”
<u>Claim 11.</u> The method of claim 1 wherein the substance applicator is associated with at least one of: a. a mixer in fluid communication with the substance receptacle and a substance flow path;	<u>Wagers:</u> [0028] “In one example the <i>agricultural product reservoir 116</i> is distributed throughout the row units 114 for instance to corresponding <i>spray units associated with each of the one or more row units 114</i> or associated with two or more row units 114.”

b. a seed hopper configured to receive the seed from a seed receptacle; c. a seed meter configured to receive the seed from the seed hopper and further transfer it through a seed flow path; and d. the seed drop tube.	[0028] “The <i>agricultural product reservoirs 118</i> are configured to provide the agricultural product <i>contemporaneously with dispensing</i> and planting of seeds” [0029] “As further shown in FIG. 2 the first and second sets of row units 202, 204 (each of the individual row units associated with the sets) is spaced apart according to a row unit set lateral offset 206 (lateral offset herein). In one example, <i>each of the first and second sets of row units 202, 204 includes separate components for each of the respective row units (e.g., <u>coulters</u>, <u>seed metering systems</u> including seed wheels, seed hoppers and the like).</i>” [0036] “For instance, the <u>seed metering system 120</u> of the exemplary row unit 114 includes in one example one or more of a seed disk 412 and a motor, such as a hydraulic motor associated with the seed disk 412. In one example, the controller 402 provides instructions to <i>each of the features of the row unit 114 for instance including</i> the features of the <u>seed metering system 120</u> as well as other features such as the <u>coulter</u> (corresponding to a <u>coulter</u> down pressure) and <i>one or more agricultural product dispensers such as a sprayer or a pneumatic dispenser 418</i>. In one example the controller 402 communicates with the row unit 114 by way of an electronic control unit 420 associated with the individual row unit. The optional electronic control unit 420 receives control signals from the controller 402, interprets them and accordingly provides separate control signals (e.g., instructions) to each of the components.” <u>Mitchell:</u> Further, Mitchell discloses: (Page 2, lines 36-47) “Leading downwardly from the conduit, 15, is a number of spouts, 17, which pass through the hollow teeth, 8; of the seeder and are relatively small, whereby they do not interfere with the passage of the grain through the said teeth. The <i>lower extremity of each of these spouts is equipped with a spray nozzle, 18, which is located just above the point 10 of the tooth, so that the liquid as it issues from</i>
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the nozzle is deposited upon the grain and the soil or earth in which it is planted, simultaneously.”

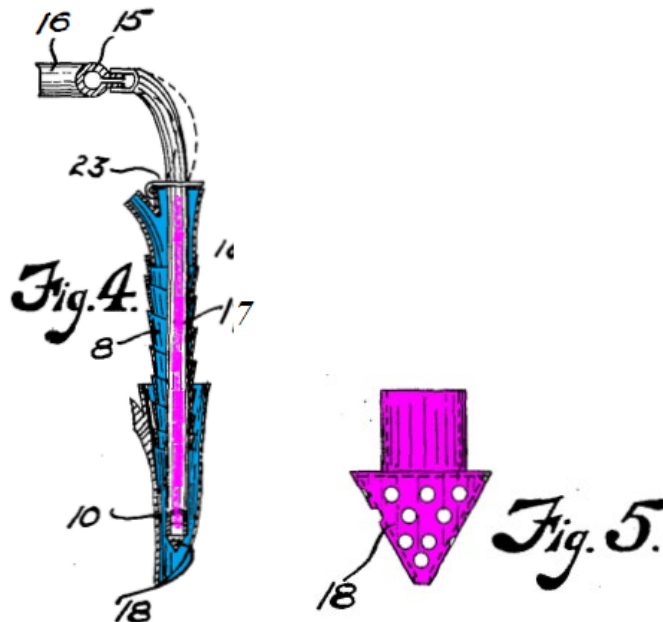
Motivation to Combine:

It is well understood that seed drop tubes, which provide for the release of seed at or near the ground, thereby allow much greater precision in seed placement, which is one of the goals of Wagers. Seed drop tubes have been ubiquitous features of in-row planters, including multi-row planters, seed drills, air seeders, and the like, for well over a century if not longer as reflected in Mitchell, which issued as a patent in 1922. Incorporating a seed drop tube like that of Mitchell in the multi-row planter disclosed in Wagers would have been straightforward. Indeed, given the widespread use of seed drop tubes, to the extent the planter disclosed in Wagers does not expressly or inherently include a seed drop tube, it would have been a standard bolt-on part widely available at the time.

As excerpted above, Wagers discloses the metering and planting of individual seeds and the application of an agricultural substance contemporaneous with the dispensing of the seed. It was well understood at the time that there were numerous well-known means for applying substance to individual seeds during planting, all of which are readily incorporated in the multi-row planter disclosed in Wagers, and all of which are consistent with and would further the express objective of Wagers to improve planting precision. One such example is the hollow teeth and spray nozzle configuration of Mitchell, which provides for the spray of seed while in transit to the ground. One would have been motivated to incorporate the spray nozzle configuration of Mitchell because of the precision it affords. Incorporating such a configuration in the multi-row planter disclosed in Wagers would have been straightforward. As excerpted above (including for claim 6), Wagers discloses spray nozzles that are associated with the individual row units, which include “coulters, seed metering systems including seed wheels, seed hoppers and the like.” [0028]-[0029].

Claim 12. The method of claim 1 further comprising the steps of: transferring the seed into the seed drop tube; and applying the selected type of the seed-applied substance to the seed proximate to or within the seed drop tube.

Mitchell:



(Page 2, lines 36-47) “Leading downwardly from the conduit, 15, is a number of *spouts*, 17, which pass through the *hollow teeth*, 8; of the seeder and are relatively small, whereby they do not interfere with the passage of the grain through the said teeth. The *lower extremity of each of these spouts is equipped with a spray nozzle, 18, which is located just above the point 10 of the tooth*, so that the liquid as it issues from the nozzle is deposited upon the grain and the soil or earth in which it is planted, simultaneously.”

Given the shape of the tip of the hollow teeth 8 (seed drop tube) where the tip is in contact with the ground, as depicted in Fig. 4 above, one of ordinary skill in the art would understand that the anti-smut substance of Mitchell is necessarily applied to the seed both within hollow teeth 8 and just beyond (proximate to) the hollow teeth 8.

Motivation to Combine:

It is well understood that seed drop tubes, which provide for the release of seed at or near the ground, thereby allow much greater precision in seed placement, which is one of the goals of Wagers. Seed drop tubes have been ubiquitous features of in-row planters, including multi-row planters, seed drills, air seeders, and the like, for well over a century if not longer as

	reflected in Mitchell, which issued as a patent in 1922. Incorporating a seed drop tube like that of Mitchell in the multi-row planter disclosed in Wagers would have been straightforward. Indeed, given the widespread use of seed drop tubes, to the extent the planter disclosed in Wagers does not expressly or inherently include a seed drop tube, it would have been a standard bolt-on part widely available at the time. As excerpted above for claim 1, Wagers discloses the metering and planting of individual seeds and the application of an agricultural substance contemporaneous with the dispensing of the seed. It was well understood at the time that there were numerous well-known means for applying substance to individual seeds during planting, all of which are readily incorporated in the multi-row planter disclosed in Wagers, and all of which are consistent with and would further the express objective of Wagers to improve planting precision. One such example is the hollow teeth and spray nozzle configuration of Mitchell, which provides for the spray of seed while in transit to the ground. One would have been motivated to incorporate the spray nozzle configuration of Mitchell because of the precision it affords. Incorporating such a configuration in the multi-row planter disclosed in Wagers would have been straightforward. As excerpted below for claims 6 and 11, Wagers discloses spray nozzles that are associated with the individual row units, which include “coulters, seed metering systems including seed wheels, seed hoppers and the like.” [0028]-[0029].
<u>Claim 13.</u> The method of claim 1 wherein the desired application amount of the selected type of the seed-applied substance to be applied to the seed is either: always the same amount of seed-applied substance; or only either one specific amount of seed-applied	<u>Wagers:</u> [0051] “As further shown in FIG. 5E, in one example a shutoff valve 548 is associated with the agricultural product dispenser 418. In one example the valve controller 542 further operates the shutoff valve 548 to accordingly shut off the flow of one or more of liquid or granular agricultural product to the respective row unit 114. Accordingly in one example <i>the control valve 544 is used to apply a particular rate of an agricultural product with the respective row unit 114 while the shutoff valve 548 is used to toggle between application</i>

substance or no amount of the seed-applied substance.	<i>or an interruption of application of the agricultural product at the rate provided by the control valve 544.</i> One of ordinary skill in the art would understand it was and is a common agricultural practice to apply an agricultural product at a fixed rate throughout a given field if the relevant conditions within the field are uniform or, alternatively to alternate between no application and a fixed application if, as an example, one variety of seed is planted on part of a field and another variety is planted in another part of the field. Thus, it would have been obvious to use the shutoff valve of Wagers to apply an agricultural product in such a manner.
<u>Claim 14.</u> The method of claim 1, wherein the type of the seed-applied substance and the desired application amount of the selected type of the seed-applied substance can vary as the planter changes location within the field by changing the type, number or amount of one or more of the seed-applied substances applied to the seed when generating the combination of the seed and the seed-applied substance.	<u>Wagers:</u> [0040] “In a similar manner one or more of the sprayer or pneumatic dispenser 418 for liquid and granular agricultural products <i>418 are adjusted to provide a desired type and amount of the respective agricultural product based on</i> the seed selected and optionally <i>one or more of the terrain characteristics</i> [408] for instance provided by the terrain characteristic module” [0062] “dynamically changing one or more of the remotely adjustable planting characteristics further includes <i>selecting an agricultural product (e.g., one or more of a liquid or granular product) for application according to the monitored <u>planter location</u> 104 on the prescription map</i>”
<u>Claim 15.</u> The method of claim 1, wherein the combination of seed and the selected type of the seed-applied substance can vary based at least in part upon a seed-applied substance type, a number of seed-applied	<u>Wagers:</u> [0040] “In a similar manner one or more of the sprayer or pneumatic dispenser 418 for liquid and granular agricultural products <i>418 are adjusted to provide a desired type and amount of the respective agricultural product based on</i> the seed selected and optionally <i>one or more of the terrain characteristics</i> [408] for instance provided by the terrain characteristic module”

substances, or the desired application amount of one or more of the selected type of seed-applied substance.

[0062] “dynamically changing one or more of the remotely adjustable planting characteristics further includes *selecting an agricultural product (e.g., one or more of a liquid or granular product) for application according to the monitored planter location 104 on the prescription map*”

Claim 16. The method of claim 1, wherein the combination of seed and the selected type of the seed-applied substance can vary based at least in part upon a seed type.

Wagers:

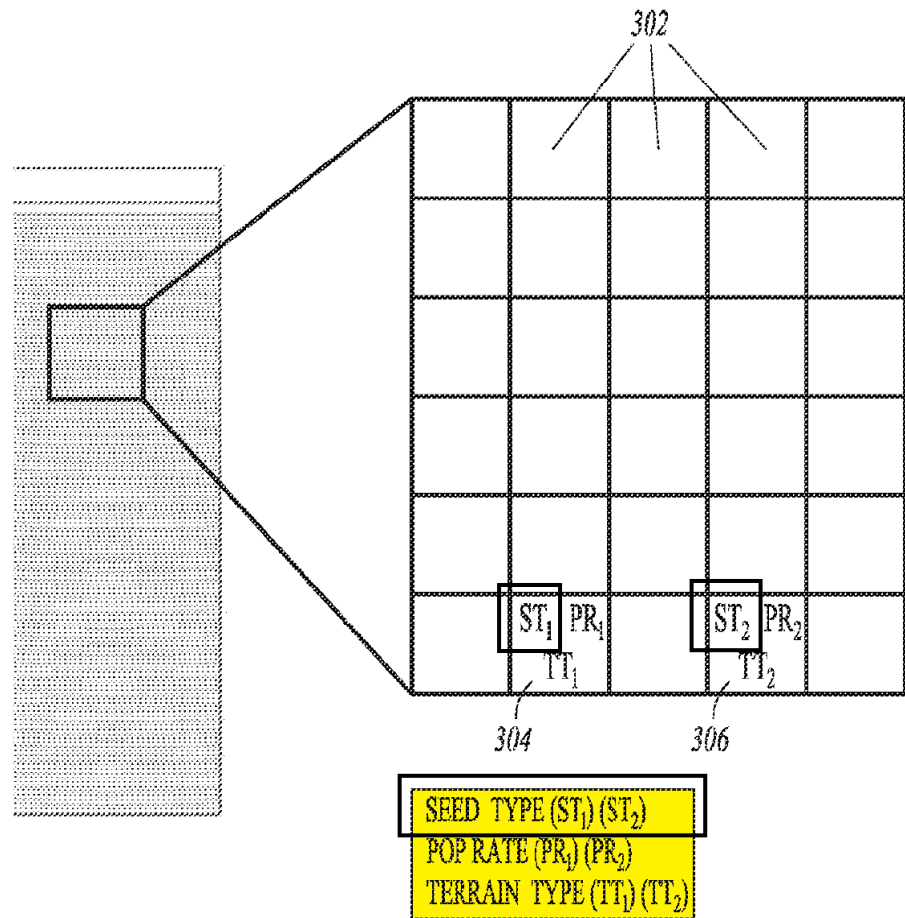


FIG. 3

[0008] “The method monitors a planter location on a prescription map of a field, *selects a seed type based on the monitored planter location on the prescription map, and then dynamically changes one or more of the planter characteristics based on at least the selected seed type.* ... Dynamic changing of the planter characteristics ensures that each of a variety of seed types are handled and planted according to the characteristics of the seed (and optionally other characteristics of the field or prescription map). *Some of*

the planter characteristics that are dynamically changed during operation of the planter include, but are not limited to, vacuum level, population rate, *coulter* down pressure, *agricultural product selection and application rate* or the like.”

[0037] “In one example the seed database 406 accordingly *associates one or more planter characteristics such as* seed disk vacuum level, *coulter* down-pressure, population rate (corresponding to operation of hydraulic motor configured to rotate the seed disk) and *agricultural product dispensation with each of the types of seeds.*”

[0040] “In a similar manner one or more of the sprayer or pneumatic dispenser 418 for liquid and granular agricultural products 418 *are adjusted to provide a desired type and amount of the respective agricultural product based on the seed selected* and optionally one or more of the terrain characteristics for instance provided by the terrain characteristic module”

Claim 8. The method of claim 1, wherein the step of generating the combination of the seed and the selected type of the seed-applied substance further comprises:

providing a timing mechanism; and calculating, with the timing mechanism, both *delivery time of the selected type of the seed-applied substance from the substance receptacle through a substance flow path to the substance applicator* and *travel time of the seed through a seed flow path*.

Wagers:

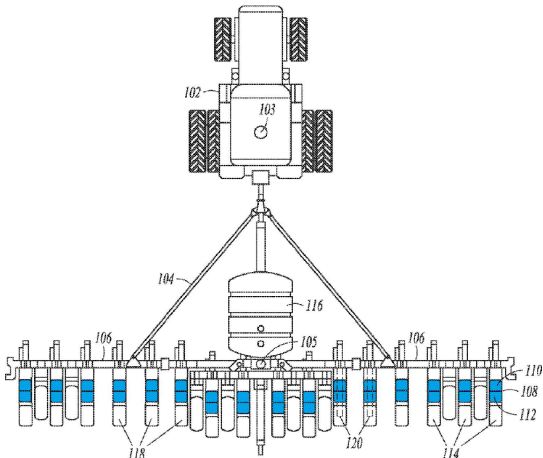


FIG. 1

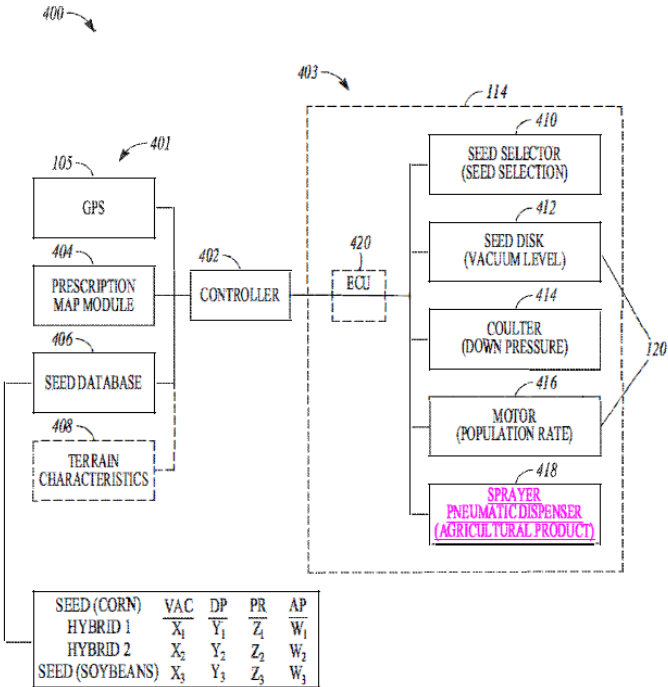


FIG. 4

[0029] “In one example, *each of the first and second sets of row units 202, 204 includes separate components for each of the respective row units (e.g., coulters, seed metering systems including seed wheels, seed hoppers and the like).*”

[0033] “In one example, the seed type prescribed in each of the Zones 302 correspondingly determines one or more planter characteristics of the multi-hybrid planter 104 including for instance one or more remotely adjustable planting characteristics of one or more of the row units 114 previously shown in FIG. 1 including, but not limited to, population rate of the selected seed type, planter vacuum level for a seed disk, row unit down-pressure of one or more of the row unit coulters, and the selection of one or more agricultural products and the rate of application of the one or more agricultural products.”

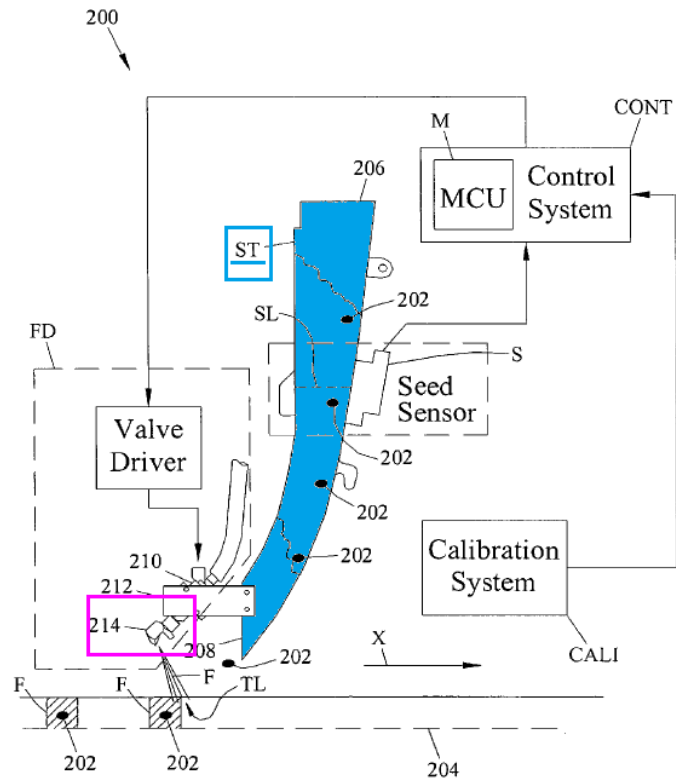
[0036] “In one example, the controller 402 provides instructions to each of the features of the row unit 114 for instance including the features of the *seed metering system 120 as well as other features such as the coulter (corresponding to a coulter down pressure) and one or more agricultural product dispensers* such as a *sprayer* or a *pneumatic dispenser 418*.”

[0040] “In one example a seed selector 410 is operated to accordingly feed the selected seed to the *seed metering system 120 (e.g., including the seed disk driven by a motor such as a hydraulic motor, the vacuum fan)*. The seed disk 412 accordingly adjusts its vacuum level according to the seed type selected based on instructions from the controller 402. The vacuum level is adjusted in one example to reliably hold each of the seeds along the seed disk (e.g., based on the respective size, shape, and weight of the seed) *for planting according to a population rate for instance a population rate determined by a rotational speed provided by the motor 416*. In another example the population rate controlled by the motor 416 is also determined by the controller 402 by way of the prescription provided in the seed database 406. In still another example, the *controller 402 controls a down-pressure of the coulter 414 according to the seed type being planted*. The coulter pressure is in one example adjusted upwardly or downwardly to provide a desired depth for planting of the selected seed.”

[0046] FIG. 5C shows one example of a seed disk 416 for instance a *seed disk motor controller 520 for use with the seed disk of a seed metering system 120. The controller 520 adjusts the population rate of a seed for instance a seed selected by way of the controller 402 (e.g., in cooperation with a prescription map module 404, seed database 406 and the like)*. As shown in FIG. 5C a population rate input 518 corresponding for instance to a seed disk motor speed is input to the seed disk motor controller 520. The *seed disk motor controller 520 actuates a control valve 522 to accordingly adjust the speed of a seed meter 524 (e.g., a motor)*.

[0088] “controlling the population rate of the one or more seed metering systems includes *individually controlling the population*

	<i>rate of the one or more seed metering systems</i> of the corresponding row units” [0089] “dynamically changing one or more remotely adjustable planting characteristics includes <i>controlling a planter vacuum level and corresponding retention force of the selected seed type along respective seed disks</i> of the one or more seed metering systems” [0090] “dynamically changing one or more remotely adjustable planting characteristics includes <i>controlling a row unit down pressure of one or more row unit coulters</i> based on the selected seed type and the planter location” [0116] “wherein the prescription map module includes a <i>seed type prescription map having a plurality of indexed locations distributed over the seed type prescription map, each of the indexed locations corresponding to one seed type</i> of two or more seed types” One of ordinary skill in the art would understand that multi-seed planters, liked those disclosed in Wagers, that include seed metering systems and depth-setting coulters for placing seeds at prescribed distances and soil depth, would necessarily have seed drop tubes below the seed metering wheels for placing the seeds at the rate set by the metering wheel in the furrow set by the coulters. Seed drop tubes are a well understood and necessary component ubiquitous in all such multi-seed planters and have been in used in planters since the advent of mechanized agriculture over a century ago (see, e.g., Mitchell – U.S. Patent No. 1,409,564 – issued March 14, 1922). The planting precision disclosed in Wagers, as excerpted above, requires the use of seed drop tubes, which are a necessary component of the multi-seed planters disclosed therein. <u>Wilkerson:</u>
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[0029] A meter (not shown) can retrieve seeds 202 from the seed hopper and release seeds 202 at predetermined intervals into a top portion 206 of a seed tube ST. The dropped seeds 202 can be transmitted by gravity through seed tube ST to an open bottom end 208 where seeds 202 are directed into furrow 204. System 200 can be attached to the mobile farm equipment and moved in the direction indicated by direction arrow x such that seeds 202 are deposited at different positions along the length of furrow 204. The spacing of seeds 202 in furrow 204 can be controlled by changing the rate that seeds 202 are released into seed tube ST and the speed that open bottom end 208 moves in the direction of direction arrow x.

[0030] "System 200 can time the release of fluid F from fluid dispenser FD such that fluid F is released on and/or near each seed 202 in furrow 204 ... System 200 can comprise a seed sensor S, a fluid dispenser (generally designated FD), and a control system (or control unit) CONT for dispensing fluid F on and/or near each seed 202. Seed sensor S can be positioned between the seed meter (not shown) and furrow 204 for detecting each time one or more seeds 202 pass a sensed location SL in seed tube ST. Seed sensor S can also be in communication with control system CONT for indicating to control system CONT that one or more seeds 202 are detected."

[0031] "Control system CONT can receive an indication from seed sensor S each time one or more seeds 202 pass sensed location SL. In addition, control system CONT can communicate with fluid dispenser FD for providing control signals to dispense fluid F on and/or near each seed 202 placed in furrow 204. *Control system CONT can control fluid dispenser FD to dispense fluid F a predetermined time after receiving indication from seed sensor S that one or more seeds 202 have passed sensed location SL. The predetermined time can be set such that fluid dispenser FD deposits fluid F on and/or near each seed S as it reaches a target location, generally designated TL.*

[0032] *The predetermined time can be selected as the time calculated for seed 202 to move from sensed location SL to target location TL where fluid dispenser FD dispenses fluid F. Thus, when control system CONT receives an indication that seed 202 passes sensed location SL, control system CONT can control fluid dispenser FD to dispense fluid F at target location TL after the predetermined time.* During operation, seed 202 can arrive at target location TL at the predetermined time after passing sensed location SL and receive fluid F. The result is that fluid F is deposited directly on one or more seeds 202 positioned in furrow 204."

[0035] Control system CONT can comprise a programmable microcontroller unit (MCU) M having an interface with seed sensor S for receiving an indication of seed detection or seed event. *MCU M can implement a process for calculating the predetermined time for seed arrival at target location TL.* The predetermined time (or seed arrival time) can be determined based on an average time for seed 202 to move from sensed location SL and the target location TL.

[0036] *MCU M can track one or more seeds in transit at any time between sensed location SL and target location TL. MCU M can include one or more timers each associated with one or more seeds 202 operable to track time for seeds 202 in transit between sensed location SL and target location TL.* Multiple timers can be utilized when more than one seed is in transit at any time between sensed location SL and target location TL. This can occur when the time between the dispensing of seeds 202 is less than the seed travel time between the sensed location in seed tube ST and the liquid application location.

[0037] *Referring to FIG. 2, MCU M can simultaneously process multiple seed arrival times.* According to one embodiment, MCU M can be a microcontroller unit with Part Number MC68HC11E9 available from Motorola, Inc. of Schaumburg, Ill., U.S.A. MCU M can include a freerunning, 16-bit counter (TCNT). *The counter can be*

*driven by a programmable prescaler of the system clock. Input capture (IC) functions can allow time stamping of seed events. When a predefined edge transition occurs on a selected pin of the MCU, the TCNT value can be latched and an interrupt generated. Output compare (OC) functions can allow precise timing of actions via writable Timer Output Compare (TOC) registers. **MCU M can generate an interrupt when TCNT equals the value stored in a TOC register.***

[0038] The output of seed sensor S can be connected to an IC channel of MCU M. Two OC channels of MCU M can control the ON/OFF timing of the high-speed valve. Each time one of seeds 202 is detected, the TCNT value can be latched to a register of MCU M. A delay, corresponding to average travel time (predetermined time), can be added to the latched value. The result, representing predicted seed arrival time at furrow 204, can be stored in a memory. *Stored seed arrival times can be processed in the interrupt routine of the OC channel that controlled ON timing of fluid dispenser FD.* Stored values can be consecutively loaded into a TOC register (such as TOC1) such that an interrupt is generated at each predicted seed arrival time. *The interrupt routine can implement the following processes: (1) fluid dispenser FD is actuated; (2) the turn off time for fluid dispenser FD can be calculated and this value loaded into the TOC register (such as TOC2) that controlled turn off timing; and (3) the next stored value of seed arrival time is loaded into the TOC1 register. When TCNT equals the value stored in TOC2, a second interrupt can be generated, and fluid dispenser FD turned off.*

[0039] *As stated above, fluid dispenser FD can dispense fluid F on or at a desired location near seed 202 in response to actuation signals from control system CONT.* According to one embodiment, fluid dispenser FD can comprise a high-speed electromechanical valve 210, a valve driver circuit 212, and a nozzle 214. Fluid dispenser FD can also comprise a fuel injector for serving as a high-speed fluid valve. An exemplary fuel injector is the fuel injector with Part Number P82X-765 available from RC Engineering, Inc. of Saginaw, Mich., U.S.A. An exemplary nozzle is a lowpressure nozzle that produces a 50-degree flat-fan pattern such as the nozzle with Part Number 5005 available from Spraying Systems Co. *Actuator and nozzle 214 can be rigidly mounted at outlet end 208.*

[0061] *The fluid systems and methods described herein can also be applied to multi-row planters. FIG. 9 is a schematic diagram illustrating an exemplary fluid dispensing system, generally designated 900, applied to a multi-row planter.*

[0062] *Master controller 906 can control the operation of row controllers 908.* Each row controller 908 can communicate with a number of row units 910. *Each row unit 910 can comprise a seed*

tube, a seed detector, and a fluid dispenser, which can operate similar to seed tube ST, seed detector SD, and fluid dispenser FD, respectively, shown in FIG. 5. Each row controller 1108 can control its corresponding row units 910 similar to component 702 shown in FIG. 5. Each row controller 908 can also utilize a shift register for tracking seeds as described with respect to FIG. 4.

[0065] According to another embodiment, calibration can include a function relating seed arrival time to field speed, desired spray band length, valve installation geometry, and other variables influenced by seed type and the seed tube. *The seed arrival time can be subdivided into two periods: (1) a time period within seed tube ST which comprises the seed travel time between the sensed location in seed tube ST (FIG. 2) and output end 208 (FIG. 2) of seed tube ST; and (2) a time period outside of seed tube ST which comprises the seed travel time between output end 208 of seed tube ST and the location of fluid application by fluid dispenser FD (FIG. 2).*

[0066] The time period within seed tube ST (FIG. 2) can be assumed to be constant for a particular seed tube and seed type combination. This time period can be measured on a stationary system while operating the seed meter at a desired rotational speed. To measure this period, *a second sensor can be positioned at output 208 (FIG. 2) of seed tube ST and time durations between upper and lower seed sensor pulses can be calculated.*

Motivation to Combine:

Planters utilizing timing mechanisms to measure both delivery time of the seed applied substance and travel time of the seed, like those disclosed in Wilkerson, were well known and have been used in agricultural planters since well before the 2015 priority date of the 027 patent. As reflected in the similarity between the multi-row planters disclosed in Wagers and Wilkerson, one of ordinary skill in the art would have recognized that the multi-row planter of Wagers could have been readily equipped with any number of seed drop tubes incorporating a timing mechanism to calculate both the timing of the application of the seed applied substance and the timing of the seed to travel to the application location. The timing mechanism would have furthered the goal in Wagers of maximizing precision in the application of the seed applied substance during planting. This goal is also shared by Wilkerson in [0033]: “[seed detection] can ensure that system performance is not solely dependent on the ability of the meter and seed tube ST to deliver seeds 202 at uniform intervals to a location for receiving fluid F from fluid dispenser FD ... [and] ensures that the dispensing of fluid F corresponds with the actual dropping of each seed 202, rather than the expected dropping of each seed 202.”

US 12,102,027

Claim 9. The method of claim 1 further comprising the steps of:

providing **a mixer** in fluid communication with the substance receptacle and a substance flow path; and

mixing the seed-applied substance prior to the selected type of the seed-applied substance being applied to the seed.

Wagers + Batcheller (claims 9, 10)

Wagers:

[0028] “In another example, the multi-seed planter 104 includes one or more **agricultural product reservoirs 116, 118**. For instance, in one example a **liquid fertilizer or herbicide** is provided in the agricultural product reservoir 116. In one example the agricultural product reservoir 116 is distributed throughout the row units 114 for instance to corresponding **spray units** associated with each of the one or more row units 114 or associated with two or more row units 114.”

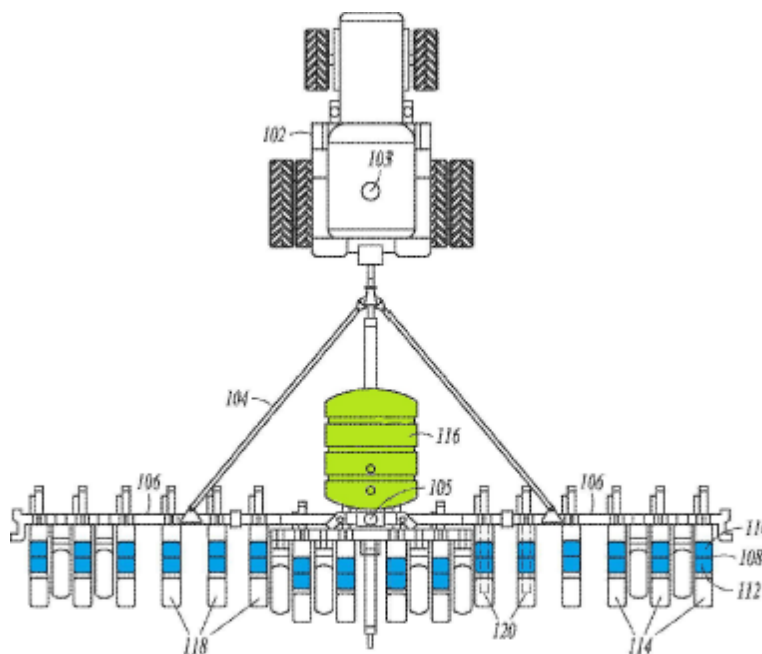


FIG. 1

[0040] “In a similar manner one or more of the sprayer or pneumatic dispenser 418 for liquid and granular agricultural products 418 are **adjusted to provide a desired type and amount of the respective agricultural product** based on the seed selected and optionally one or more of the terrain characteristics [408] for instance provided by the terrain characteristic module”

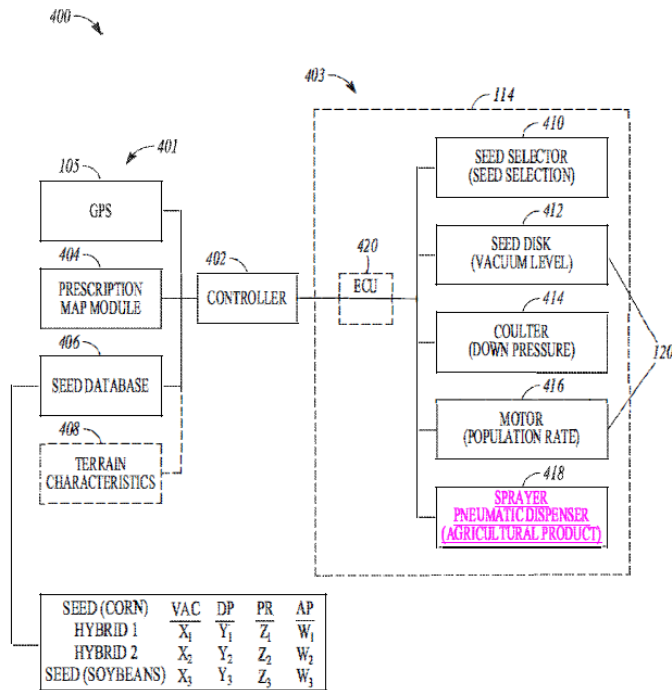


FIG. 4

Batcheller:

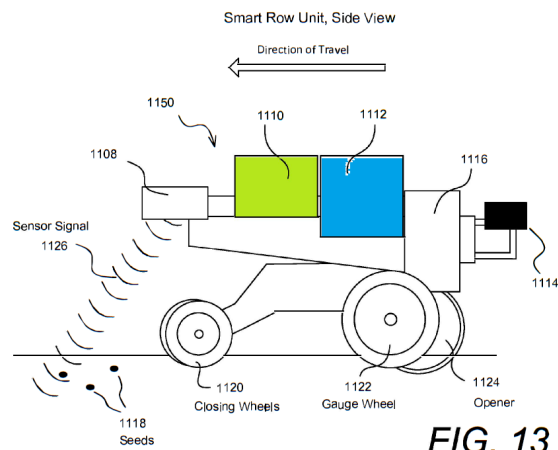


FIG. 13

[0134] The Smart row unit 1150 also has **a seeding system 1112** which comprises a bin containing the seed to be planted, **a metering system for controlling the rate at which seed is dropped into the ground as well as the position at which it is dropped**, and a processor for interpreting soil data from the soil sensing system 1116 and for controlling the seed placement.

[0135] The **seeding system 1112 is tied into a nutrient system 1110 which contains chemicals** that can be used to Supplement the

	nutrients missing from the Soil as detected by the soil sensing system 1116. If the soil is found to be lacking enough nitrogen, for example, based on the current soil conditions, the type of crop, the season, etc., then additional nitrogen can be added to the soil or mixed with the seeds before they go into the ground. [0143] “The <i>nutrient system 1110 contains several separate types of chemicals</i>, which may include fertilizers and pesticides, individual soil nutrients, and water, all of which can be added to the furrow or to the seed itself as required based on the soil conditions. <i>The nutrient may be separated by type and mixed together in the nutrient system 1110 as required to create the proper supplement</i> to add to the soil.” <u>Motivation to Combine:</u> The mixing of compounds just prior to field application is common practice and has been since the dawn of agriculture. Given this long-standing practice and Wagers’ focus on providing “a desired type and amount of the respective agricultural product” based on seed type, as excerpted above, one of ordinary skill in the art would have been motivated to incorporate a mixer in the multi-row planter disclosed in Wagers. Such mixers were well known at the time as reflected in Batcheller, and could have been readily incorporated in the Wagers planter.
<u>Claim 10.</u> The method of claim 1 further comprising the step of: adjusting a mixture ratio of the seed-applied substance during operation of the planter.	<u>Wagers:</u> [0028] “In another example, the multi-seed planter 104 includes one or more <i>agricultural product reservoirs 116, 118</i>. For instance, in one example a <i>liquid fertilizer or herbicide</i> is provided in the agricultural product reservoir 116. In one example the agricultural product reservoir 116 is distributed throughout the row units 114 for instance to corresponding <i>spray units</i> associated with each of the one or more row units 114 or associated with two or more row units 114.”

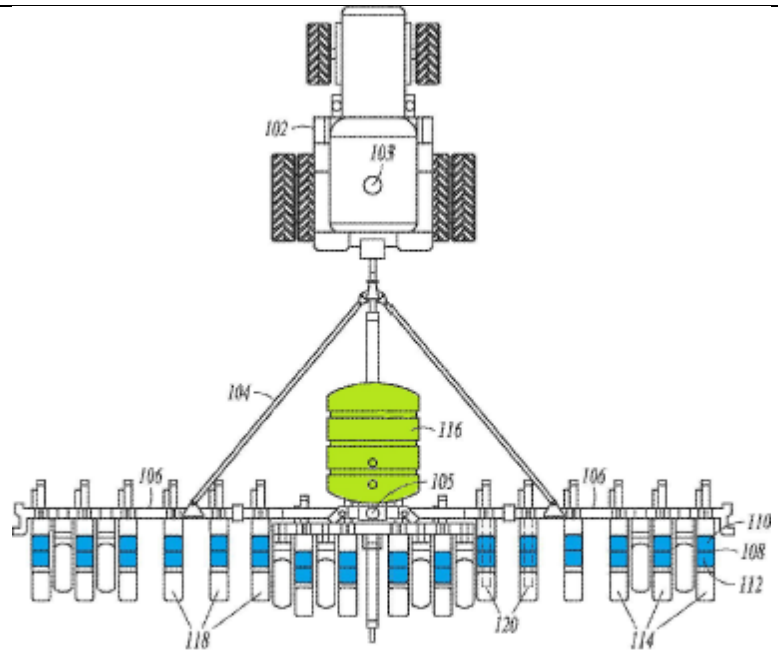


FIG. 1

[0040] “In a similar manner one or more of the sprayer or pneumatic dispenser 418 for liquid and granular agricultural products 418 are **adjusted to provide a desired type and amount of the respective agricultural product** based on the seed selected and optionally one or more of the terrain characteristics [408] for instance provided by the terrain characteristic module”

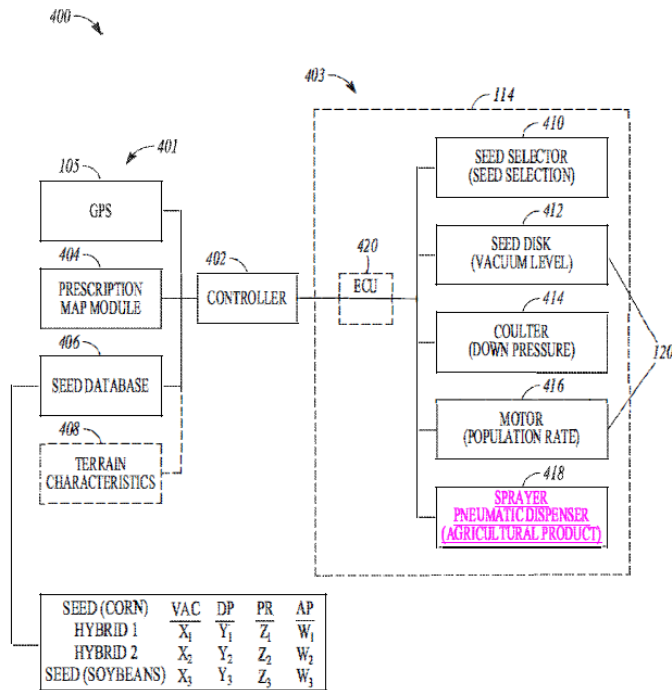


FIG. 4

Batcheller:

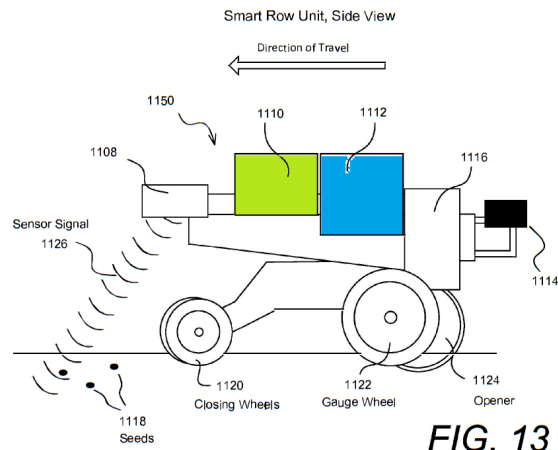


FIG. 13

[0134] The Smart row unit 1150 also has **a seeding system 1112** which comprises a bin containing the seed to be planted, **a metering system for controlling the rate at which seed is dropped into the ground as well as the position at which it is dropped**, and a processor for interpreting soil data from the soil sensing system 1116 and for controlling the seed placement.

[0135] The **seeding system 1112 is tied into a nutrient system 1110 which contains chemicals** that can be used to Supplement the

	nutrients missing from the Soil as detected by the soil sensing system 1116. If the soil is found to be lacking enough nitrogen, for example, based on the current soil conditions, the type of crop, the season, etc., then additional nitrogen can be added to the soil or mixed with the seeds before they go into the ground. [0143] “The <i>nutrient system 1110 contains several separate types of chemicals</i>, which may include fertilizers and pesticides, individual soil nutrients, and water, all of which can be added to the furrow or to the seed itself as required based on the soil conditions. The nutrient may be separated by type and <i>mixed together in the nutrient system 1110 as required to create the proper supplement</i> to add to the soil.” <u>Motivation to Combine:</u> The mixing of compounds just prior to field application is common practice and has been since the dawn of agriculture. Given this long-standing practice and Wagers’ focus on providing “a desired type and amount of the respective agricultural product” based on seed type, as excerpted above, one of ordinary skill in the art would have been motivated to incorporate a mixer in the multi-row planter disclosed in Wagers. Such mixers were well known at the time as reflected in Batcheller, and could have been readily incorporated in the Wagers planter.
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Claim 17. The method of claim 1, wherein the *seed drop tube* comprises an *air tube*.

Wagers:

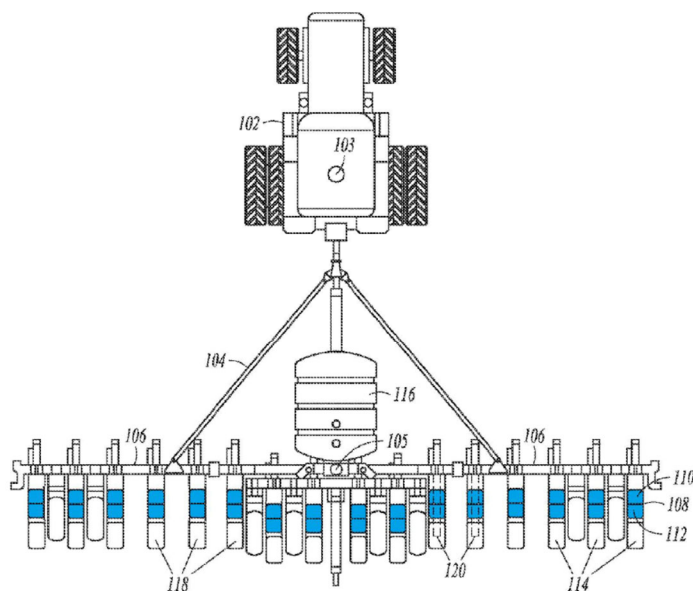


FIG. 1

[0029] “In one example, *each of the first and second sets of row units 202, 204 includes separate components for each of the respective row units (e.g., coulters, seed metering systems including seed wheels, seed hoppers and the like).*”

[0033] “In one example, the seed type prescribed in each of the Zones 302 correspondingly determines one or more planter characteristics of the multi-hybrid planter 104 including for instance one or more remotely adjustable planting characteristics of one or more of the row units 114 previously shown in FIG. 1 including, but not limited to, *population rate of the selected seed type, planter vacuum level for a seed disk, row unit down-pressure of one or more of the row unit coulters*, and the selection of one or more agricultural products and the rate of application of the one or more agricultural products.”

[0040] “In one example *a seed selector 410 is operated to accordingly feed the selected seed to the seed metering system 120 (e.g., including the seed disk driven by a motor such as a hydraulic motor, the vacuum fan)*. The seed disk 412 accordingly adjusts its vacuum level according to the seed type selected based on instructions from the controller 402. The *vacuum level is adjusted in one example to reliably hold each of the seeds along the seed disk (e.g., based on the respective size, shape, and weight of the seed) for planting according to a population rate for instance a population rate determined by a rotational speed provided by the*

motor 416. In another example the population rate controlled by the motor 416 is also determined by the controller 402 by way of the prescription provided in the seed database 406. In still another example, the **controller 402 controls a down-pressure of the coulter 414 according to the seed type being planted.** The coulter pressure is in one example adjusted upwardly or downwardly to provide a desired depth for planting of the selected seed.”

[0088] “controlling the population rate of the one or more seed metering systems includes **individually controlling the population rate of the one or more seed metering systems** of the corresponding row units”

[0089] “dynamically changing one or more remotely adjustable planting characteristics includes **controlling a planter vacuum level and corresponding retention force of the selected seed type along respective seed disks** of the one or more seed metering systems”

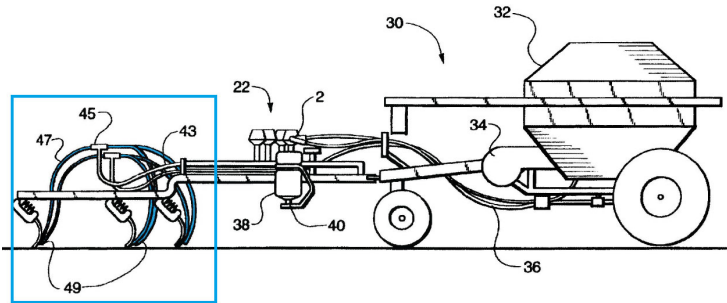
[0090] “dynamically changing one or more remotely adjustable planting characteristics includes **controlling a row unit down pressure of one or more row unit coulters** based on the selected seed type and the planter location”

[0116] “wherein the prescription map module includes a **seed type prescription map having a plurality of indexed locations distributed over the seed type prescription map, each of the indexed locations corresponding to one seed type** of two or more seed types”

One of ordinary skill in the art would understand that multi-seed planters, liked those disclosed in Wagers, that include seed metering systems and depth-setting coulters for placing seeds at prescribed distances and soil depth, would necessarily have seed drop tubes below the seed metering wheels for placing the seeds at the rate set by the metering wheel in the furrow set by the coulters. **Seed drop tubes** are a well understood and necessary component ubiquitous in all such multi-seed planters and have been used in planters since the advent of mechanized agriculture over a century ago (see, e.g., Mitchell – U.S. Patent No. 1,409,564 – issued March 14, 1922). The planting precision disclosed in Wagers, as excerpted above, requires the use of seed drop tubes, which are a necessary component of the multi-seed planters disclosed therein.

Memory:

Fig. 3



(Col. 1, lines 24-29) “Seeding implements are well known. Implements such as *air seeders convey the seeds from the reservoir to the seed deposition outlets of the implement by means of a flow of air through conduits*. The air flow is derived from a fan or air compressor, which typically is mounted on the implement and powered by the prime mover, normally a tractor.”

(Col. 2, line 66 – Col. 3, line 5) “The implement *conveys seeds in a flow of air carried by conduits to entrain the seeds within the air flow*. The seed treating unit is placed on the implement remote from the storage tank for the seeds to receive airborne seeds from an inlet tube, treat the seeds with a coating material, and discharge the seeds through an outlet tube to planting mechanisms.”

(Col. 4, lines 46-51) “The outlets 3 of the devices 22 are connected to and in flow communication with corresponding transport tubes 43. *The transport tubes 43 deliver coated seed to distributors 45 that operate to distribute the coated seeds to a plurality of delivery tubes connected to the seed deposition outlets 49 for depositing the coated seeds into the ground.*”

Motivation to Combine:

Seed drop tubes that use a flow of air to facilitate the discharge and planting of seeds, like those disclosed in Memory, were well known and have been used in agricultural planters since well before the 2015 priority date of the 027 patent. One of ordinary skill in the art would have recognized that the multi-row planter of Wagers could have been readily equipped with any number of seed drop tube types including air tubes, brush tubes, as well as gravity tubes. Each of these types of seed drop tubes would have furthered the express goal in Wagers of maximizing planting precision.

Claim 18. The method of claim 1, wherein the *seed drop tube* comprises *a brush tube*.

Wagers:

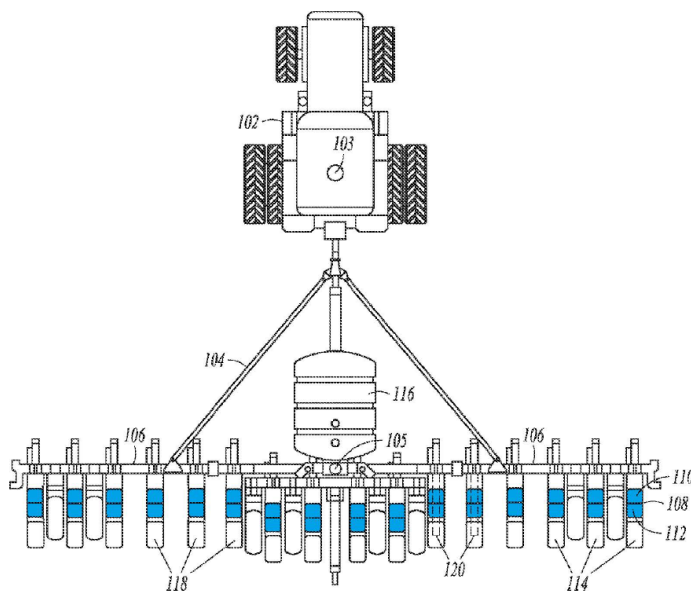


FIG. 1

[0029] “In one example, *each of the first and second sets of row units 202, 204 includes separate components for each of the respective row units (e.g., coulters, seed metering systems including seed wheels, seed hoppers and the like).*”

[0033] “In one example, the seed type prescribed in each of the Zones 302 correspondingly determines one or more planter characteristics of the multi-hybrid planter 104 including for instance one or more remotely adjustable planting characteristics of one or more of the row units 114 previously shown in FIG. 1 including, but not limited to, *population rate of the selected seed type, planter vacuum level for a seed disk, row unit down-pressure of one or more of the row unit coulters*, and the selection of one or more agricultural products and the rate of application of the one or more agricultural products.”

[0040] “In one example *a seed selector 410 is operated to accordingly feed the selected seed to the seed metering system 120 (e.g., including the seed disk driven by a motor such as a hydraulic motor, the vacuum fan)*. The seed disk 412 accordingly adjusts its vacuum level according to the seed type selected based on instructions from the controller 402. The *vacuum level is adjusted in one example to reliably hold each of the seeds along the seed disk (e.g., based on the respective size, shape, and weight of the seed) for planting according to a population rate for instance a population rate determined by a rotational speed provided by the motor 416*. In another example the population rate controlled by the motor 416 is also determined by the controller 402 by way of the

	prescription provided in the seed database 406. In still another example, the <i>controller 402 controls a down-pressure of the coulter 414 according to the seed type being planted.</i> The coulter pressure is in one example adjusted upwardly or downwardly to provide a desired depth for planting of the selected seed.” [0088] “controlling the population rate of the one or more seed metering systems includes <i>individually controlling the population rate of the one or more seed metering systems</i> of the corresponding row units” [0089] “dynamically changing one or more remotely adjustable planting characteristics includes <i>controlling a planter vacuum level and corresponding retention force of the selected seed type along respective seed disks</i> of the one or more seed metering systems” [0090] “dynamically changing one or more remotely adjustable planting characteristics includes <i>controlling a row unit down pressure of one or more row unit coulters</i> based on the selected seed type and the planter location” [0116] “wherein the prescription map module includes a <i>seed type prescription map having a plurality of indexed locations distributed over the seed type prescription map, each of the indexed locations corresponding to one seed type</i> of two or more seed types” One of ordinary skill in the art would understand that multi-seed planters, liked those disclosed in Wagers, that include seed metering systems and depth-setting coulters for placing seeds at prescribed distances and soil depth, would necessarily have seed drop tubes below the seed metering wheels for placing the seeds at the rate set by the metering wheel in the furrow set by the coulters. Seed drop tubes are a well understood and necessary component ubiquitous in all such multi-seed planters and have been used in planters since the advent of mechanized agriculture over a century ago (see, e.g., Mitchell – U.S. Patent No. 1,409,564 – issued March 14, 1922). The planting precision disclosed in Wagers, as excerpted above, requires the use of seed drop tubes, which are a necessary component of the multi-seed planters disclosed therein. <u>Garner:</u>
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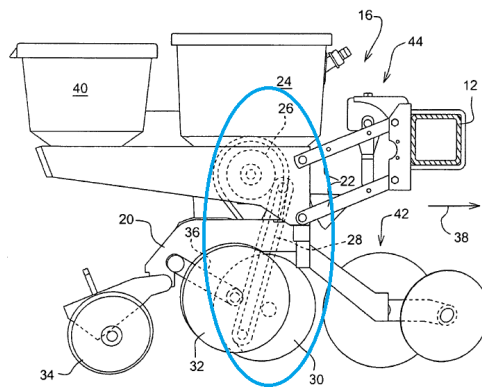
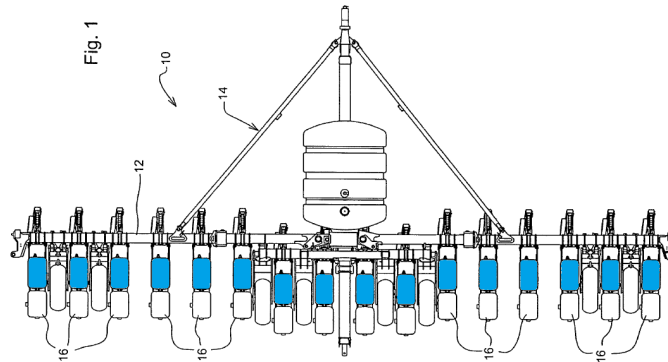


Fig. 2

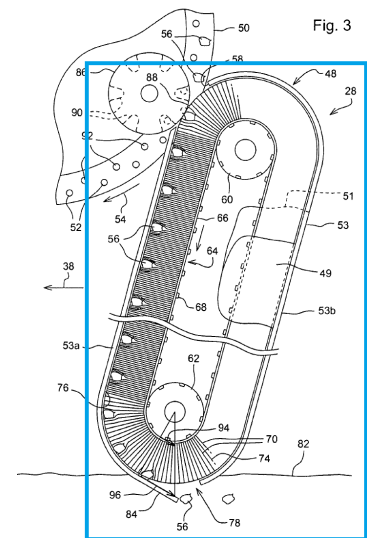


Fig. 3

(Col. 2, line 65 - Col. 3, line 19) Planter 10 includes a tool bar 12 as part of a planter frame 14. Mounted to the tool bar are multiple planting row units 16. Row units 16 are typically identical for a given planter but there maybe differences. A row unit 16 is shown in greater detail in FIG. 2. The row unit 16 is provided with a central frame member 20 having a pair of upwardly extending arms 21 (FIG. 4) at the forward end thereof. The arms 21 connect to a parallelogram linkage 22 for mounting the row unit 16 to the tool bar 12 for up and down relative movement between the unit 16 and toolbar 12 in a known manner. **Seed is stored in seed hopper 24 and provided to a seed meter 26. Seed meter 26 is of the type that uses a vacuum disk as are well known to meter the seed. Other types of meters can be used as well. From the seed meter 26 the seed is carried by a delivery system 28 into a planting furrow, or trench, formed in the soil by furrow openers 30.** Gauge wheels 32 control the depth of the furrow. Closing wheels 34 15 close the furrow over the seed. The gauge wheels 32 are mounted to the frame member 20 by arms 36. The toolbar and

	row unit are designed to be move over the ground in a forward working direction identified by the arrow 38. (Col. 3, lines 40-54) “The seed delivery system housing 48 has spaced apart front and rear walls 49 and 51 and a side wall 53 therebetween. <i>An upper opening 58 in the housing side wall 53 admits the seed from the metering disk 50 into the housing.</i> A pair of pulleys 60, 62 are mounted inside the housing 48. The pulleys support a belt 64 for rotation within the housing. One of the pulleys is a drive pulley while the other is an idler pulley. <i>The belt has a base member 66 to engage the pulleys and elongated bristles 70 extending therefrom. The bristles are joined to the base member at proximal, or radially inner, ends of the bristles. Distal, or radially outer, ends 74 of the bristles touch, or are close to touching, the inner surface 76 of the housing side wall 53.</i> A lower housing opening 78 is formed in the side wall 53 and is positioned as close to the bottom 80 of the seed trench as possible.” (Col. 2, lines 15-30) “The present invention provides a <i>seed delivery system that removes the seed from the seed meter by capturing the seed.</i> The delivery system then moves the seed down to a lower discharge point and accelerates the seed rearward to a horizontal velocity approximately equal to the forward travel speed of the seeding machine such that the seed, when discharged, has a low or zero horizontal velocity relative to the ground. Rolling of the seed in the trench is reduced as a result of the near zero horizontal velocity relative to the ground. Furthermore, as the seed experiences a controlled descent from the point at which it is removed from the meter to a point very near the bottom of the trench, the system becomes a nearly impervious to the field dynamics experienced by the row unit. The combination of controlled descent and discharge at a substantially zero horizontal speed relative to the 30 ground reduces seed spacing variability.” <u>Motivation to Combine:</u> Brush-type seed drop tubes, like those disclosed in Garner, were well known and have been used in agricultural planters since well before the 2015 priority date of the 027 patent. As reflected in the similarity between the multi-row planters disclosed in Wagers and Garner, one of ordinary skill in the art would have recognized that the multi-row planter of Wagers could have been readily equipped with any number of seed drop tube types including brush tubes, air tubes, as well as gravity tubes. Each of these types of seed drop tubes would have furthered the express goal in Wagers of maximizing planting precision. Garner discloses the brush meter as a way of reducing variation, i.e. improving accuracy of seed delivery. <i>Abstract</i>, col 1, ln 64 to col. 2, ln 11.
<u>Claim 19.</u> The method of claim 1, wherein the <i>seed drop tube</i> comprises <i>a seed accelerator</i>.	<u>Wagers:</u>

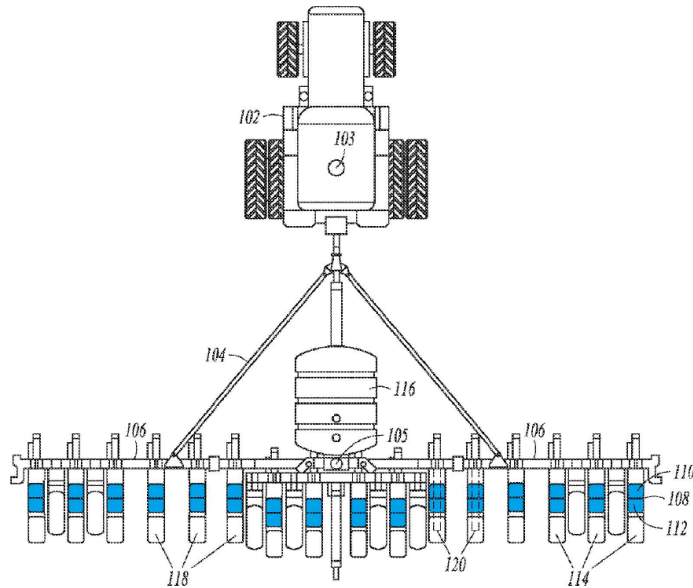


FIG. 1

[0029] “In one example, **each of the first and second sets of row units 202, 204 includes separate components for each of the respective row units (e.g., coulters, seed metering systems including seed wheels, seed hoppers and the like).**”

[0033] “In one example, the seed type prescribed in each of the Zones 302 correspondingly determines one or more planter characteristics of the multi-hybrid planter 104 including for instance one or more remotely adjustable planting characteristics of one or more of the row units 114 previously shown in FIG. 1 including, but not limited to, **population rate of the selected seed type, planter vacuum level for a seed disk, row unit down-pressure of one or more of the row unit coulters**, and the selection of one or more agricultural products and the rate of application of the one or more agricultural products.”

[0040] “In one example **a seed selector 410 is operated to accordingly feed the selected seed to the seed metering system 120 (e.g., including the seed disk driven by a motor such as a hydraulic motor, the vacuum fan).** The seed disk 412 accordingly adjusts its vacuum level according to the seed type selected based on instructions from the controller 402. The **vacuum level is adjusted in one example to reliably hold each of the seeds along the seed disk** (e.g., based on the respective size, shape, and weight of the seed) **for planting according to a population rate for instance a population rate determined by a rotational speed provided by the motor 416.** In another example the population rate controlled by the motor 416 is also determined by the controller 402 by way of the prescription provided in the seed database 406. In still another example, the **controller 402 controls a down-pressure of the coulter 414 according to the seed type being planted.** The coulter pressure is in one example

	adjusted upwardly or downwardly to provide a desired depth for planting of the selected seed.” [0088] “controlling the population rate of the one or more seed metering systems includes <i>individually controlling the population rate of the one or more seed metering systems</i> of the corresponding row units” [0089] “dynamically changing one or more remotely adjustable planting characteristics includes <i>controlling a planter vacuum level and corresponding retention force of the selected seed type along respective seed disks</i> of the one or more seed metering systems” [0090] “dynamically changing one or more remotely adjustable planting characteristics includes <i>controlling a row unit down pressure of one or more row unit coulter</i>s based on the selected seed type and the planter location” [0116] “wherein the prescription map module includes a <i>seed type prescription map having a plurality of indexed locations distributed over the seed type prescription map, each of the indexed locations corresponding to one seed type</i> of two or more seed types” One of ordinary skill in the art would understand that multi-seed planters, liked those disclosed in Wagers, that include seed metering systems and depth-setting coulter for placing seeds at prescribed distances and soil depth, would necessarily have seed drop tubes below the seed metering wheels for placing the seeds at the rate set by the metering wheel in the furrow set by the coulter. <i>Seed drop tubes</i> are a well understood and necessary component ubiquitous in all such multi-seed planters and have been used in planters since the advent of mechanized agriculture over a century ago (see, e.g., Mitchell – U.S. Patent No. 1,409,564 – issued March 14, 1922). The planting precision disclosed in Wagers, as excerpted above, requires the use of seed drop tubes, which are a necessary component of the multi-seed planters disclosed therein. <u>Garner:</u>
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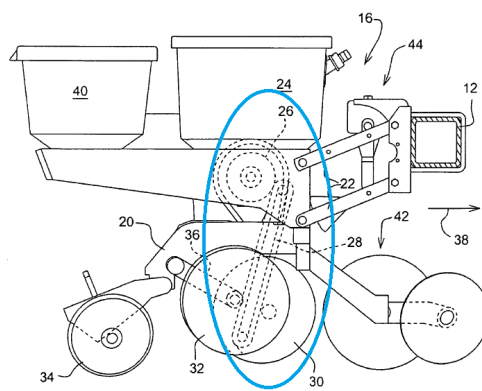
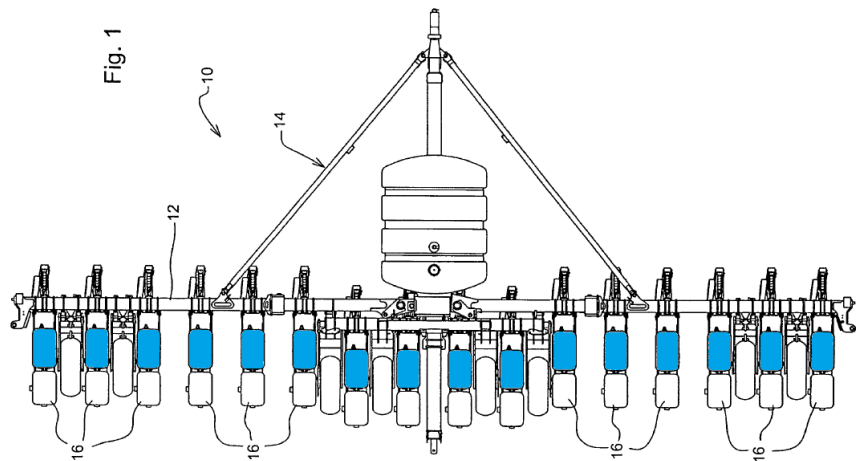
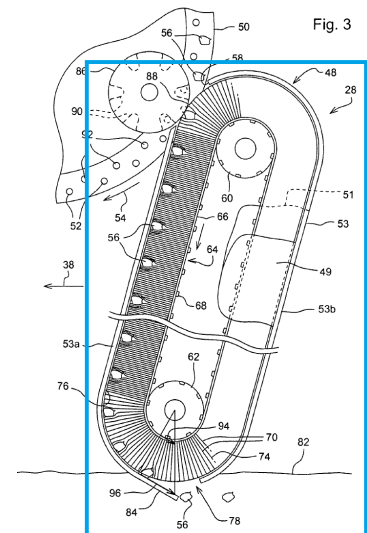


Fig. 2



(Col. 2, line 65 - Col. 3, line 19) Planter 10 includes a tool bar 12 as part of a planter frame 14. Mounted to the tool bar are multiple planting row units 16. Row units 16 are typically identical for a given planter but there maybe differences. A row unit 16 is shown in greater detail in FIG. 2. The row unit 16 is provided with a central frame member 20 having a pair of upwardly extending arms 21 (FIG. 4) at the forward end thereof. The arms 21 connect to a parallelogram linkage 22 for mounting the row unit 16 to the tool bar 12 for up and down relative movement between the unit 16 and toolbar 12 in a known manner. **Seed is stored in seed hopper 24 and provided to a seed meter 26. Seed meter 26 is of the type that uses a vacuum disk as are well known to meter the seed. Other types of meters can be used as well. From the seed meter 26 the seed is carried by a delivery system 28 into a planting furrow, or trench, formed in the soil by furrow openers 30.** Gauge wheels 32 control the depth of the furrow. Closing wheels 34 15 close the furrow over the seed. The gauge wheels

32 are mounted to the frame member 20 by arms 36. The toolbar and row unit are designed to be move over the ground in a forward working direction identified by the arrow 38.

(Col. 3, lines 40-54) “The seed delivery system housing 48 has spaced apart front and rear walls 49 and 51 and a side wall 53 therebetween. *An upper opening 58 in the housing side wall 53 admits the seed from the metering disk 50 into the housing.* A pair of pulleys 60, 62 are mounted inside the housing 48. The pulleys support a belt 64 for rotation within the housing. One of the pulleys is a drive pulley while the other is an idler pulley. *The belt has a base member 66 to engage the pulleys and elongated bristles 70 extending therefrom. The bristles are joined to the base member at proximal, or radially inner, ends of the bristles. Distal, or radially outer, ends 74 of the bristles touch, or are close to touching, the inner surface 76 of the housing side wall 53.* A lower housing opening 78 is formed in the side wall 53 and is positioned as close to the bottom 80 of the seed trench as possible.”

(Col. 2, lines 15-30) “The present invention provides a *seed delivery system that removes the seed from the seed meter by capturing the seed.* The delivery system then moves the seed down to a lower discharge point and accelerates the seed rearward to a horizontal velocity approximately equal to the forward travel speed of the seeding machine such that the seed, when discharged, has a low or zero horizontal velocity relative to the ground. Rolling of the seed in the trench is reduced as a result of the near zero horizontal velocity relative to the ground. Furthermore, as the seed experiences a controlled descent from the point at which it is removed from the meter to a point very near the bottom of the trench, the system becomes a nearly impervious to the field dynamics experienced by the row unit. The combination of controlled descent and discharge at a substantially zero horizontal speed relative to the 30 ground reduces seed spacing variability.”

(Col. 4, lines 27-33) “The lower opening 78 and the ramp 84 are positioned along the curved belt path around the pulley 62. The *bristle distal ends thus cause the linear speed of the seeds to accelerate relative to the speed of the belt base member 66 and the housing as shown by the two arrows 94 and 96. The seeds are then propelled by the bristles over the ramp 84 and discharged through the lower opening 78 into the seed trench.*”

Motivation to Combine:

Brush-type seed drop tubes that by design accelerate seeds as they are discharged, like those disclosed in Garner, were well known and have been used in agricultural planters since well before the 2015 priority date of the 027 patent. As reflected in the similarity between the multi-row planters disclosed in Wagers and Garner, one of ordinary skill in the art would have recognized that the multi-row planter of Wagers could have been readily equipped with any number of seed drop tube types

	including brush tubes, air tubes, as well as gravity tubes. Each of these types of seed drop tubes would have furthered the express goal in Wagers of maximizing planting precision. Garner discloses the brush meter as a way of reducing variation, i.e. improving accuracy of seed delivery. <i>Abstract</i> , col 1, ln 64 to col. 2, ln 11.
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