

**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE PATENT TRIAL AND APPEAL BOARD**

PRECISION PLANTING LLC,

Petitioner,

U.S. Patent No. 8,770,121

v.

IPR Case No.: IPR2024-00008

MASCHIO GASPARDO S.p.A.,

Patent Owner

DECLARATION OF DAVIDE LOCAS

I, Davide Locas, declare as follows:

I. INTRODUCTION

1. I am a European Patent and Trademark attorney with the firm of Cantaluppi and Partners located in Italy. Our firm has been retained as European patent counsel by Patent Owner, MASCHIO GASPARDO S.p.A. (“Maschio”) in this *Inter Partes* Review proceeding (“IPR”) before the Patent Trial and Appeal Board (“Board” or “PTAB”) of the United States Patent and Trademark Office (“USPTO”) regarding U.S. Patent No. 8,770,121 (“the ‘121 patent”) (Exhibit 1001 to the Petition).¹ I am being compensated for the time I spend on this matter, in

¹ In this Declaration, I reference documents by the exhibit or paper numbers that I understand have been attached to them in this IPR of the ‘121 patent.

addition to expenses. My compensation in this case is in no way contingent on the nature of my findings, the presentation of my findings in testimony, or the outcome of this or any other proceeding. I have no interest in this proceeding.

2. This Declaration is based on the information currently available to me. To the extent that additional information becomes available, I reserve the right to continue my investigation and study, which may include review of documents and information that may be produced, as well as testimony from depositions that have not yet taken place. My opinions are set forth before.

II. BACKGROUND AND QUALIFICATIONS

3. I have summarized in this section my educational background, career history, publications, and other relevant qualifications. My full *curriculum vitae* is attached as Appendix C to this Declaration.

4. Although I am a European Patent and Trademark attorney and not admitted to practice in the United States, I have become familiar with U.S. patent laws in my practice. My familiarity is based on 20 years of practice with colleagues who are U.S patent attorneys and agents.

5. My technical background is in mechanical engineering, and I graduated from the University of Padua (equivalent to a master's degree). According to the European patent law, professional representatives are not required to have attended law school, since they need only possess a university-level scientific or technical

qualification. Knowledge of patent law, civil law, and comparative law are nevertheless required to pass the Italian and European examinations for becoming professional representatives and bearing the title of (either Italian or European) patent attorney. During and after my training for becoming a patent attorney I attended several post-graduate courses, including the training course in European Patent Law organized by the Center for International Intellectual Property Studies (CEIPI) of the University of Strasbourg, and the Industrial Property Course – Patents, organized by the Department of Energy of Politecnico di Milano. I am a qualified European patent attorney since 2008, allowing me to represent clients for all proceedings before the European Patent Office, and a European Patent Litigator since 2017, allowing me to represent clients also before the Unified Patent Court for matters relating to both validity and infringement of European patents.

6. During my career as a patent attorney, I have dealt regularly with the U.S. national phase of the Patent Cooperation Treaty (PCT) applications, for which I advised my clients in view of the indications and suggestions received by my U.S. associates. In view of this, I have become familiar with some common aspects of patent prosecution before the USPTO, such as novelty and obviousness rejections. Because the U.S. market is generally important for European clients, I am often asked to provide opinions, shared with my U.S. associates, on matters relating to claim interpretation and the validity and infringement of U.S. patents.

III. MATERIALS REVIEWED

7. The opinions contained in this Declaration are based on the documents that I reviewed, my professional judgment, as well as my education, experience, and knowledge regarding technologies related to the '121 patent.

8. In forming my opinions expressed in this Declaration, I reviewed:

- U.S. Patent No. 8,770,121 (Exhibit 1001)
- Prosecution History U.S. Patent No. 8,770,121 (Exhibit 1002)
- Declaration of Dr. Mark Fleming and CV (Exhibits 1003 and 1018)
- Transcript of Deposition of Mark Fleming taken June 27, 2024 (Exhibit 2014)
- EP 2,637,492,B1(Exhibit 1004)
- EP Opposition File History (Exhibit 1005)
- EPO Dismissal dated November 20, 2023, of Precision's Appeal (Exhibit 2008)
- EPO Dismissal dated January 19, 2022, of Precision's Appeal (Exhibit 2009)
- U.S. Patent No. 7,228,807 to VenHuizen (Exhibit 1006)
- E.P. Patent No. 0536543 to Fiorido (Exhibit 1007)
- Amazone Manual – English (Exhibit 1011)
- U.S. Patent No. 9,127,708 (Exhibit 2017)

- Complaint (Exhibit 2011)
- Precision's Petition for IPR (Paper No. 2)
- Board's Decision Granting Institution of IPR (Paper No. 12)
- The Appendices attached to this Declaration.

IV. U.S. LEGAL STANDARDS

A. Overview

9. I am not a U.S. attorney or an expert on U.S. patent law. The U.S. legal standards that I applied in reaching the conclusions expressed throughout this Declaration were provided to me by counsel – although I confirmed at least some of those standards through my own experience. In preparing this Declaration, I have endeavored to faithfully apply these legal standards. I do not intend to offer opinions on the law.

10. I have been informed that an issued U.S. patent is presumed valid and that the challenger of the patent's validity bears the burden of proving invalidity of the patent.

B. Patent Claims

11. Patent claims describe the invention made by the inventor and describe what the patent owner owns and what the owner may prevent others from doing.

12. Claims may describe products, such as machines, or processes for making or methods of using a product. Claims are usually divided into parts or steps

called limitations.

13. There are two types of claims: independent claims and dependent claims. An independent claim sets forth all the requirements that must be met in order to be covered by that claim. Thus, it is not necessary to look at any other claim to determine what an independent claim covers. A dependent claim does not itself recite all of the requirements of the claim, but refers to another claim for some of its requirements. In this way, the claim depends on another claim. The law considers a dependent claim to incorporate all of the requirements of the claims to which it refers.

14. The dependent claim then adds its own additional requirements. To determine what a dependent claim covers, it is necessary to look at both the dependent claim and any other claims to which it refers.

15. In that case, the dependent claims incorporate the limitations of the independent claim upon which they depend and, if a reference fails to disclose any of the limitations of an independent claim, the claims which depend on that claim cannot be made invalid by that reference. As a result, any of the references at issue in this proceeding that fail to disclose all of the limitations of an independent claim necessarily also fail to disclose all of the limitations of claims which depend on that claim.

C. Burden of Proof for Invalidity

16. I understand that the party challenging the validity of an issued U.S. patent in an IPR bears the burden of proving invalidity through facts supported by a preponderance of the evidence. I understand that a “preponderance of the evidence” means evidence sufficient to prove that a fact is more likely true than it is not.

D. Claim Construction

17. I understand that the first step in determining validity is to properly construe the claims. I further understand that, in this proceeding, the Board must determine the scope of the claims by using the same claim construction standard that United States District Courts use. Under this standard, words of a claim are given their “ordinary” and “customary” meaning as understood by a hypothetical person of skill in the art (a “POSA”) at the time of the invention. I understand that such a person looks primarily to the claims, specification, and file history (collectively, the intrinsic evidence) in understanding the meaning of the claim terms. I further understand that evidence external to the patent (e.g., expert testimony, prior art, and dictionary definitions) may be relevant to claim construction. I have applied this understanding in this Declaration.

E. Person of Ordinary Skill in the Art (“POSA”)

18. I understand that a POSA may be defined by factors such as: (a) the levels of education and experience of the inventor and other persons actively involved

in the field; (b) the types of problems encountered in the field; (c) prior art solutions to those problems; (d) rapidity with which innovations are made; and (e) the sophistication of the technology.

F. Prior Art

19. I understand that a patent cannot be invalidated based on one person's testimony alone without corroborating evidence, particularly documentary evidence. Moreover, I understand that corroboration is required of any witness whose testimony alone is asserted to invalidate a patent, regardless of his or her level of interest in relation to that patent. Accordingly, even if the testifying individual has no interest in the litigation, I understand that corroboration is still required.

20. In this Declaration, I may use the phrase "prior art" when describing specific references. My use of this phrase should not be interpreted, however, as agreement that the reference or references described qualifies or qualify as prior art under the U.S. patent laws. I merely use this phrase to address the items labeled as "prior art" by Precision and its expert, Dr. Mark Fleming.

G. Anticipation

21. I understand that a patent claim can be found invalid as anticipated if each and every limitation of the claim, as properly construed, is found either explicitly or inherently in a single prior art reference. If the single prior art reference does not disclose any one claim limitation, then that claim is not anticipated. I further

understand that the single prior art reference cannot merely disclose each limitation; rather, it must disclose all of the limitations as arranged in the claim. I have been informed that for a prior art reference to “inherently” disclose something, the reference must necessarily function in accordance with, or include the claimed limitations, to anticipate. The missing descriptive matter cannot merely probably or possibly include the claimed limitations. I further understand that, with respect to an anticipation analysis, it is improper to combine separate, distinct embodiments of a single prior art reference.

22. I understand that for a claim to be anticipated, each claim limitation must be disclosed in a single prior art reference, and the claimed arrangement or combination of those limitations must also be disclosed in that same prior art reference. I understand that for a reference to be anticipatory, the reference must contain an enabling disclosure. I understand that merely naming or describing the subject matter is insufficient if it cannot be produced without undue experimentation.

H. Obviousness

23. I understand that a patent claim can be determined to be invalid as obvious if the differences between the claim and the prior art references would have been obvious to a person of ordinary skill in the art at the time of the invention, taking into account (1) the scope and content of the prior art, (2) the differences between the prior art and the claims, (3) the level of ordinary skill in the art, and (4)

any objective indicia of non-obviousness. I understand that, if present, objective indicia of non-obviousness concern real-world evidence of non-obviousness of the claimed invention (such as copying by another of the claimed invention; long-felt but unmet need in the art for the claimed invention; and failure of others in the art to achieve the results of the claimed invention), and that the evidence must be related to the novel features of the claimed invention. I further understand that a claim can be found to be obvious in light of either a single prior art reference or multiple prior art references. I understand that references qualify as prior art for an obviousness determination only when they are analogous to the claimed invention. Two separate tests define the scope of analogous prior art: (1) whether the art is from the same field of endeavor, regardless of the problem addressed; and (2) if the reference is not within the field of the inventor's endeavor, whether the reference still is reasonably pertinent to the particular problem with which the inventor is involved.

24. To be obvious in light of a single prior art reference or multiple prior art references, there must be a reason either to modify either the single prior art reference or to combine the two or more prior art references to achieve the claimed invention. I understand that this reason may come from a teaching, suggestion, or motivation to combine or may come from the reference or references themselves, the knowledge or "common sense" of one skilled in the art, or from the nature of the problem to be solved, and may be explicit or implicit from the prior art as a whole.

25. I also understand that a POSA must have reasonably expected that the combination of references would work, which is sometimes referred to as a “reasonable expectation of success.”

26. I further understand that a reference that “teaches away” from a given combination may negate a motivation to modify the prior art to meet the claimed invention. It is improper to combine references where the references teach away from their combination.

27. A reference may be said to teach away when a POSA, upon reading the reference, would be discouraged from following the path set out in the reference, or would be led in a direction divergent from the path that was taken by the claimed invention, or if the reference suggests that the line of development flowing from the reference’s disclosure is unlikely to yield the result sought by the claimed invention. When the prior art teaches away from combining certain known elements, discovery of a successful way of combining them is more likely to be nonobvious.

28. I understand that if the teachings of a prior art reference would lead a POSA to make a modification that would render another prior art device inoperable, then such a modification would generally not be obvious. I understand that if a proposed modification would render the prior art device unsatisfactory for its intended purpose, then the proposed modification would generally not be obvious.

29. I understand that it is improper to use hindsight in making the

obviousness determination.

30. I understand that some articulated reasoning with some rational underpinning to support the legal conclusion of obviousness must be made.

V. EUROPEAN PATENT LAW

31. Although I am not a U.S. patent attorney, I am fully qualified as a European Patent Attorney and as a European Patent Litigator. According to European practice, a Patent Attorney is only allowed to represent clients for proceedings, either ex parte or inter partes, before the European Patent Office (EPO). The EPO does not deal with patent infringement but only with validity. Nevertheless, claim interpretation is a matter discussed before the EPO when the validity of a patent is challenged. The qualification of European Patent Litigator allows me to represent clients also before the Unified Patent Court, i.e., the international court that since June 2023 is competent in respect of civil litigation on matters relating to European patents.

32. According to my knowledge, general patentability requirements under European law and U.S. law are similar, since an invention should be novel and not obvious to a POSA.

33. The practice of the EPO and the interpretation of the points of law are provided by the Guidelines for Examination in the EPO and by the Case Law of the Boards of Appeal of the EPO, and they deviate -- in some cases dramatically -- from

U.S. practice. In order to illustrate this deviation, I selected three pairs of corresponding patents granted to Precision both in the United States and in Europe and compared the respective independent claim 1 of each patent pair. The comparison is attached as Appendix D. The differences between the comparative claims are self-evident.

34. The requirement of non-obviousness in the European practice is determined in terms of inventive step, i.e., an invention shall be considered as involving an inventive step if, having regard to the state of the art, it is not obvious to a person skilled in the art.

35. According to the practice of the EPO, the assessment of the inventive step is based on a problem-solution approach. In the problem-solution approach, there are three main stages: (i) determining the “closest prior art,” (ii) establishing the “objective technical problem” to be solved, and (iii) considering whether or not the claimed invention, starting from the closest prior art and the objective technical problem, would have been obvious to the skilled person.

36. The question to be answered in the EPO approach is whether there is any teaching in the prior art as a whole that would (not simply could, but would) have prompted the skilled person, faced with the objective technical problem, to modify or adapt the closest prior art while taking account of that teaching, thereby arriving at something falling within the terms of the claims, and thus achieving what

the invention achieves. This means the skilled person should have at least an implicit prompting or an implicitly recognizable incentive to effectively consider a combination of elements from the prior art.

37. In the context of the problem-solution approach, it is permissible to combine the disclosure of one or more documents, with the closest prior art. The fact that more than one disclosure must be combined with the closest prior art in order to arrive at a combination of features, however, normally represents an indication of the presence of an inventive step.

38. A further aspect that should be taken into due consideration in all proceedings before the EPO, as well as before any Court dealing with the infringement of a European Patent, is the possibility to amend the application and the patent after grant.

39. The European patent law, that is the European Patent Convention or EPC, provides at Art. 123(2) that a European patent application or European patent may not be amended in such a way that it contains subject-matter which extends beyond the content of the application as filed. The underlying idea of this article is that applicants are not allowed to improve their position by adding subject-matter not disclosed in the application as filed, which would give them an unwarranted advantage and could be damaging to the legal security of third parties relying on the content of the original application. In more detail, an applicant is allowed to

introduce only features that are disclosed in a direct and unambiguous manner in the specification as filed.

40. An amendment is regarded as introducing subject-matter which extends beyond the content of the application as filed, and is therefore unallowable, if the overall change in the content of the application (whether by way of addition, alteration, or excision) results in the skilled person being presented with information which is not directly and unambiguously derivable from that previously presented by the application.

41. The above interpretation of the admissibility of amendments has been reached in successive referrals on the relevant point of law. According to the EPO practice, the judicial body in charge of issuing binding opinions on important points of law is the Enlarged Board of Appeal. Over time, the Enlarged Board of Appeal issued several opinions on the admissibility of amendments, making the possibility of introducing amendments stricter and stricter.

42. One relevant opinion stipulates that only amendments deriving directly and unambiguously from the content of the application as filed can be considered admissible. This opinion, that defined the law interpretation which is now called “gold standard,” was issued in 2011, i.e., after the priority date of the application that issued as the ‘121 patent (November 12, 2010).

43. In 2012, however, the Guidelines of the EPO still provided that at least where the amendment is by way of addition, the test for the allowability of the amendment normally corresponds to the test for novelty, which is a test less strict than the one defined according to the gold standard.

44. As a matter of fact, it was not possible to consider the gold standard when drafting the patent application. Nevertheless, the EPO applied the gold standard during the prosecution of the application and in the proceedings after the grant.

45. One important aspect of practice deriving from the gold standard is that it is possible to extract a specific feature in isolation from an originally disclosed combination of features and use it to delimit claimed subject-matter only if there is no structural and functional relationship between the relevant features. This means that, as a general rule, if a feature is disclosed only within a specific embodiment, it is possible to introduce an amendment based on such feature only in combination with all the features of the embodiment structurally and functionally linked thereto. This concept is called “intermediate generalization” and was introduced in the Guidelines of the EPO in 2012.

46. The U.S. patent law does not have a direct counterpart to the concept of intermediate generalization.

47. The Guidelines of the EPO, as well as the Case Law of the Board of Appeal, also provide relevant indications in connection with claim interpretation.

48. Means-plus-function claims, and similar formulations, are allowed under European patent law. According to the EPO practice, however, such formulation encompasses any structural feature suitable for carrying out the function of the means-plus-function feature. In view of this, the means-plus-function wording is typically used in European patents in order to define a feature in its broadest term, without any structural limitation. A means-plus-function wording is generally allowed in EPO proceedings even if a single embodiment is disclosed by the application.

49. This practice is divergent from the U.S. law in which a claim including a means-plus-function limitation shall be construed to cover only the corresponding structure described in the specification and equivalents thereto.

50. The practice of the EPO derives from the general concept that each claim must be read giving the words the meaning and scope which they normally have in the relevant art, unless in particular cases the description gives the words a special meaning, by explicit definition or otherwise. The claim must also be read with an attempt to make technical sense out of it. Such a reading may involve a departure from the strict literal meaning of the wording of the claims, but it is not

possible to exclude from this reading what is literally covered by the terms of the claims.

51. After the grant, the validity of a European patent can be challenged by any third party in a centralized manner within nine months from the mention of the grant by filing an “opposition.”

52. Typical grounds for opposition include lack of novelty and lack of inventive step over new references brought forward by the opposer. Sometimes, however, the opposer may just bring forward matters of interpretation of the claims over references that had already been cited during grant proceedings.

53. The patent proprietor may respond to the objections raised by the opposer by submitting patentability arguments and/or claim amendments. In respect of claim amendments, it is important to note that any addition of features from the description must comply with the EPO practice, according to which any amendment must be derivable in a direct and unambiguous manner from the specification as filed and, as mentioned before, it is not possible to isolate an element originally described in combination with other features. This typically obliges the patent proprietor to add to the claims a number of features that are actually irrelevant to the objection which is being addressed by the amendment.

54. The EPO will consider the submissions of both the opposer and the patent proprietor and check the patent for compliance with the requirements of the

EPC. If the EPO is of the opinion that a ground for opposition prejudices the maintenance of the European patent, it will revoke the patent. Otherwise, the EPO will maintain the patent as originally granted or as amended in opposition proceedings.

55. After opposition, any party adversely affected may file an appeal to the decision of the opposition division. The Board of Appeal of the EPO (representing the first and final judicial instance in the procedures before the EPO) is in charge of revising the decision. The Board of Appeal may decide to set aside the decision previously taken by the opposition division and also to remit the case to the opposition division for further prosecution. In this last case, the opposition division will be bound by the opinion given by the Board of Appeal. In case the Board of Appeal remits the case to the opposition division, any decision relating to the further prosecution of the case can itself be appealed. This further appeal cannot cover matters for which the Board of Appeal already gave its opinion/decision.

56. The Board of Appeal is the final judicial instance of the EPO. This means that any decision from the Board of Appeal is considered final. The validity of the patent can be further challenged before national courts, but national courts will not have the power to review a decision to revoke a European patent. It should be also noted that a national court will not be able to revoke the European patent in its entirety, but only the national portion thereof.

VI. EUROPEAN PATENT NO. 2 637 492 (Exhibit 1005)

57. Maschio Gaspardo S.p.A. owns European Patent No. 2 637 492 titled “SEED DISTRIBUTION ELEMENT FOR PRECISION SEED DRILLS, SEED DRILL INCLUDING SAID ELEMENT” and granted on December 3, 2014. *See* Exhibit 1004. I represented Maschio during prosecution of the ‘492 patent. EP Patent No. 2 637 492 corresponds to the ‘121 patent.

58. Precision Planting LLC filed a Notice of Opposition against the ‘492 patent before the EPO on September 2, 2015. *See* Exhibit 1005, 866. I represented Maschio during the opposition.

59. My summary of the opposition is provided in Appendix A. The opposition hinged on the claim limitation “thrust-bearing element.”

60. The EPO Opposition Division issued a decision to revoke the ‘492 patent on November 17, 2017. *See* Exhibit 1005, 503. As part of the decision, the EPO determined that Maschio’s Second Auxiliary Request (which introduced the wording “wherein the thrust-bearing element (26) is mounted on the movable portion” in claims 1 and 10) contravenes the provisions of Article 123(2) EPC because claims 1 and 10 were amended in such a way that their subject matter extends beyond the application as originally filed. Although the wording is taken literally from the originally filed description, the EPO determined that the wording constitutes “an intermediate generalisation (Guidelines H, V, 3.2.1).” Thus, the EPO

rejected what would have been an acceptable claim amendment under U.S. patent law.

61. Maschio filed a statement of its grounds for appeal March 27, 2018. *See* Exhibit 1005, 480. With the statement of grounds of appeal, Maschio filed new auxiliary requests 1 to 11. The Sixth Auxiliary Request presented claims 1 and 10 amended by introducing the feature “the thrust-bearing element (26) comprising a shaft (27) rotatably mounted by means of bearings (28) in a seat (29) of the movable portion (12).” Thus, the claims of the Sixth Auxiliary Request recited subject matter that very closely approximates the interpretation of claims 1 and 10 of the ‘121 patent as, Maschio proposes, they should be interpreted under U.S. patent law. The Seventh Auxiliary Request presented claims 1 and 10 amended by introducing the feature of the Sixth Auxiliary Request further amended by introducing the additional feature

the shaft (27) having flanging (30) by means of which it is fixed to a thrust-bearing plate (31) which can bear on the surface of the disc which faces the seal (24) in a zone radially inside the ring of holes (23) in order to withstand at least some of the axial load produced by the disc (16) on the seal (24).

Thus, the claims of the Seventh Auxiliary Request recited subject matter that introduced limitations into claims 1 and 10, Maschio proposes, that are unnecessary under U.S. patent law.

62. Precision filed a response to the appeal on August 14, 2018, asking that the appeal be dismissed. *See* Exhibit 1005, 351. Noteworthy is that Precision did not assert either Fiorido or Amazone in its response (which are asserted in the U.S. IPR). Precision stated that the parties' disagreement about whether independent claims 1 and 10 lack novelty in view of VenHuizen "is primarily based on a misinterpretation of [the thrust-bearing element recited in] the claims." *See* Exhibit 1005, 355. Specifically, Precision argued that, under European patent law:

... the assessment of novelty and inventive step should not be based on a narrow interpretation of the claims – as suggested by the Patentee - but rather follow a literal approach. . . . There is no support for anything other than a strict definitional approach to ensure legal certainty in assessing patentability, in particular novelty and inventive step over the prior art.

In no case can the term 'thrust bearing element' be interpreted as referring to some sort of roller bearing or rotary bearing as alleged by the Patentee (Patentee's submission pages 4 and 5). In fact, the claim wording itself defines the thrust bearing element in a broad sense and does not support a narrow interpretation of the term 'thrust bearing element', i.e. an interpretation in the sense of a rotary bearing. (Emphasis in original.)

If the term 'thrust bearing element' only refers to a rotary bearing as alleged by the Patentee, then the additional feature which requires that the thrust bearing element is supported rotatably in the movable portion would be redundant as the rotary bearing

itself already allows for relative rotation. [Paragraph change.] The function of the ‘thrust bearing element’ only resides in providing support against axial thrust forces. Rotational properties of the thrust bearing element are defined by a complementary rotational support, i.e. by the additional feature ‘[the thrust bearing element] *is supported rotatably*’ (e.g. by means of additional bearings 28 in a seat 29 of the movable portion 12; page 5, lines 24-25). Hence, **any element** that provides support against axial thrust on the disc is a thrust bearing element. (Emphasis in **bold** added; other emphasis in original.)

See Exhibit 1005, 355-57.

63. Precision also argued in its response to the appeal, with respect to Auxiliary Requests 6 and 7, that they violate Article 123(2) EPC and have to be rejected as inadmissible because the additional features of these Auxiliary Requests “are based on the extraction of isolated features from a set of features originally disclosed only in combination, i.e. the specific embodiment in the description. Consequently, each of the Auxiliary Requests 5 to 7 is based on an inadmissible intermediate generalization.” Exhibit 1005, 376 (emphasis in original). With respect to the patentability of the additional features, Precision challenged those features only as “rendered obvious by D10.” Exhibit 1005, 376. D10 is US 2003/0183647 and is not part of the U.S. IPR. Regardless, a reasonable view of Precision’s position is that none of VenHuizen, Fiorido, or Amazone (all of which are part of the U.S.

IPR) discloses or suggests the additional features recited in Auxiliary Requests 6 and 7.

64. On March 24, 2020, the EPO Board of Appeal issued its preliminary, non-binding observations in preparation for the oral proceedings. Exhibit 1005, 272. The Board noted that the Fifth Auxiliary Request amended both claims 1 and 10 to specify that the thrust-bearing element is rotatably supported on the movable portion. Exhibit 1005, 275 (emphasis in original). The Board observed: “The added function of being supported specifically on the movable portion is fulfilled in that context by means of some features specific to that embodiment, namely that the thrust-bearing element comprises **a shaft** rotatably mounted by means of **bearings in a seat of the movable portion**. They are thus closely structurally and functionally linked to the new feature. The inclusion of only one of these closely linked features represents therefore an unallowable intermediate generalisation.” Exhibit 1005, 276 (emphasis added). Thus, applying European patent law, the Board required more structure to link with the claimed function – but stated that the shaft, bearings, and seat provided the missing structure.

65. The Sixth Auxiliary Request amended both claims 1 and 10 to specify that the “thrust-bearing element (26) is supported rotatably in the movable portion (12) in order to withstand at least some of the axial load produced by the disc (16) on the seal (24), wherein the thrust-bearing element (26) is mounted on the movable

portion, the thrust-bearing element (26) comprising a shaft (27) rotatably mounted by means of bearings (28) in a seat (29) of the movable portion (12).” (Underlined portion added to the original claims.) In its preliminary, non-binding observations, the Board observed: “The sixth auxiliary request appears to overcome the above added subject-matter issue [observed for the fifth auxiliary request] by adding the cited missing [structural] features.” Exhibit 1005, 276.

66. Finally, in its preliminary, non-binding observations, the Board observed that VenHuizen fails to disclose a thrust-bearing element supported on the movable portion. “The subject-matter of claims 1 and 10 of both requests [six and seven] appear thus to be new.” Exhibit 1005, 276.

67. On July 23, 2020, oral proceedings were held before the EPO Board of Appeal and the Board issued its decision. Exhibit 1005, 226. The Board stated: “The interpretation of the claimed feature ‘thrust-bearing element’ is in dispute” and held “any element that restrains the axial movement of the disc when vacuum is applied, as does the thrust-bearing element of the described embodiment, meets the claimed limitation.” Exhibit 1005, 233, 235. The Board further stated: “According to established case law, it will normally not be allowable to base an amended claim on the extraction of isolated features from a set of features originally disclosed only in combination, e.g. a specific embodiment in the description.” Exhibit 1005, 239 (this European patent law is inconsistent with U.S. patent law). Applying that law

contrary to the previously comprised Board in its preliminary, non-binding observations dated March 24, 2020, the newly comprised Board determined that the inclusion of only some of the structural features for the thrust-bearing element in claims 1 and 10 of auxiliary request 6 represented an unallowable intermediate generalization under European patent law. Exhibit 1005, 240. Like the previously comprised Board, however, the newly comprised Board determined that the claims of auxiliary request 7 complied with the formal requirements of the European patent law (i.e., the European Patent Convention or EPC). Exhibit 1005, 240. The Board also determined that the claims of auxiliary request 7 were novel, noting that Precision “only contests the novelty of the claimed subject-matter in the light of D10. No other prior art [i.e., not D1, D2, or D6] is cited with regard to novelty.” Exhibit 1005, 241.

68. On October 11, 2021, Precision filed observations in response to the preliminary and non-binding opinion of the Opposition Division. Exhibit 1005, 179. Precision provided arguments as to why the subject-matter of claims 1 and 10 of Auxiliary Request 7 does not involve an inventive step in view of VenHuizen that parallel the arguments presented in the Petition filed in the U.S. IPR.

69. On January 7, 2022, the Opposition Division confirmed that the claims of Auxiliary Request 7 met the inventive step requirement and rejected the opposition. Exhibit 1005, 145. The Opposition Division specifically repeated

Precision's arguments that claims 1 and 10 of Auxiliary Request 7 do not involve an inventive step and concluded "that these arguments are not convincing." Exhibit 1005, 151-52.

70. Precision filed its "Grounds for Appeal" on May 16, 2022. Exhibit 1005, 51. Precision argued that "[t]he subject matter of claims 1 or 10 is rendered obvious by D10 and the common general knowledge of the person" in Paragraph 2.2. Exhibit 1005, 55. Recall that D1 is US 7,228,807 which issued to VenHuizen and D10 is US 2003/0183647 which issued as US 6,932,236 to VenHuizen. The focus of Precision's arguments in its "Grounds for Appeal" is on D10 rather than on D1.

71. On November 11, 2023, the EPO Board of Appeal published a copy of the minutes of the oral proceedings held on November 14, 2023. *See* Exhibit 2008. The EPO Board of Appeal dismissed Precision's appeal and confirmed the validity of the claims of EP '492, which is now definitely maintained in the form as amended after the previous opposition proceeding. The EPO Board rejected Precision's position that claims 1 and 10 lacked an inventive step in view of, among other references, VenHuizen, "and also in view of the common general knowledge and/or the prior art described in paragraph [0006] of the patent."

72. In summary, the EPO maintained European Patent No. 2 637 492 in amended form as explained above. This decision was appealed by Precision, but the

EPO dismissed the appeal, thereby confirming the validity of the patent as amended in opposition proceedings.

VII. PRECISION PLANTING LLC PATENT FAMILY

73. Counsel for Precision contacted my law firm early in 2020 expressing Precision's interest in a license to the '121 patent. The parties were unsuccessful in reaching agreement on the terms of a license.

74. I have reviewed a family of patent applications that were based upon U.S. Provisional Patent Application No. 16/694,471 and were filed with and prosecuted before the USPTO on behalf of Precision. All documents that I reviewed are available on the database of the PTO, www.uspto.gov. My review is summarized in Appendix B.

75. Precision copied, verbatim, claims 1-16 of the '121 patent in three different patent applications. *See* Appendices B1, B2, and B3.

76. During prosecution of U.S. Patent Application No. 14/793,360, Precision filed an Information Disclosure Statement on July 10, 2015, citing both the VenHuizen and Amazone references but not the Fiorido publication. *See* Appendix B4. Therefore, Precision took the position that the claims of the '121 patent are patentable over the VenHuizen and Amazone references, and that the Fiorido publication was insufficiently material to the claims to even make the publication of record.

77. During prosecution of U.S. Patent Application No. 16/694,471, Precision filed an Information Disclosure Statement on June 19, 2020, citing the VenHuizen, Fiorido, and Amazone references. *See* Appendix B5. Therefore, Precision took the position that the claims of the ‘121 patent are patentable over the VenHuizen, Fiorido, and Amazone references.

78. Also, during prosecution of U.S. Patent Application No. 16/694,471, the USPTO issued an Office Action dated October 5, 2021, which on page 3 stated: “The claims recite ‘a thrust-bearing element’. However, this specific type of bearing has not been disclosed throughout the continuation (CON) chain of applications. The limitations requiring a thrust-bearing element therefore comprise new matter.” *See* Appendix B6. Precision responded, on April 5, 2022, in part by amending the limitation “a thrust-bearing element” to “a shaft coupled to bearings held in place by the movable portion of the housing.” *See* Appendix B7.

VIII. CONCLUSION

79. This Declaration represents the opinions that I have formed up to date based on the material currently available to me. I reserve the right to revise, supplement, and/or amend my opinions stated in this Declaration based on new information that becomes available to me and on my continuing analysis of the materials available to me.

80. I declare that all statements made herein of my knowledge are true, and that all statements made on information and belief are believed to be true, and that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine, imprisonment, or both, under Section 1001 of Title 18 of the United States Code.

DATED: 07/19/2024



Davide Locas

Appendix A

Summary of the Prosecution of European Patent No. 2 637 492 (Exhibit 1005)

1. Maschio Gaspardo S.p.A. owns European Patent No. 2 637 492 titled “SEED DISTRIBUTION ELEMENT FOR PRECISION SEED DRILLS, SEED DRILL INCLUDING SAID ELEMENT” and granted on December 3, 2014. *See* Exhibit 1004. The ‘492 patent is based upon European Patent Application No. 117797027 filed on November 10, 2011. Like the U.S. ‘121 patent, the corresponding European ‘492 patent claims priority to Italian Patent Application No. PD 2010A000338 filed on 11/12/2010 (through PCT Published Patent Application No. WO 2012/062876)². *See* Exhibit 1005, 1415 for a certified copy of the priority document PD ‘338. Thus, EP Patent No. 2 637 492 corresponds to the ‘121 patent.

2. Precision Planting LLC filed a Notice of Opposition against the ‘492 patent before the European Patent Office (EPO) on September 2, 2015. *See* Exhibit 1005, 866. Precision submitted the following evidence in support of its opposition:

D1 = US 7 228 807 issued to VenHuizen; *See* Exhibit 1006

² Independent claims 1 and 10 of the PCT application recited similar subject matter to claims 1 and 10 of the ‘121 patent. References D1 and D2 were cited in the international search report as non-relevant (i.e., documents defining the general state of the art which is not considered to be of particular relevance). Further, the Written Opinion of the International Searching Authority determined that claims 1 and 10 were patentable over the prior art because the claims recited a thrust-bearing element supported rotatably in a movable housing to withstand axial load produced by the disk. *See* Exhibit 1005, 1520.

D2 = EP 0 536 543 issued to Fiorido; *See* Exhibit 1007

D3 = EP 2 848 109

D4 = US 4 664 290

D5 = EP 140 699

D6 = Publication by Amazone; *See* English version at Exhibit 1011

D7 = DE 689 16 976

D8 = WO 1996/02123

D9 = Translation of the Italian priority document

Although Precision cited the D2 reference, Precision did not rely on the Fiorido reference in its arguments challenging the validity of the claims of the ‘492 patent. Rather, Precision argued that independent claims 1 and 10 of the ‘492 patent lacked novelty (akin to being anticipated under U.S. patent law) and lacked an inventive step (akin to being obvious to a person of ordinary skill in the art at the time of the invention under U.S. patent law) over D1 (*See* Exhibit 1005, 877), D3 (*See* Exhibit 1005, 879), D4 (*See* Exhibit 1005, 881), D5 (*See* Exhibit 1005, 884), D6 (*See* Exhibit 1005, 885), D7 in combination with common general knowledge (*See* Exhibit 1005, 887), and D7 in combination with D8 (*See* Exhibit 1005, 890). With respect to claim interpretation, Precision stated: “claim 1 only requires that the thrust-bearing element 26 is in some way supported in the movable portion 12. It does not have to be supported by the movable portion 12. It could, for example, also be supported –

in the movable portion 12 – by the transmission shaft 20.” Exhibit 1005, 875 (emphasis in original). *See also* page 877 with respect to claim 10.

3. Maschio filed its response to the Notice of Opposition on April 22, 2016. *See* Exhibit 1005, 666. Maschio distinguished D1 on the ground that D1 fails to disclose the claimed thrust-bearing element supported rotatably in the movable portion of the housing in order to withstand at least some of the axial load produced by the disc on the seal. *See* Exhibit 1005, 673. Maschio distinguished D6 on the ground that D6 fails to disclose any thrust-bearing element able to withstand at least some of the axial loaded produced by the disc on the seal. *Id.* at 675.

4. Precision filed its reply to Maschio’s response on July 15, 2016. *See* Exhibit 1005, 640. Precision replied to Maschio’s arguments with respect to D1 at page 651 and with respect to D6 at page 655. Commenting on claim interpretation, Precision stated: “There is no support for anything other than a strict definitional approach to ensure legally [sic] certainty in assessing patentability, in particular novelty and inventive step over the prior art (*See Case Law of the Boards of Appeal (2013), II. A. 6.3.2; also T 1279/04*). Thus, the assessment of claim 1 has to be based on the wording of the claim.” Exhibit 1005, 652.

5. The EPO Opposition Division issued a preliminary opinion and summons to attend oral proceedings on December 21, 2016. *See* Exhibit 1005, 627.

6. Precision filed observations to the EPO's preliminary opinion and summons on August 22, 2017. *See* Exhibit 1005, 617. Precision stated that "the function and structure of the handles in D1, D4 and D5 fall within the meaning of claim 1 of the patent in suit." *Id.* at 622.

7. Maschio filed observations to the EPO's preliminary opinion and summons on August 24, 2017. *See* Exhibit 1005, 543. Maschio presented three auxiliary requests, as permitted by European patent law, with the First Auxiliary Request presenting the claims as filed and the Second and Third Auxiliary Requests presenting different sets of amended claims.

8. On October 24, 2017, oral proceedings were held. During these proceedings, Maschio filed a new second auxiliary request replacing the previous second auxiliary request and withdrew the third auxiliary request. *See* Exhibit 1005, 510.

9. The EPO Opposition Division issued a decision to revoke the '492 patent on November 17, 2017. *See* Exhibit 1005, 503. As part of the decision, the EPO determined that claims 1 and 10 as filed lacked novelty over D1. *See* Exhibit 1005, 513-14. The EPO further determined that reference A6 (the Amazone publication) did not constitute prior art. *See* Exhibit 1005, 504. Finally, the EPO still further determined that the Second Auxiliary Request (which introduced the wording "wherein the thrust-bearing element (26) is mounted on the movable portion" in

claims 1 and 10) contravenes the provisions of Article 123(2) EPC because claims 1 and 10 were amended in such a way that their subject matter extends beyond the application as originally filed. Although the wording is taken literally from the originally filed description, the EPO determined that the wording constitutes “an intermediate generalisation (Guidelines H, V, 3.2.1).” Thus, the EPO rejected what would have been an acceptable claim amendment under U.S. patent law.

10. Maschio filed a Notice of Appeal of the EPO Opposition Division’s decision on January 26, 2018. *See* Exhibit 1005, 496.

11. Maschio filed a statement of its grounds for appeal March 27, 2018. *See* Exhibit 1005, 480. Maschio asked the EPO Board of Appeal to set aside the decision of the Opposition Division and to maintain the patent as granted (main request). Specifically, Maschio offered its interpretation of the claim limitation “a thrust-bearing element is rotatably supported in the movable portion for withstanding at least some of the axial load produced by the sowing disc on the seal” and distinguished both D1 and D6 on the basis of that limitation. *See* Exhibit 1005, 481-86. Maschio acknowledged the Opposition Division’s determination that D6 does not constitute prior art and further distinguished D6 on the ground that D6 fails to disclose a motor-driven transmission shaft rotating at controlled speed a sowing disc. With the statement of grounds of appeal, Maschio filed new auxiliary requests 1 to 11. The Sixth Auxiliary Request presented claims 1 and 10 amended by introducing

the feature “the thrust-bearing element (26) comprising a shaft (27) rotatably mounted by means of bearings (28) in a seat (29) of the movable portion (12).” The Seventh Auxiliary Request presented claims 1 and 10 amended by introducing the feature of the Sixth Auxiliary Request further amended by introducing the additional feature “the shaft (27) having flanging (30) by means of which it is fixed to a thrust-bearing plate (31) which can bear on the surface of the disc which faces the seal (24) in a zone radially inside the ring of holes (23) in order to withstand at least some of the axial load produced by the disc (16) on the seal (24).”

12. Precision filed a response to the appeal on August 14, 2018, asking that the appeal be dismissed. *See* Exhibit 1005, 351. With the response, Precision submitted the following new evidence:

D10 = US 2003/0183647 which issued in 2005 as U.S. Patent No.

6,932,236 to VenHuizen

D11 = US 2002/0043201

D12 = ES 2 013 539 and its English-language machine translation

(D12’)

Noteworthy is that Precision did not assert either D2 or D6 in its response (which are asserted in the U.S. IPR). Precision stated that the parties’ disagreement about whether independent claims 1 and 10 lack novelty in view of D1 “is primarily based on a misinterpretation of [the thrust-bearing element recited in] the claims.” *See*

Exhibit 1005, 355. Specifically, under European patent law, “the assessment of novelty and inventive step should not be based on a narrow interpretation of the claims – as suggested by the Patentee - but rather follow a literal approach. . . . There is no support for anything other than a strict definitional approach to ensure legal certainty in assessing patent ability, in particular novelty and inventive step over the prior art.” *See* Exhibit 1005, 355-56. “In no case can the term ‘thrust bearing element’ be interpreted as referring to some sort of roller bearing or rotary bearing as alleged by the Patentee (Patentee’s submission pages 4 and 5). In fact, the claim wording itself defines the thrust bearing element in a broad sense and does not support a narrow interpretation of the term ‘thrust bearing element’, i.e. an interpretation in the sense of a rotary bearing.” Exhibit 1005, 356-57 (emphasis in original). “If the term ‘thrust bearing element’ only refers to a rotary bearing as alleged by the Patentee, then the additional feature which requires that the thrust bearing element is supported rotatably in the movable portion would be redundant as the rotary bearing itself already allows for relative rotation. [Paragraph change.] The function of the ‘thrust bearing element’ only resides in providing support against axial thrust forces. Rotational properties of the thrust bearing element are defined by a complementary rotational support, i.e. by the additional feature ‘[the thrust bearing element] *is supported rotatably*’ (e.g. by means of additional bearings 28 in a seat 29 of the movable portion 12; page 5, lines 24-25). Hence, **any element** that provides

support against axial thrust on the disc is a thrust bearing element.” Exhibit 1005, 357 (emphasis in **bold** added; other emphasis in original).

With respect to Auxiliary Requests 5 to 7, Precision argued that they violate Article 123(2) EPC and have to be rejected as inadmissible because the additional features of these Auxiliary Requests “are based on the extraction of isolated features from a set of features originally disclosed only in combination, i.e. the specific embodiment in the description. Consequently, each of the Auxiliary Requests 5 to 7 is based on an inadmissible intermediate generalization.” Exhibit 1005, 376 (emphasis in original). With respect to the patentability of the additional features, Precision challenged those features only as “rendered obvious by D10.” Exhibit 1005, 376.

13. The EPO Board of Appeal issued a summons on December 19, 2019 to attend oral proceedings scheduled for July 23, 2020. Exhibit 1005, 290.

14. On March 24, 2020, the EPO Board of Appeal issued its preliminary, non-binding observations in preparation for the oral proceedings. Exhibit 1005, 272. The Board noted that the Fifth Auxiliary Request amended both claims 1 and 10 to specify that the thrust-bearing element is rotatably supported on the movable portion. Exhibit 1005, 275 (emphasis in original). The Board observed: “The added function of being supported specifically on the movable portion is fulfilled in that context by means of some features specific to that embodiment, namely that the thrust-bearing

element comprises **a shaft** rotatably mounted by means of **bearings in a seat of the movable portion**. They are thus closely structurally and functionally linked to the new feature. The inclusion of only one of these closely linked features represents therefore an unallowable intermediate generalisation.” Exhibit 1005, 276 (emphasis added). Thus, applying European patent law, the Board required more structure to link with the claimed function – but stated that the shaft, bearings, and seat provided the missing structure.

The Sixth Auxiliary Request amended both claims 1 and 10 to specify that the “thrust-bearing element (26) is supported rotatably in the movable portion (12) in order to withstand at least some of the axial load produced by the disc (16) on the seal (24), wherein the thrust-bearing element (26) is mounted on the movable portion, the thrust-bearing element (26) comprising a shaft (27) rotatably mounted by means of bearings (28) in a seat (29) of the movable portion (12).” (Underlined portion added to the original claims.) The Board observed: “The sixth auxiliary request appears to overcome the above added subject-matter issue [observed for the fifth auxiliary request] by adding the cited missing [structural] features.” Exhibit 1005, 276.

The Seventh Auxiliary Request amended both claims 1 and 10 to specify that the “thrust-bearing element (26) is supported rotatably in the movable portion (12) in order to withstand at least some of the axial load produced by the disc (16) on the

seal (24), wherein the thrust-bearing element (26) is mounted on the movable portion, the thrust-bearing element (26) comprising a shaft (27) rotatably mounted by means of bearings (28) in a seat (29) of the movable portion (12), the shaft (27) having flanging (30) by means of which it is fixed to a thrust-bearing plate (31) which can bear on the surface of the disc which faces the seal (24) in a zone radially inside the ring of holes (23) in order to withstand at least some of the axial load produced by the disc (16) on the seal(24).” (Underlined portion added to the Sixth Auxiliary Request.) The Board observed that, like the sixth auxiliary request, “Auxiliary request 7 also appears to overcome the added subject-matter objection, since it also includes the above features.” Exhibit 1005, 276.

Finally, the Board observed that D1 fails to disclose a thrust-bearing element supported on the movable portion. “The subject-matter of claims 1 and 10 of both requests [six and seven] appear thus to be new.” Exhibit 1005, 276.

With respect to new documents D10-D12 cited by Precision, the Board was “inclined not to admit this late filed evidence” especially because “these documents appear not to be prima facie very highly relevant for novelty. It is not clearly derivable whether the knockout assemblies of documents D10 and D12 actually withstand axial load produced by the disc, since they mainly push the seeds to eject them from the disk holes and not the disk.” Exhibit 1005, 277.

15. On July 17, 2020, the EPO Board of Appeal noted a change in the composition of the three members of the Board. Exhibit 1005, 252.

16. On July 23, 2020, oral proceedings were held before the EPO Board of Appeal and the Board issued its decision. Exhibit 1005, 226. During the oral proceedings, Maschio withdrew the main request as well as auxiliary requests 1-3 and 5 of March 27, 2018. Therefore, auxiliary request 4 of March 27, 2018 became the new main request followed by auxiliary requests 6 and 7 of March 27, 2018. The Board of Appeal determined that the new main request (which did not amend the “thrust-bearing element” over the claims as originally filed) lacked novelty over D1. The basis for this determination was the Board’s claim interpretation that “any element that restrains the axial movement of the disc when vacuum is applied, as does the thrust-bearing element of the described embodiment, meets the claimed limitation.” Exhibit 1005, 235 (emphasis added).

The Board of Appeal noted that auxiliary requests 6 and 7 attempted to overcome the added subject-matter objection underlying the decision of the Opposition Division by specifying that the thrust-bearing element is mounted on the movable portion as well as including further detail of shaft, bearings, and seat for auxiliary request 6 and, for auxiliary request 7, still further detail of flanging and plate of the specific mounting arrangement. Exhibit 1005, 237. The Board stated: “According to established case law, it will normally not be allowable to base an

amended claim on the extraction of isolated features from a set of features originally disclosed only in combination, e.g. a specific embodiment in the description.” Exhibit 1005, 239. Applying that law contrary to the previously comprised Board in its preliminary, non-binding observations dated March 24, 2020, the newly comprised Board determined that the inclusion of only some of the structural features for the thrust-bearing element in claims 1 and 10 of auxiliary request 6 represented an unallowable intermediate generalization under European patent law. Exhibit 1005, 240. Like the previously comprised Board, however, the newly comprised Board determined that the claims of auxiliary request 7 complied with the formal requirements of the European patent law (i.e., the European Patent Convention or EPC). Exhibit 1005, 240. The Board also determined that the claims of auxiliary request 7 were novel, noting that Precision “only contests the novelty of the claimed subject-matter in the light of D10. No other prior art [i.e., not D1, D2, or D6] is cited with regard to novelty.” Exhibit 1005, 241. Therefore, the Board of Appeal set aside the decision under appeal and remanded or remitted the case to the Opposition Division in order to assess whether the claims of Auxiliary Request 7 meet the requirements of the EPC with regard to inventive step. Exhibit 1005, 243.

17. On January 28, 2021, following remand from the Board, the Opposition Division issued a summons to oral proceedings to take place on December 13, 2021 and stated: “The opposition division is of the preliminary and non-binding opinion

that the subject-matter of claims 1 and 10 of auxiliary request 7 involves an inventive step.” Exhibit 1005, 217.

18. On October 11, 2021, Precision filed observations in response to the preliminary and non-binding opinion of the Opposition Division. Precision provided arguments as to why the subject-matter of claims 1 and 10 of Auxiliary Request 7 does not involve an inventive step in view of D10 or in view of D1, D4, or D5. Exhibit 1005, 179. Specifically, with respect to D1, Precision argued: “D1 further discloses a thrust-bearing element (handle 58) and this is confirmed by point 3 of the interlocutory decision of the Board of Appeal. D1 also discloses that the thrust-bearing element (handle 58) includes a shaft (drive shaft 55) rotatably mounted by means of bearings (*see* FIG. 6: shaft is supported by bearings). According to D1, a flanging (rotating retaining hub 56) is fixed to a thrust-bearing plate (left surface of handle 58). The retaining hub is fixed to the handle when the device is assembled. The thrust-bearing plate (left surface of handle) can bear against the surface of the disc which faces the seal in a zone radially inside the ring of holes thereby bearing at least some of the axial load produced by the disc on the seal. [Paragraph change omitted.] The subject matter of claim 1 therefore differs from D1 merely in that the thrust-bearing element (comprising the shaft, the flanging and the thrust-bearing plate) is mounted in the movable portion and not in the fixed portion. . . . One of ordinary skill reading D1 would know that arranging the thrust-bearing element in

the movable portion makes it easier to access and/or replace parts of the seed distribution element. [Paragraph change omitted.] The arrangement of a disc supporting element in the movable portion is one of two alternatives for arranging a thrust-bearing element, which can either be arranged in the fixed or in the movable portion. Thus, when starting from D1, choosing the other alternative and mounting a rotatable thrust-bearing element in the movable portion cannot be considered to involve an inventive step.” Exhibit 1005, 187-88.

19. On December 13, 2021, the EPO Opposition Division conducted oral proceedings and concluded “that the subject-matter of claim 1 and the corresponding kit claim 10 of the auxiliary request 7 involves an inventive step (Art. 56 EPC).” Exhibit 1005, 173. Thus, the Opposition Division held those claims patentable over D1.

20. On January 7, 2022, the Opposition Division confirmed that the claims of Auxiliary Request 7 met the inventive step requirement and rejected the opposition. Exhibit 1005, 145. The Opposition Division specifically repeated Precision’s arguments that claims 1 and 10 of Auxiliary Request 7 do not involve an inventive step in view of D10 and concluded “that these arguments are not convincing.” Exhibit 1005, 151-52.

21. Precision filed a Notice of Appeal on March 3, 2022. Exhibit 1005, 70.

22. Precision filed its “Grounds for Appeal” on May 16, 2022. Exhibit 1005, 51. Precision argued that “[t]he subject matter of claims 1 or 10 is rendered obvious by D10 and the common general knowledge of the person” in Paragraph 2.2. Exhibit 1005, 55. Paragraph 2.3 on page 10 states: “The seed meters disclosed in D1, D4 and D5 have the same basic structure as the seed meter in D10 (*see* D1, FIG. 6; D4, FIG. 3; D5, FIG. 3.), including the arrangement of the sowing disc in the fixed housing portion, the definition of the suction chamber in the movable housing portion and the arrangement of the seal in movable housing portion.” Exhibit 1005, 60.

23. Maschio filed its Observations to the Notice of Appeal on September 27, 2022. Exhibit 1005, 44. Responding to Precision’s “Grounds for Appeal,” Maschio devoted most of its Observations to supporting the Opposition Division’s conclusion that the subject matter of claims 1 and 10 involved an inventive step in view of D10 and the common general knowledge of a person skilled in the art. With respect to D1, Maschio stated: “[Precision] also mention[s] documents D1, D4, D5 as possible closest prior art. Nevertheless this can be excluded since no disclosure of the knock out element is provided in such documents and none of the[m] discloses a thrust bearing element supported on a seat in the movable portion (even considering the handles as thrust bearing elements, they are clearly not supported on [the] movable portion).” Exhibit 1005, 46.

24. On November 20, 2023, the EPO Board of Appeal published a copy of the minutes of the oral proceedings held on November 14, 2023. *See* Exhibit 2008. The EPO Board of Appeal dismissed Precision’s appeal and confirmed the validity of the claims of EP ‘492, which is now definitely maintained in the form as amended after the previous opposition proceeding. The EPO Board rejected Precision’s position that claims 1 and 10 lacked an inventive step in view of, among other references, D1, “and also in view of the common general knowledge and/or the prior art described in paragraph [0006] of the patent.”

Appendix B

Review of Precision Planting LLC Patent Family

1. I have reviewed a family of patent applications that were based upon U.S. Provisional Patent Application No. 16/694,471 and were filed and prosecuted on behalf of Precision. Certain of the family members are summarized in the table below.

Application No.	Date filed	Status	Date Issued	Notes
61/466,047	March 22, 2011	Abandoned		
PCT/US12/30192	March 22, 2012	Abandoned		
14/006,569 (National phase of PCT '192)	Sept. 20, 2013	Issued	May 31, 2016	U.S. Patent No. 9,351,440
14/793,360 (Continuation of '569)	July 7, 2015	Abandoned		Copied claims 1 – 16 from the Maschio '121 patent
15/653,496 (Continuation of '360)	July 18, 2017	Abandoned		Copied claims 1 – 16 from the Maschio '121 patent

15/653,500 (Continuation of '360)	July 18, 2017	Issued	January 28, 2020	U.S. Patent No. 10,542,664
16/694,471 (Continuation of '496)	Nov. 25, 2019	Abandoned		Copied claims 1 – 16 from the Maschio '121 patent

Application No. 14/793,360 was published as U.S. Patent Application Publication No. 2015/0305229 and a copy of the publication is attached as Appendix B1.

Application No. 15/653,496 was published as U.S. Patent Application Publication No. 2017/0311535 and a copy of the publication is attached as Appendix B2.

Application No. 16/694,471 was published as U.S. Patent Application Publication No. 2020/0296881 and a copy of the publication is attached as Appendix B3.

2. In the '360 application, Precision copied, verbatim, claims 1-16 of the '121 patent and added claims 17-32 as a slightly reworded version of claims 1-16. Precision filed an Information Disclosure Statement on July 10, 2015. *See* Appendix B4, citing both the VenHuizen and Amazone references but not the Fiorido publication. The Examiner rejected the claims under Section 112, first paragraph, as

failing to comply with the written description and enablement requirements. Precision never responded to the rejection, abandoning the ‘360 application, and instead filed two continuations, the ‘496 and ‘500 applications, both on July 18, 2017.

3. The ‘496 application had the same claims as the ‘360 application. This time, the Examiner rejected the claims as non-enabled, stating specifically that the term “thrust bearing” was not described. The Examiner also rejected the claims as anticipated by the PCT publication of Maschio, WO2012/062876. As before, the applicant did not respond, abandoning the ‘496 application, and a continuation was filed.

4. The ‘500 application had different claims and proceeded to allowance. It was issued on January 28, 2020, as U.S. Patent No. 10,542,664.

5. The ‘471 application also had the same claims as the ‘496 and ‘360 applications. Precision filed an Information Disclosure Statement on June 19, 2020, citing the VenHuizen, Fiorido, and Amazone references. *See* Appendix B5. The Examiner made the same Section 112, first paragraph, and Section 102 anticipation rejections again citing the PCT publication of Maschio, WO2012/062876. The Office Action dated October 5, 2021, on page 3, stated: “The claims recite ‘a thrust-bearing element’. However, this specific type of bearing has not been disclosed throughout the continuation (CON) chain of applications. The limitations requiring

a thrust-bearing element therefore comprise new subject matter.” *See* Appendix B6. The applicant responded, on April 5, 2022, in part by amending the limitation “a thrust-bearing element” to “a shaft coupled to bearings held in place by the movable portion of the housing.” *See* Appendix B7. The application was abandoned for failure to respond to another Office Action on March 24, 2023.

Appendix B1



US 20150305229A1

(19) **United States**

(12) **Patent Application Publication**
Sauder

(10) **Pub. No.: US 2015/0305229 A1**

(43) **Pub. Date: Oct. 29, 2015**

(54) **SEED METER**

Publication Classification

(71) Applicant: **PRECISION PLANTING LLC**,
Tremont, IL (US)

(51) **Int. Cl.**
A01C 7/04 (2006.01)

(72) Inventor: **Derek Sauder**, Tremont, IL (US)

(52) **U.S. Cl.**
CPC **A01C 7/046** (2013.01)

(21) Appl. No.: **14/793,360**

(57) **ABSTRACT**

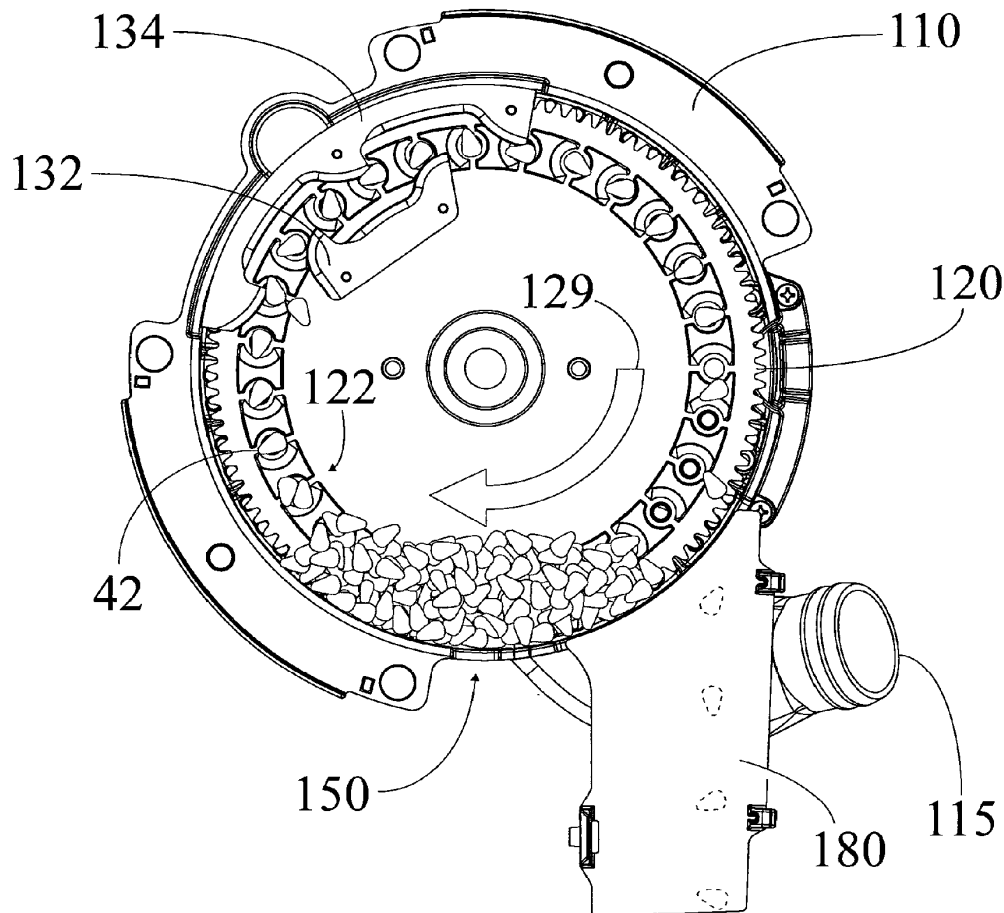
(22) Filed: **Jul. 7, 2015**

Related U.S. Application Data

(63) Continuation of application No. 14/006,569, filed on Sep. 20, 2013, filed as application No. PCT/US2012/030192 on Mar. 22, 2012.

(60) Provisional application No. 61/466,047, filed on Mar. 22, 2011.

A seed meter for an agricultural planter in which the seed disc is rotatably mounted within a seed meter housing. As the seed disc rotates, the apertures in the disc rotate along a seed aperture path through a horizontally adjacent seed pool area. The seed disc includes cavities disposed along the seed aperture path to agitate the seeds in the seed pool area. A singulator having multiple co-planar singulator surfaces is biased against the seed side surface of the seed disc.



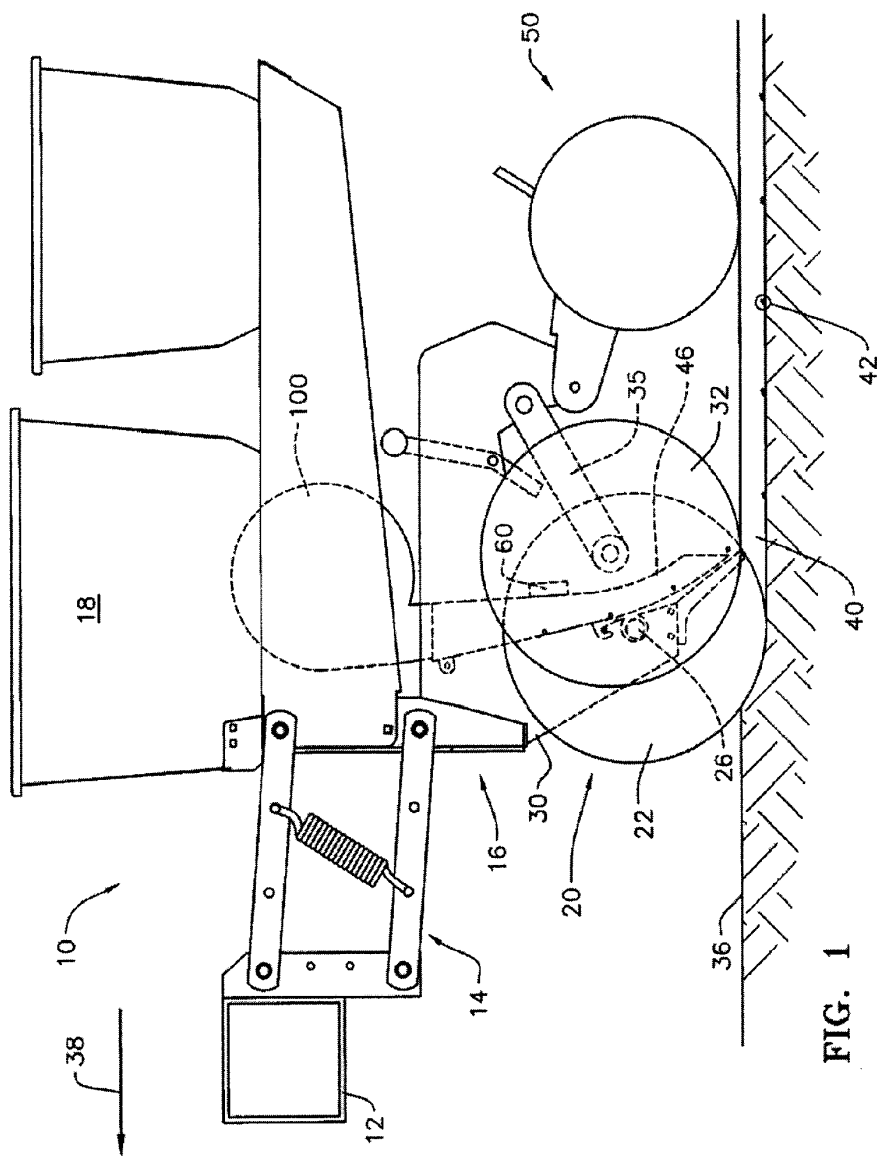


FIG. 1

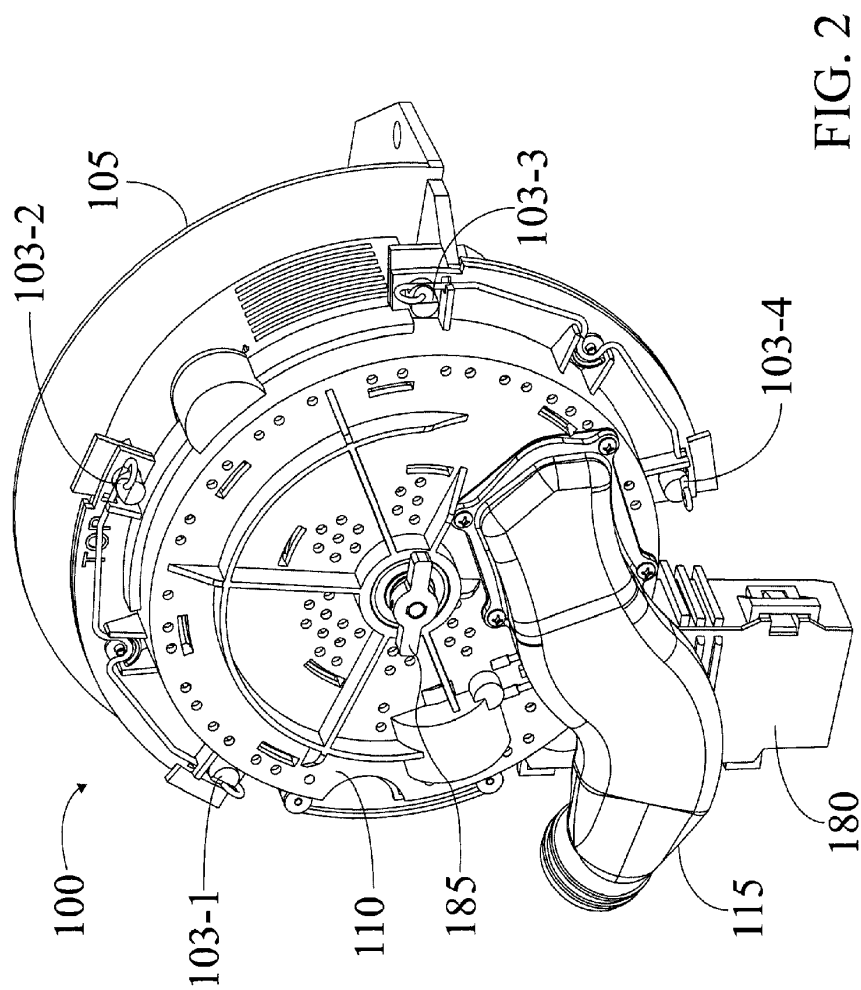


FIG. 2



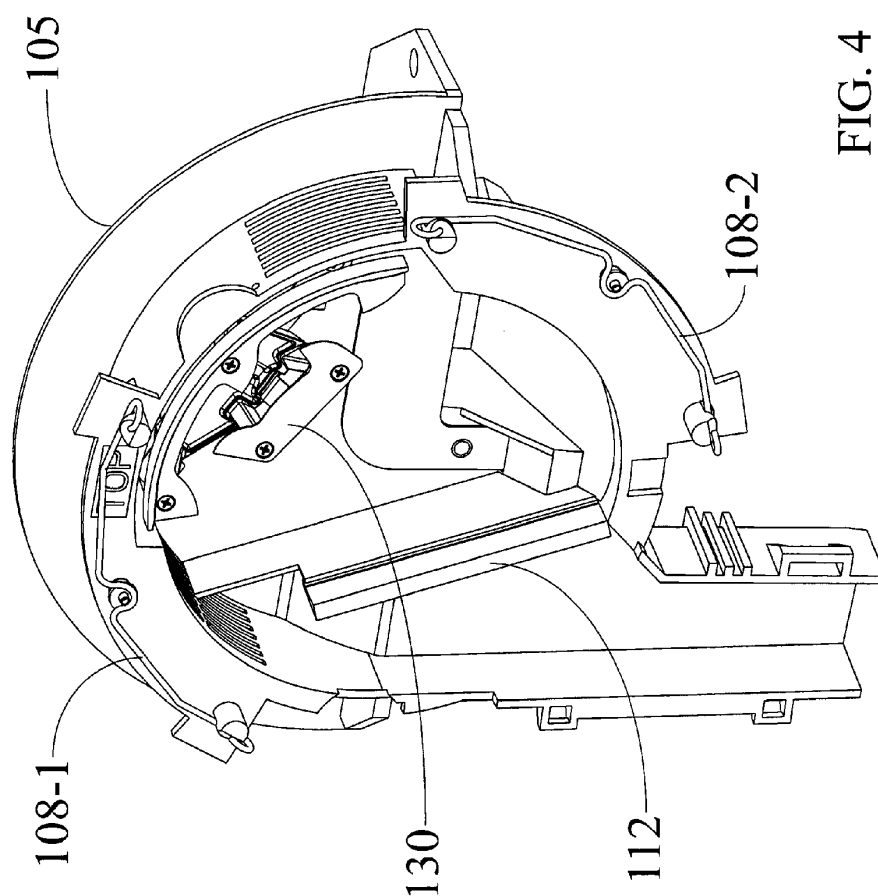


FIG. 4

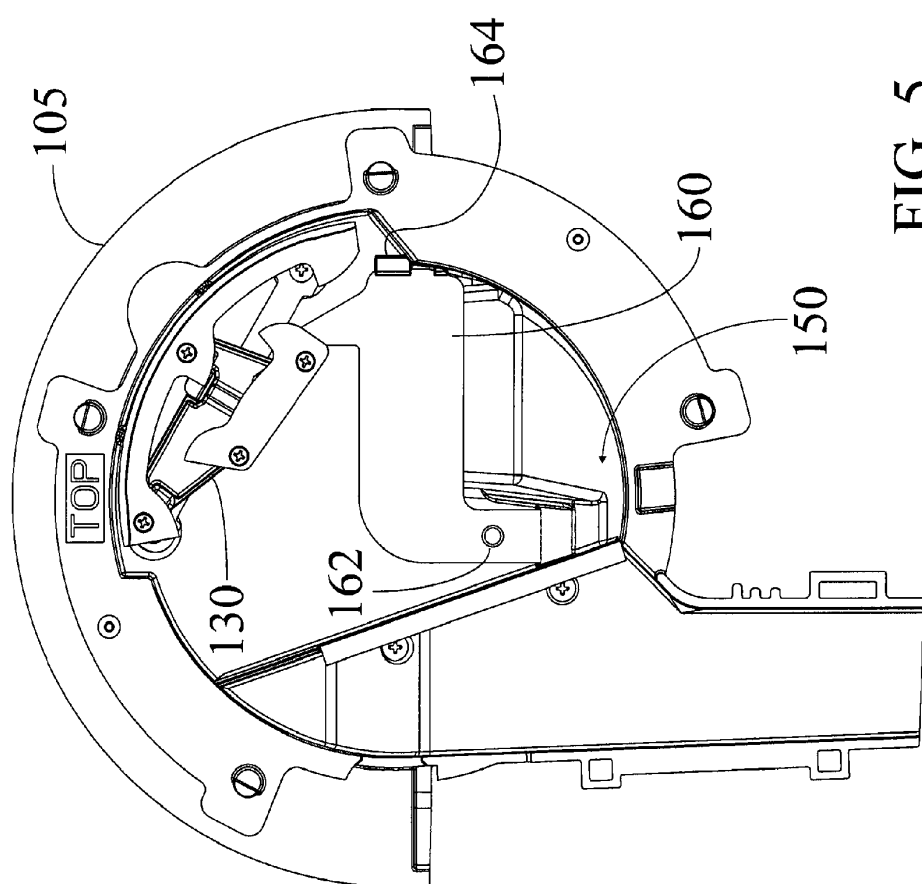
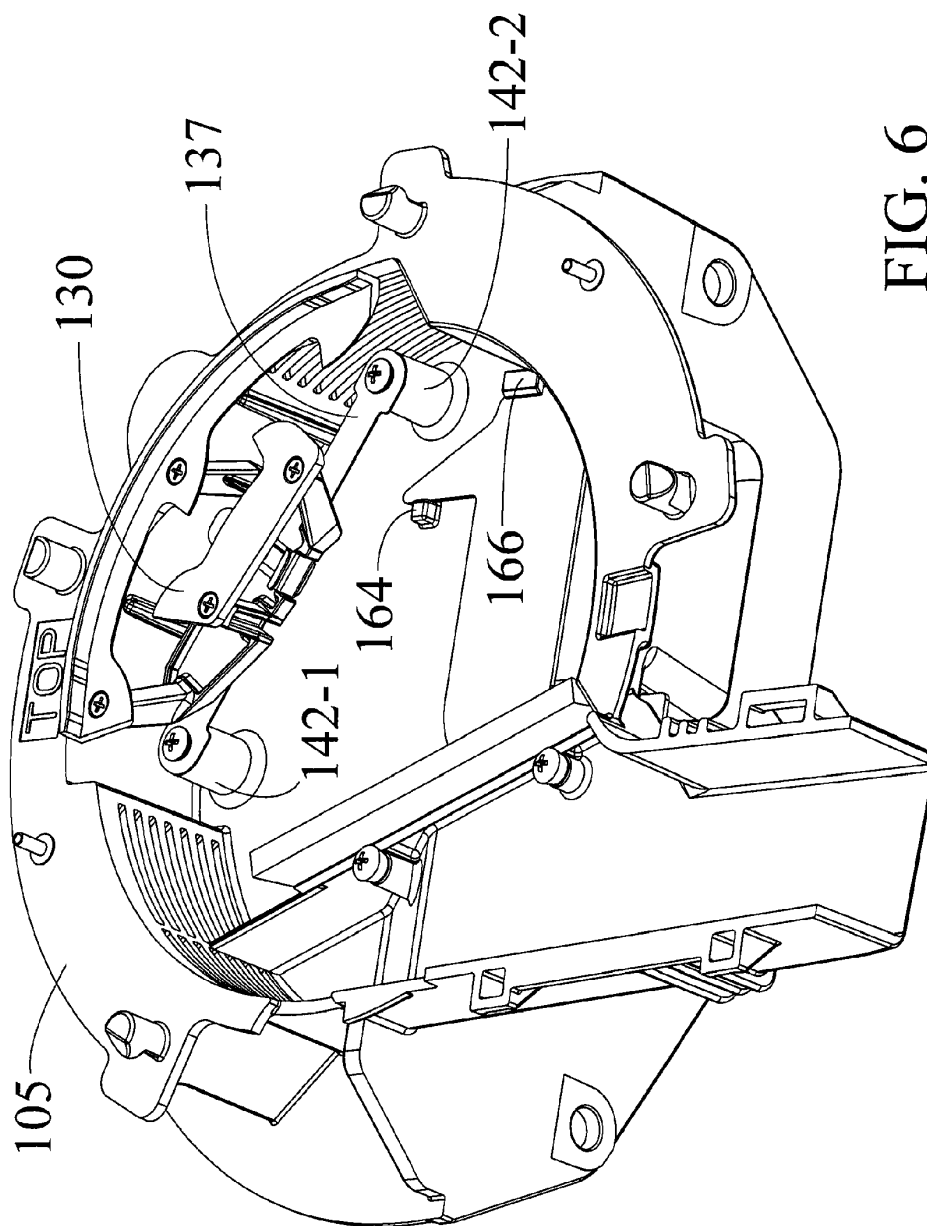


FIG. 5



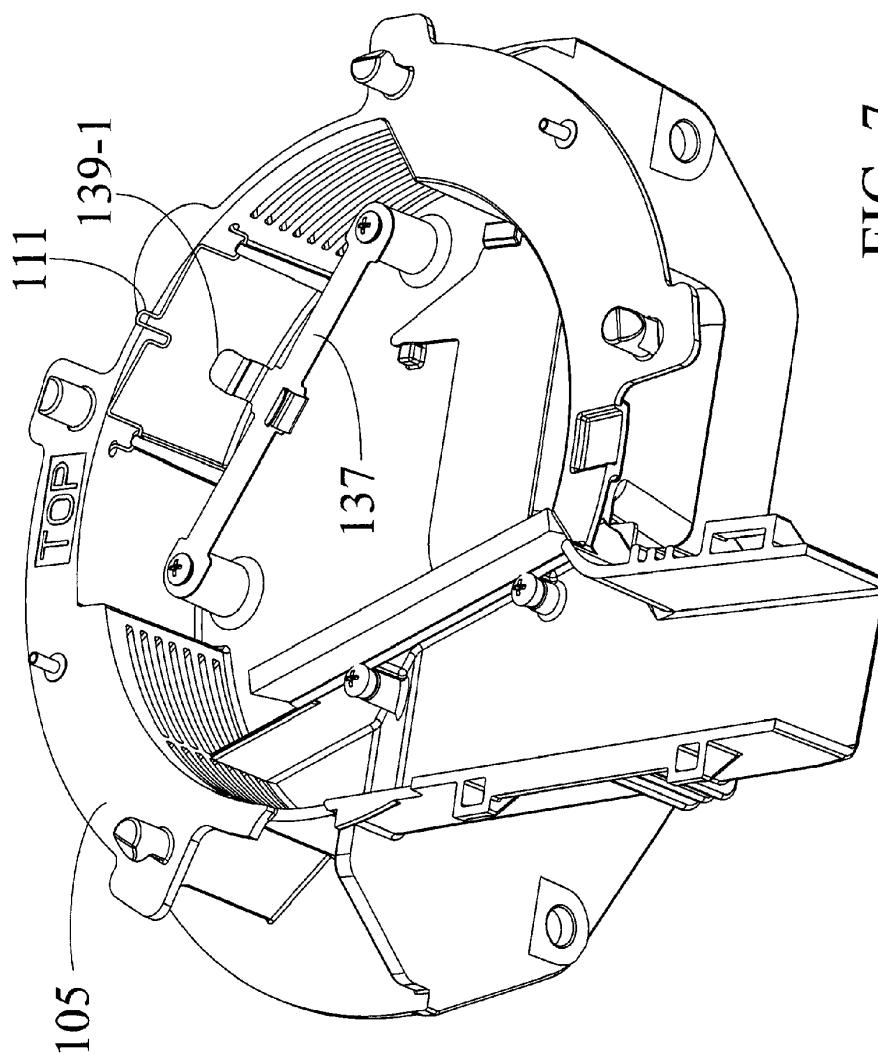


FIG. 7

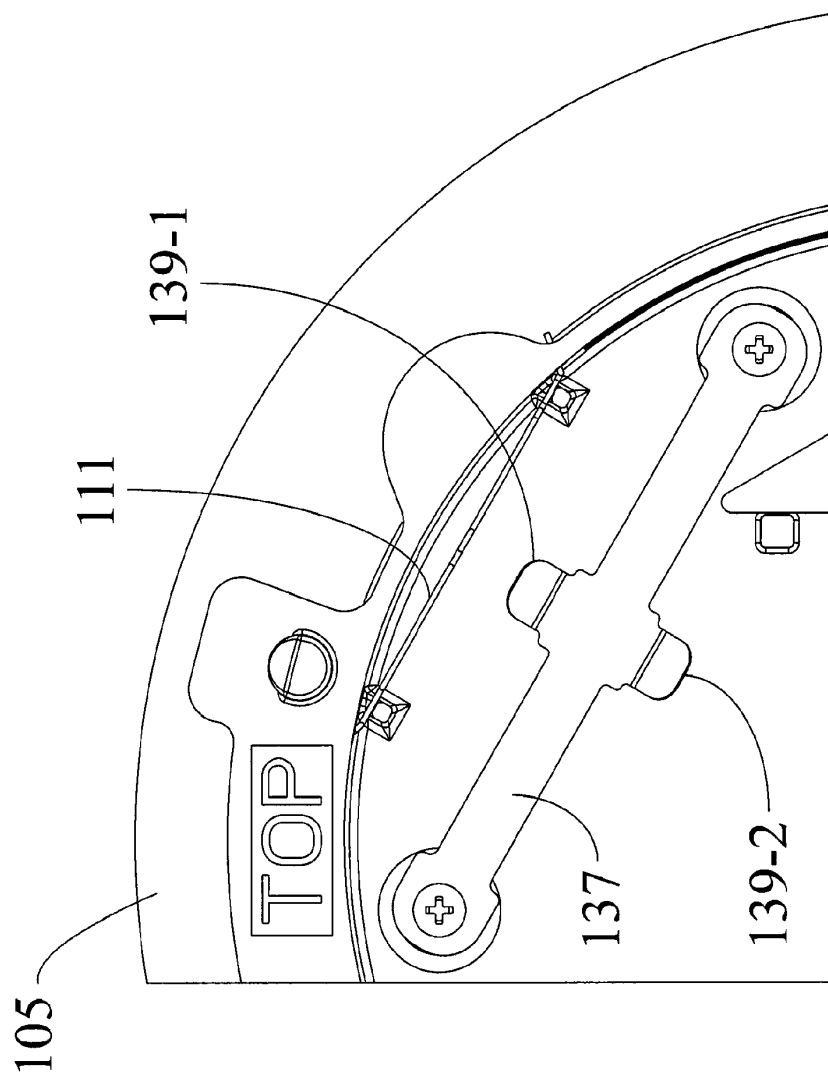


FIG. 8

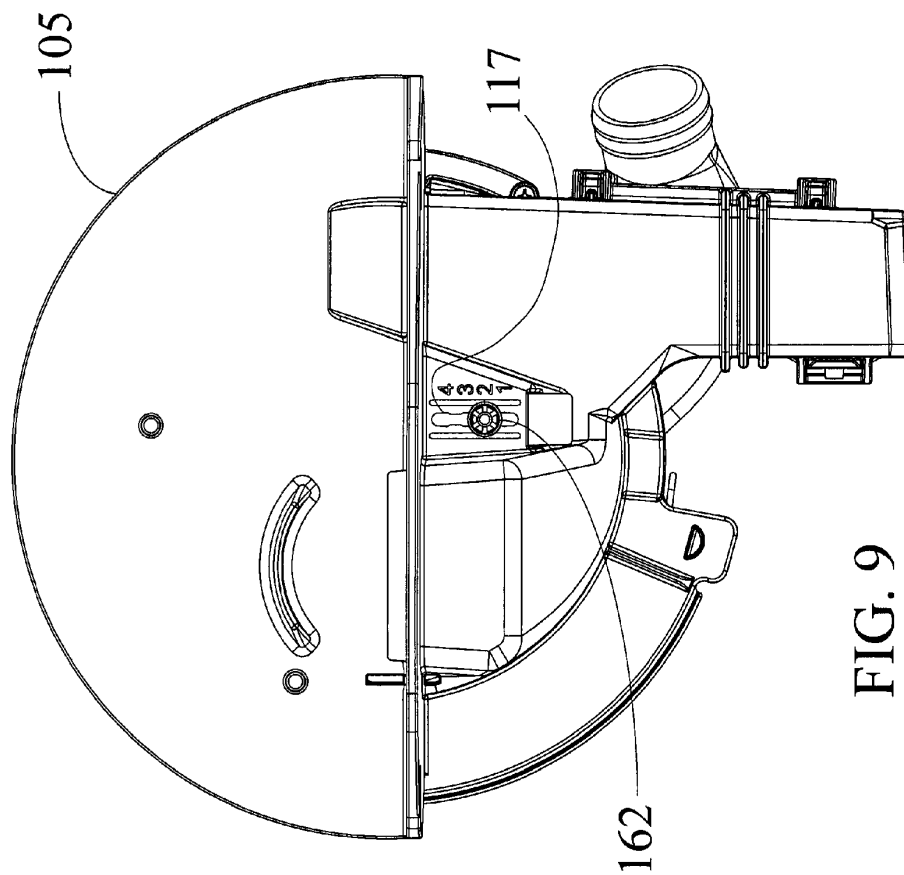


FIG. 9

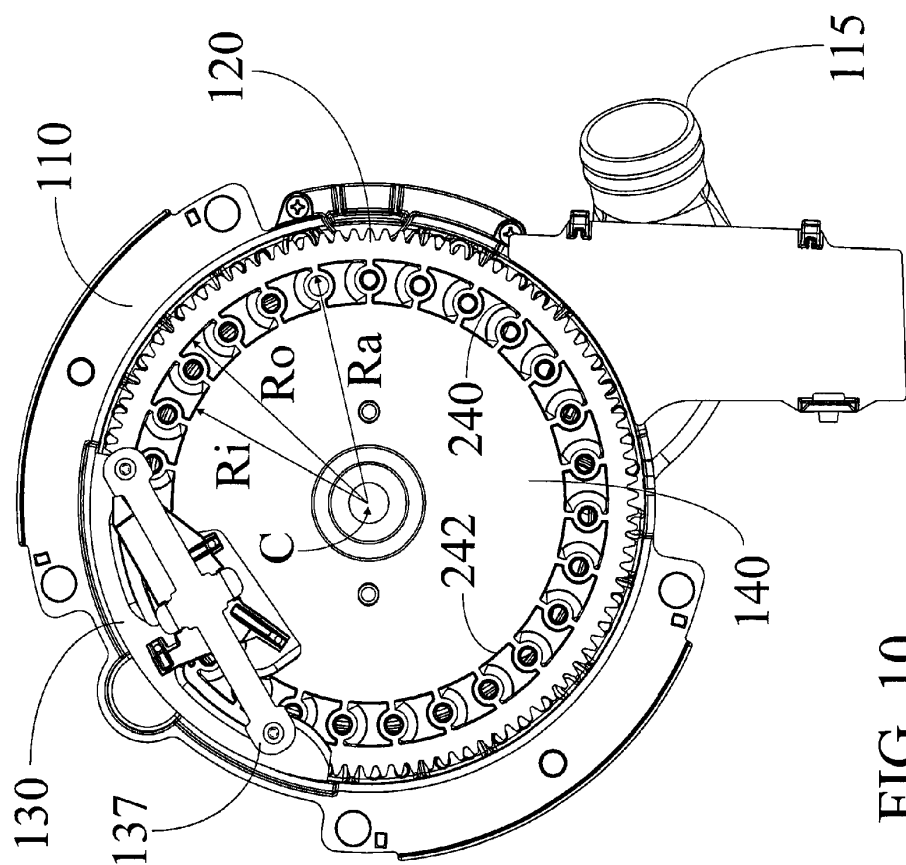


FIG. 10

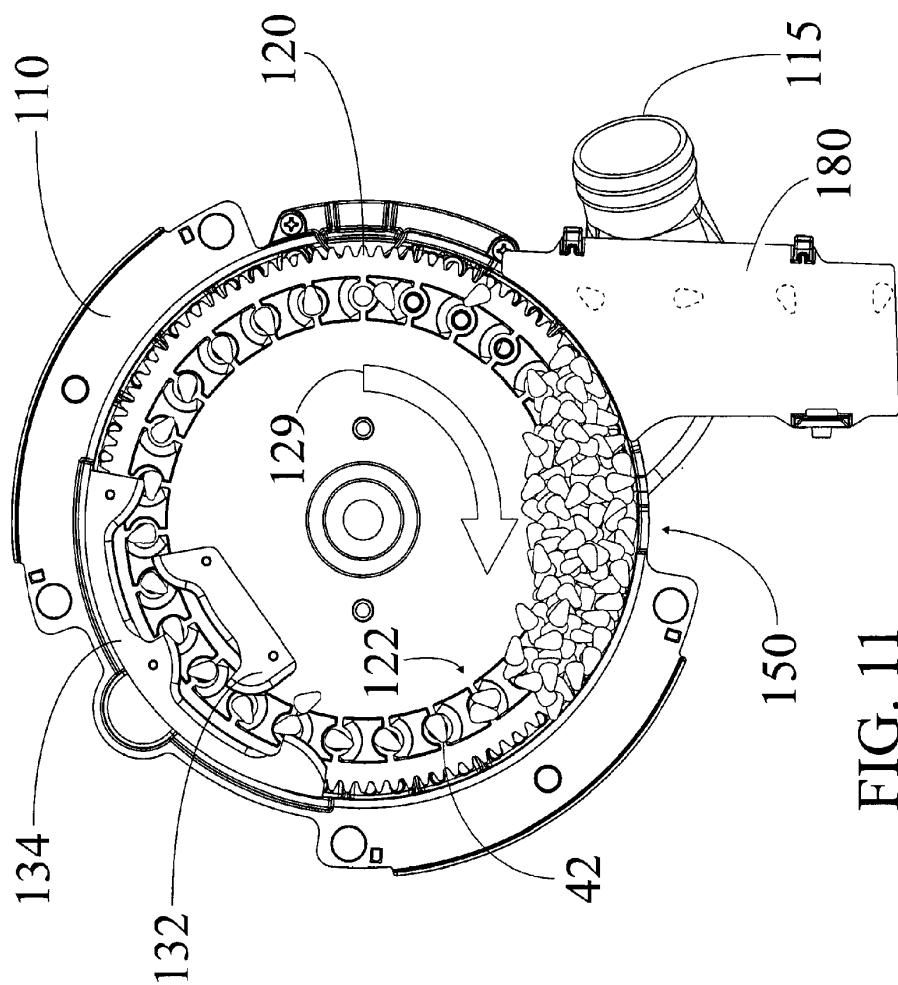


FIG. 11

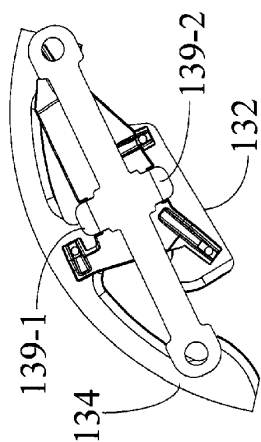


FIG. 12B

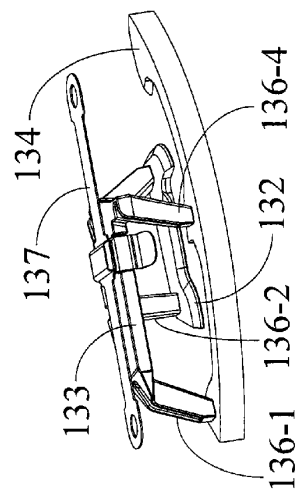


FIG. 12D

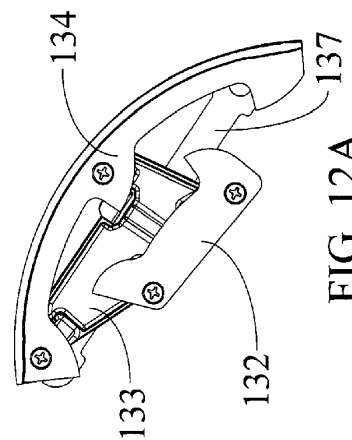


FIG. 12A

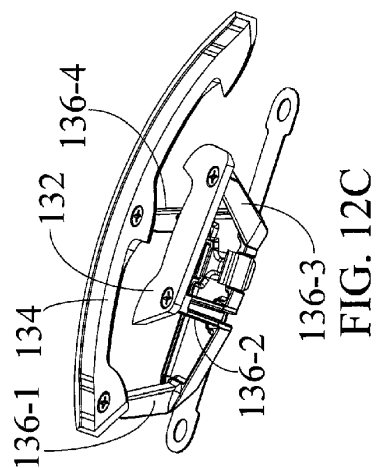


FIG. 12C

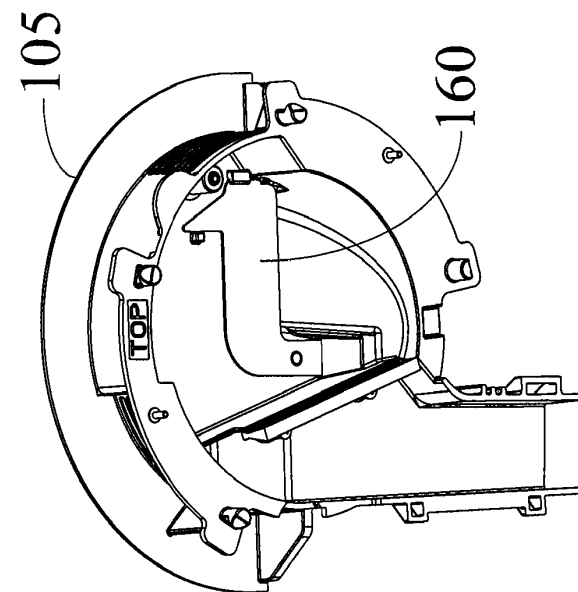


FIG. 13B

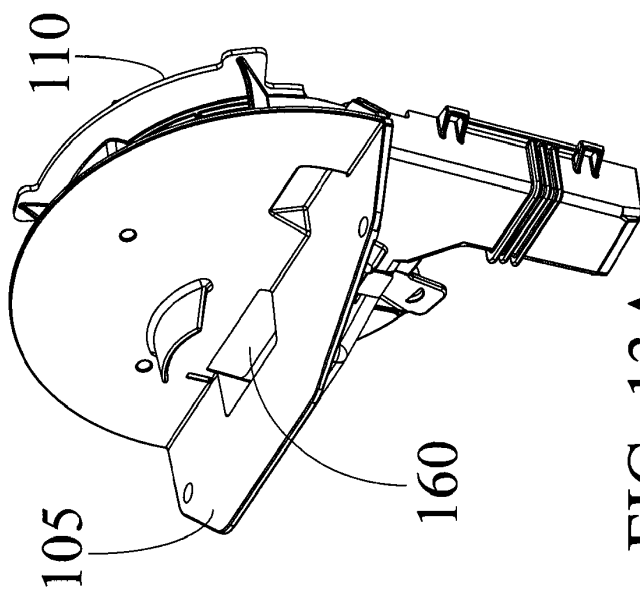
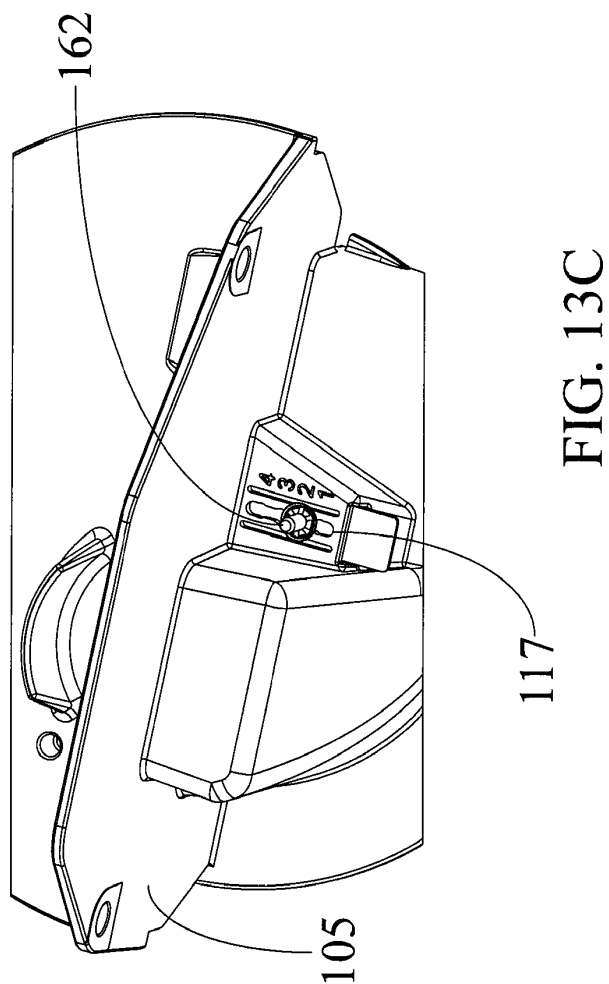


FIG. 13A



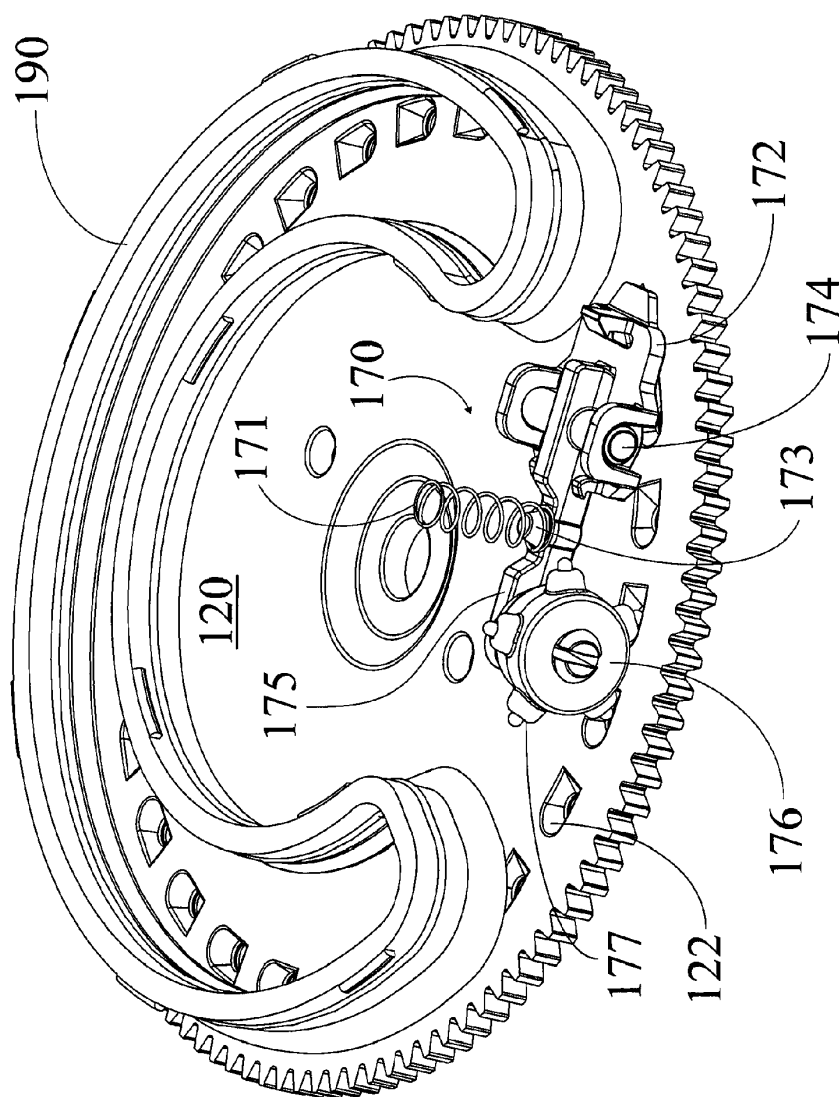


FIG. 14

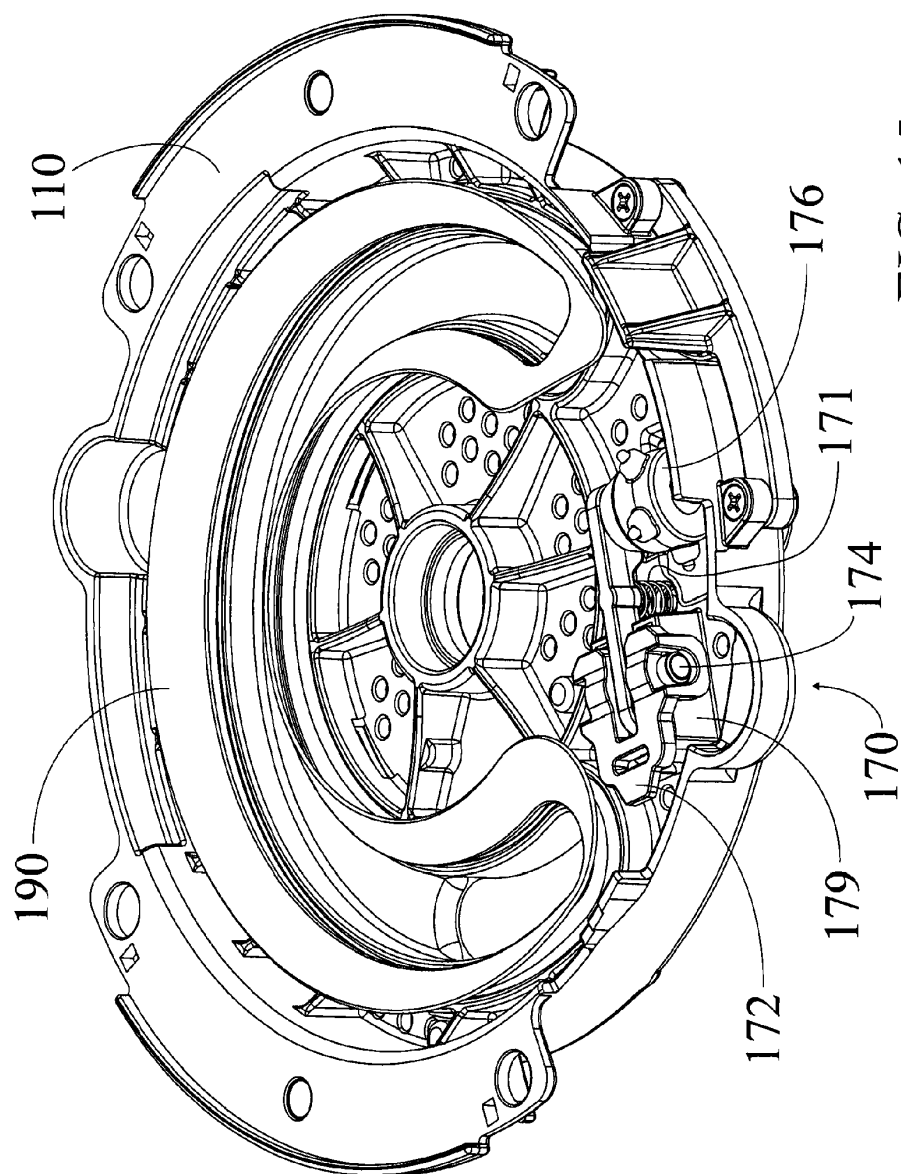


FIG. 15

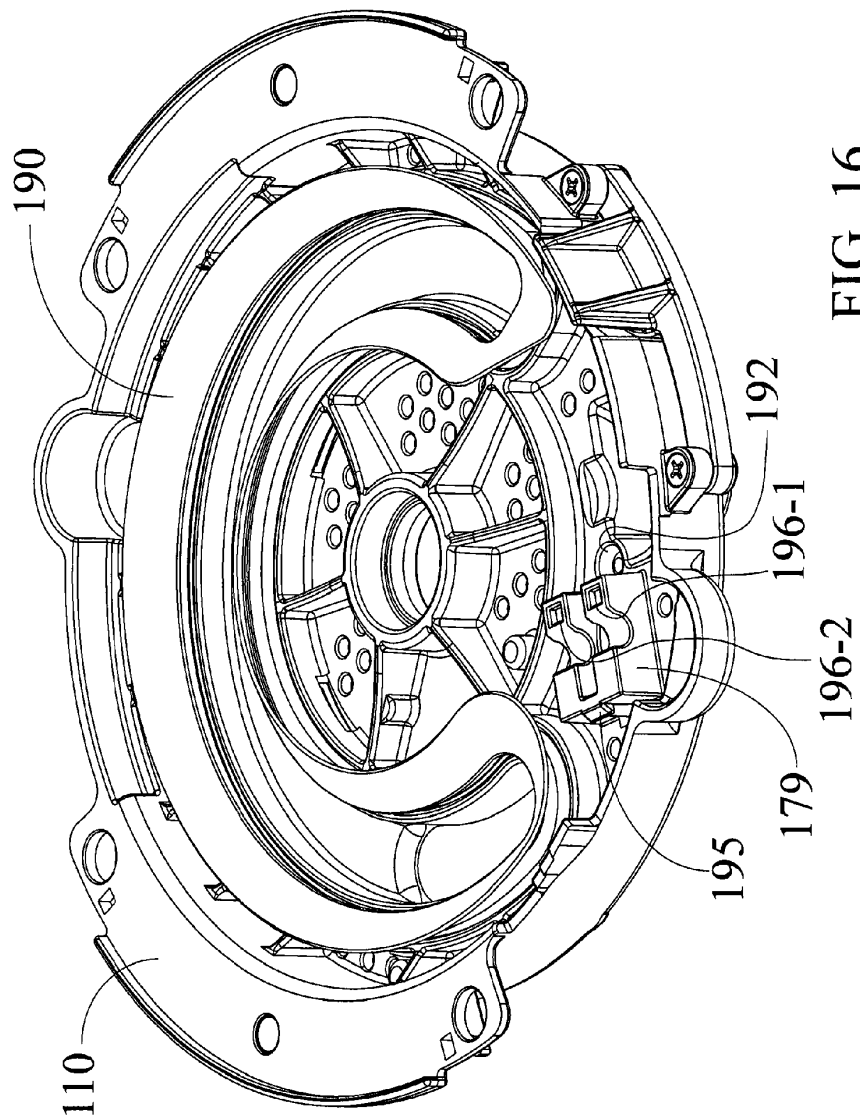


FIG. 16

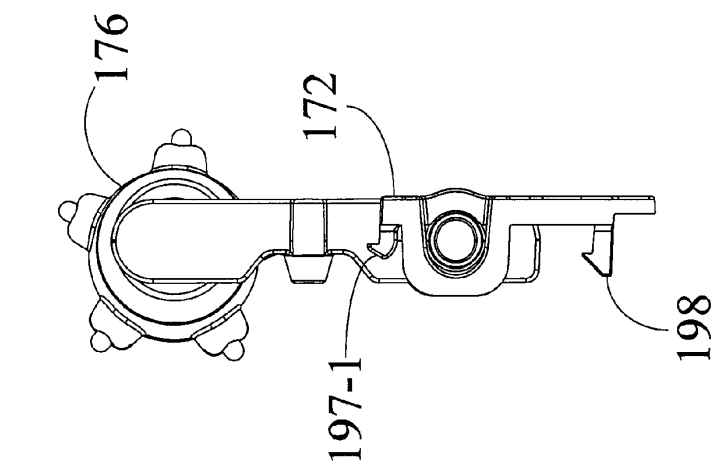


FIG. 17B

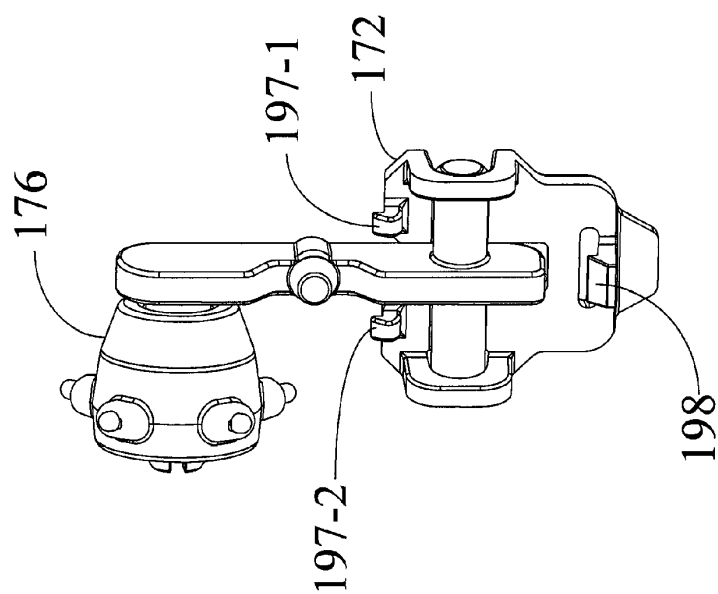
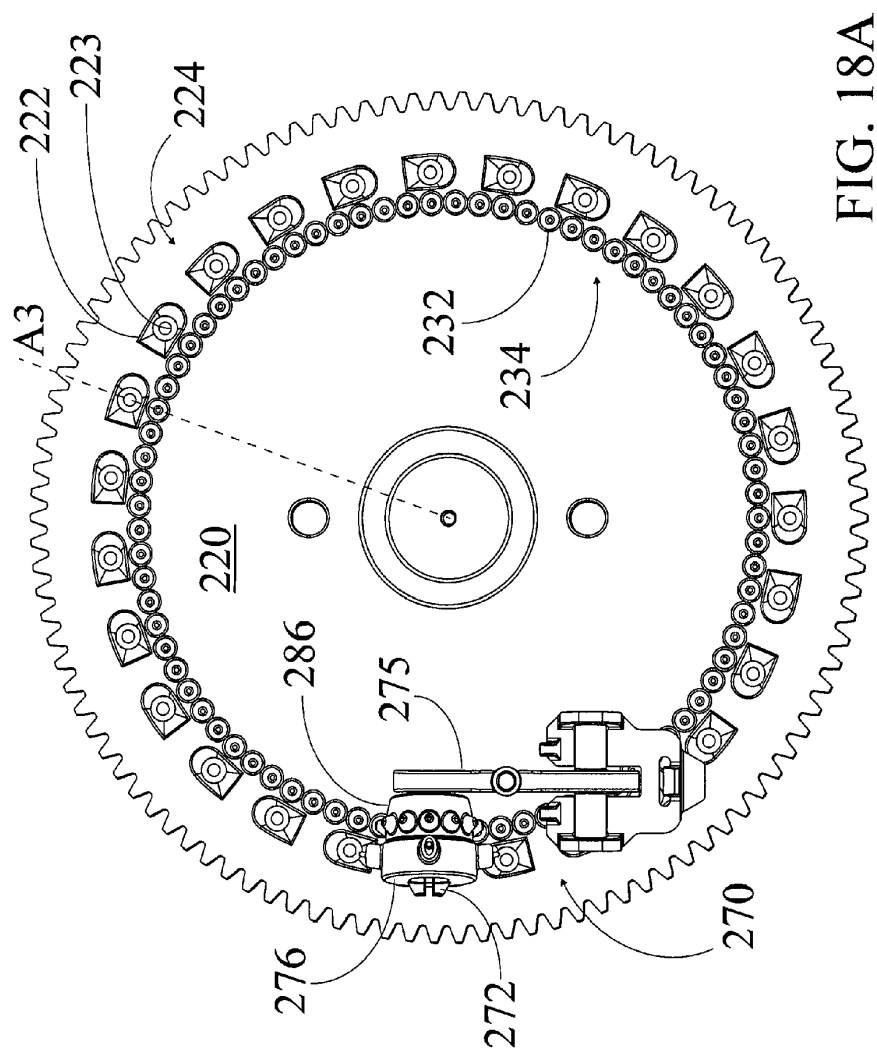


FIG. 17A



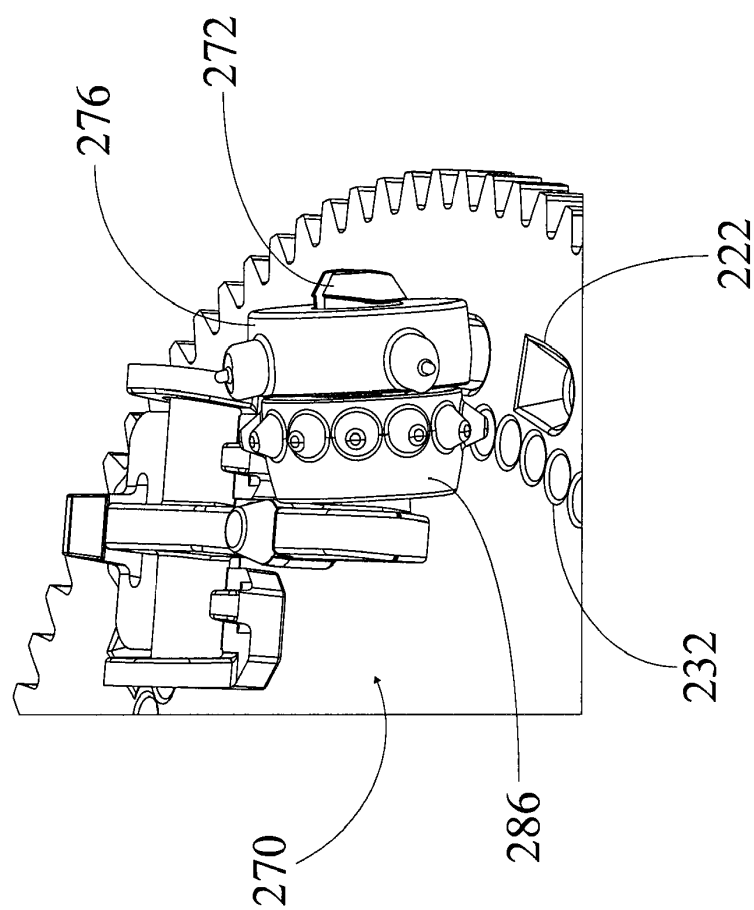


FIG. 18B

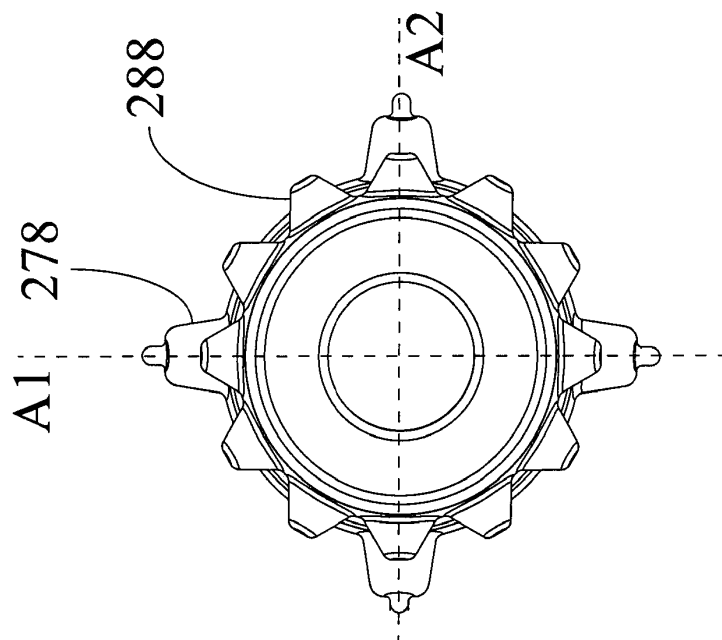


FIG. 18D

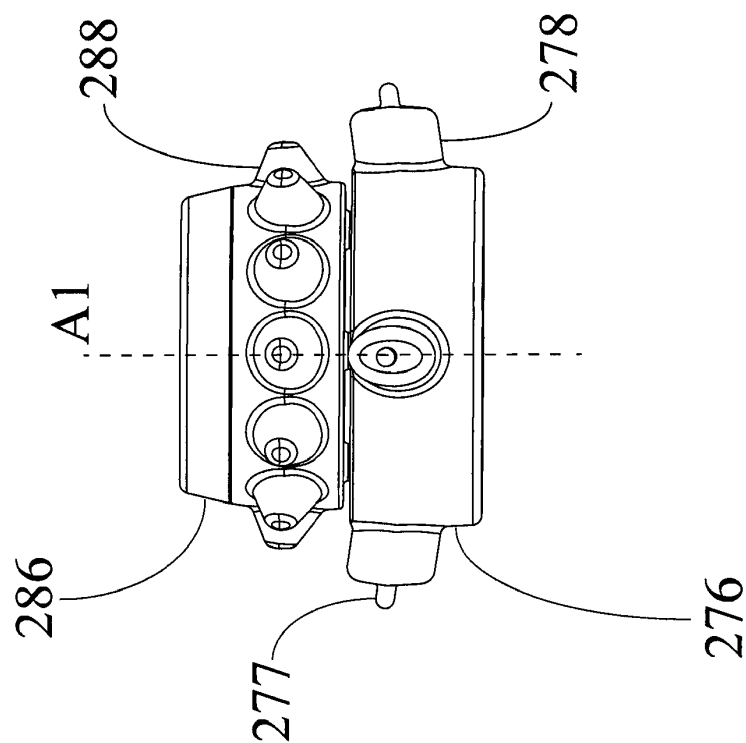


FIG. 18C

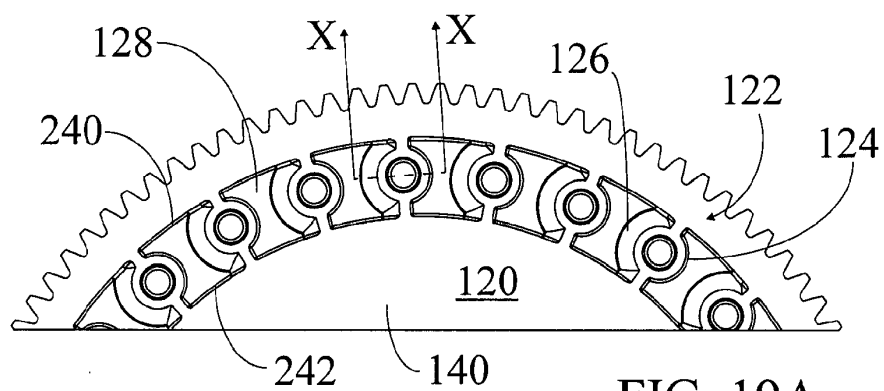
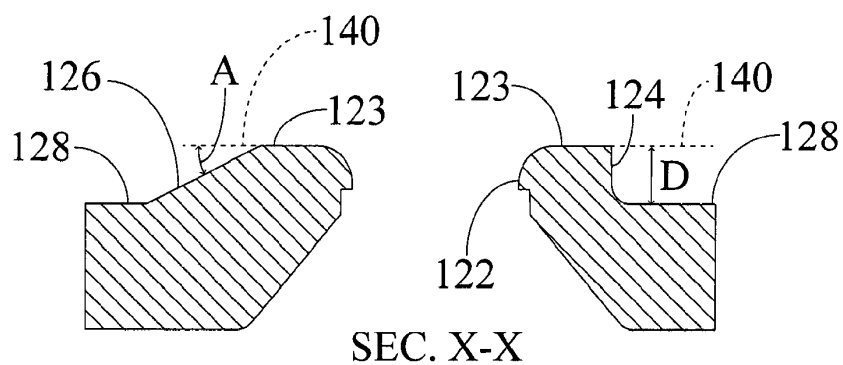


FIG. 19A



SEC. X-X

FIG. 19B

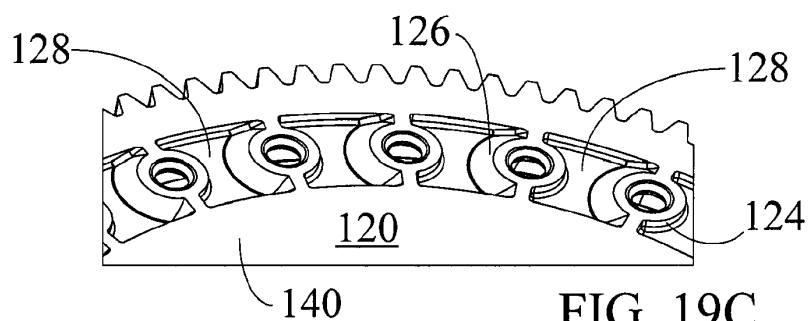


FIG. 19C

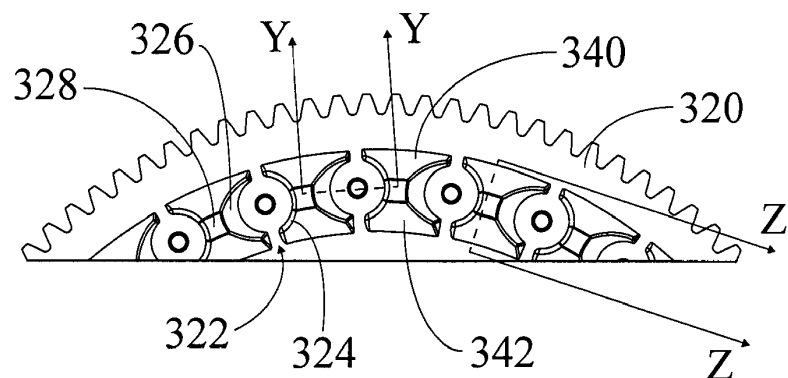


FIG. 20A

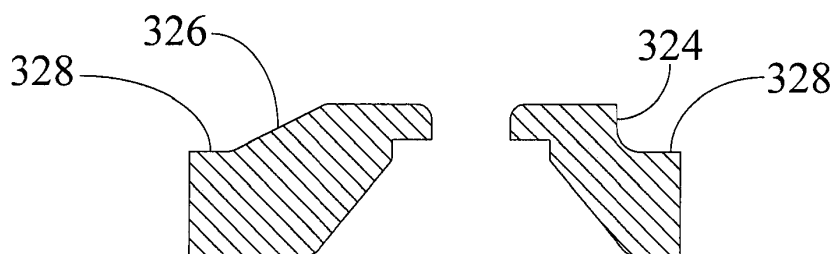


FIG. 20B

SEC. Y-Y

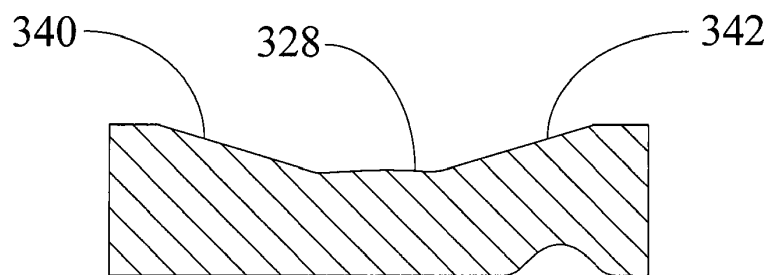


FIG. 20C

SEC. Z-Z

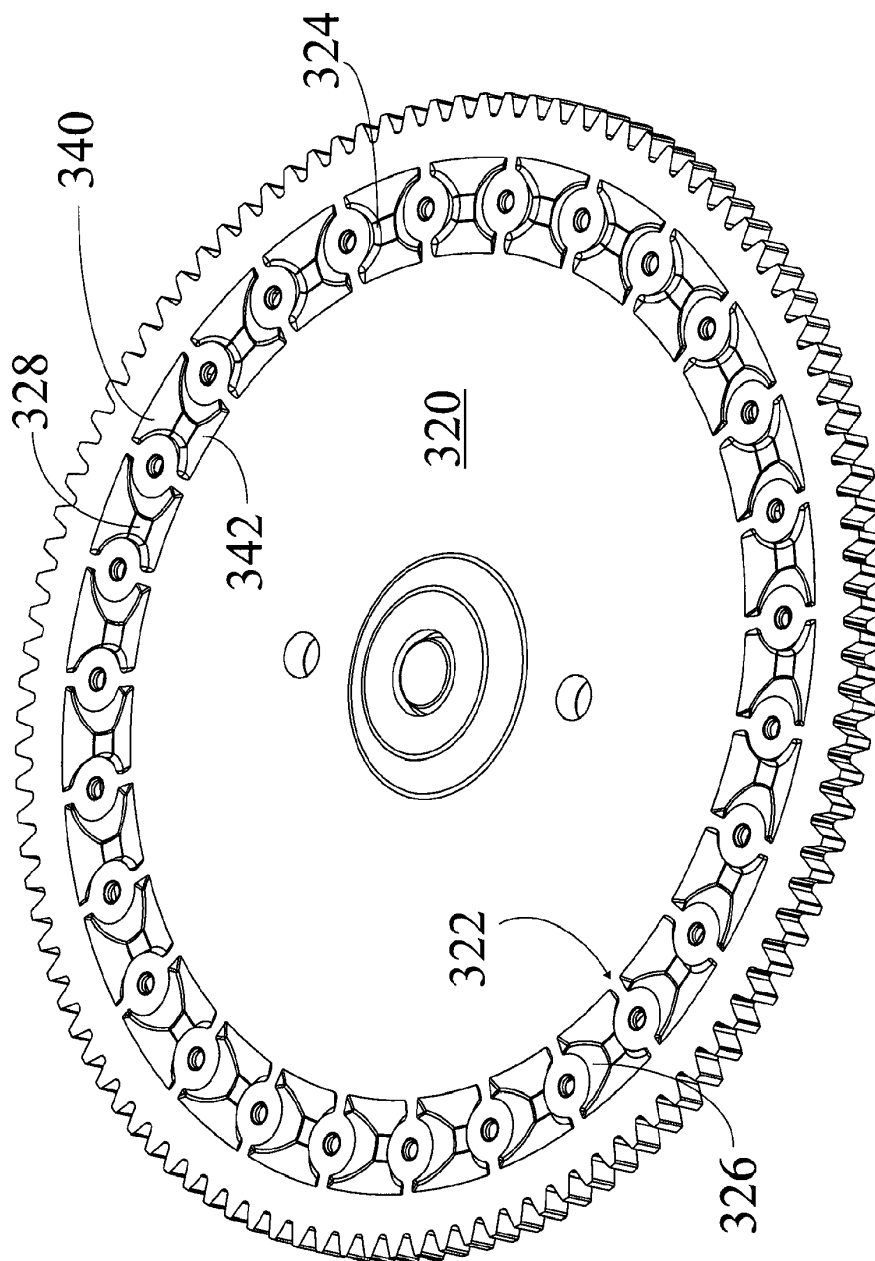


FIG. 20D

SEED METER

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application is a continuation of U.S. application Ser. No. 14/006,569 filed Sep. 20, 2013 which is the National Stage of International Application No. PCT/US2012/030192 filed Mar. 22, 2012, which claims the benefit of U.S. Provisional Application No. 61/466,047, filed Mar. 22, 2011.

BACKGROUND

[0002] In recent years, growers of corn and other crops have come to recognize the importance of planting individual seeds at the appropriate spacing due to increased seed and crop input prices, but also because they have the ability to monitor the economic impact of skips, doubles or misplaced seeds using modern planter monitors. For these reasons modern seed meters have been developed that include features which improve the singulation of seeds. However, each added feature increases the amount of time that the grower must spend replacing wear parts or making other adjustments prior to or during planting operations. Due to weather and other factors, the available time to plant corn and other crops is often extremely limited, with each planter required to cover hundreds of acres while limited in speed due to reduced seed meter performance at higher planting speeds.

[0003] Thus, there is a need for a seed meter having improved singulation and seed spacing capability at higher speeds and which is also easily repairable and modifiable.

BRIEF DESCRIPTION OF THE DRAWINGS

[0004] FIG. 1 illustrates a side elevation view of a single row unit of a conventional row crop planter.

[0005] FIG. 2 is a perspective view of an embodiment of a seed meter.

[0006] FIG. 3 is a partial perspective view of an embodiment of a seed meter.

[0007] FIG. 4 is another partial perspective view of an embodiment of a seed meter.

[0008] FIG. 5 is a partial side elevation view of an embodiment of a seed meter.

[0009] FIG. 6 is another partial perspective view of an embodiment of a seed meter.

[0010] FIG. 7 is another partial perspective view of an embodiment of a seed meter.

[0011] FIG. 8 is another side elevation view of an embodiment of a seed meter.

[0012] FIG. 9 is another side elevation view of an embodiment of a seed meter.

[0013] FIG. 10 is a partial side elevation view of an embodiment of a seed meter.

[0014] FIG. 11 is a partial side elevation view of an embodiment of a seed meter.

[0015] FIG. 12A is a perspective view of an embodiment of a seed singulator and an embodiment of an axial spring.

[0016] FIG. 12B is another perspective view of an embodiment of a seed singulator and an embodiment of an axial spring.

[0017] FIG. 12C is another perspective view of an embodiment of a seed singulator and an embodiment of an axial spring.

[0018] FIG. 12D is another perspective view of an embodiment of a seed singulator and an embodiment of an axial spring.

[0019] FIG. 13A is another perspective view of an embodiment of a seed meter.

[0020] FIG. 13B is another partial perspective view of an embodiment of a seed meter.

[0021] FIG. 13C is a partial perspective view of an embodiment of a seed meter.

[0022] FIG. 14 is a perspective view of a seed disc, vacuum seal and an embodiment of an ejector wheel assembly.

[0023] FIG. 15 is a perspective view of a vacuum cover, a vacuum seal, and an embodiment of an ejector wheel assembly.

[0024] FIG. 16 is a perspective view of a vacuum cover and vacuum seal.

[0025] FIG. 17A is a perspective view of an embodiment of an ejector wheel assembly.

[0026] FIG. 17B is a side elevation view of an embodiment of an ejector wheel assembly.

[0027] FIG. 18A is a side elevation view of another embodiment of a seed disc and another embodiment of an ejector wheel assembly.

[0028] FIG. 18B is a side elevation view of an embodiment of a seed disc and an embodiment of an ejector wheel assembly.

[0029] FIG. 18C is a side elevation view of an embodiment of an ejector wheel.

[0030] FIG. 18D is a top view of an embodiment of an ejector wheel.

[0031] FIG. 19A is a partial side elevation view of an embodiment of seed disc.

[0032] FIG. 19B is a cross-sectional view of a seed disc along the section X-X of FIG. 19A.

[0033] FIG. 19C is a partial perspective view of an embodiment of a seed disc.

[0034] FIG. 20A is a partial side elevation view of another embodiment of a seed disc.

[0035] FIG. 20B is a cross-sectional view of a seed disc along the section Y-Y of FIG. 20A.

[0036] FIG. 20C is a cross-sectional view of a seed disc along the section Z-Z of FIG. 20B.

[0037] FIG. 20D is a perspective view of an embodiment of a seed disc.

DESCRIPTION

[0038] Referring now to the drawings, wherein like reference numerals designate identical or corresponding parts throughout the several views, FIG. 1 illustrates a single row unit 10 of a conventional row crop planter. As is well known in the art, the row units 10 are mounted in spaced relation along the length of a transverse toolbar 12 by a parallel linkage 14 which permits each row unit 10 to move vertically independently of the toolbar and the other spaced row units in order to accommodate changes in terrain or upon the row unit encountering a rock or other obstruction as the planter is drawn through the field. Each row unit 10 includes a frame 16 which operably supports a seed hopper 18, a furrow opening assembly 20, a seed meter 100, a seed tube 46 and a furrow closing assembly 50.

[0039] The furrow opening assembly 20 comprises a pair of furrow opening discs 22 which are rotatably mounted on shafts 26 secured to a shank 30 comprising a part of the row unit frame 16. The furrow opening assembly 20 further com-

prises a pair of gauge wheels 32 rotatably supported by gauge wheel arms 35 also secured to the frame 16. As the planter is drawn through the field, the rotating furrow opening discs 22 cut a V-shaped furrow 40 through the soil surface 36. The egress end of the seed tube 46 is disposed between the rearwardly diverging furrow opening discs 22.

[0040] In operation, as the planter is drawn through the field along the direction of travel as indicated by the arrow 38, the seed hopper 18 communicates a constant supply of seeds 42 to the seed meter 100. The seed meter 100 meters or dispenses individual or "singulated" seeds 42 at regularly spaced intervals into the seed tube 46. The seed tube 46 directs the seeds downwardly and rearwardly between the diverging furrow opening discs 22 before depositing the seeds into the V-shaped furrow 40. The seeds are then covered with soil by the furrow closing assembly 50. A seed sensor 60 detects the passage of seeds through the seed tube 46 as is known in the art.

Novel Seed Meter Embodiments

[0041] Embodiments of a novel seed meter 100 are illustrated in FIGS. 2-20. Referring to FIGS. 2 and 3, the seed meter 100 includes a housing comprised of a vacuum cover 110 and a seed housing 105. As described further herein, the seed meter 100 functions by selecting one seed at a time from seeds communicated into the seed housing 105 and dispensing each seed through the seed exit 180. A vacuum inlet 115 is coupled to the vacuum cover 110. Vacuum hoses or tubes (not shown) connect the vacuum inlet 115 to a vacuum source (not shown) such as a vacuum impeller.

[0042] The seed housing 105 includes pivots 113 (FIG. 3) and tabs 103 (FIG. 2). When assembled, the tabs 103 extend through holes in the vacuum cover 110 such that retaining springs 108 may be biased against pivots 113 and tabs 103 to retain the seed housing 105 in position against the vacuum cover 110.

[0043] Referring to FIG. 3, the seed meter 100 is shown with the vacuum cover 110 and other components removed for clarity. A shaft 183 is rotatably coupled to bearings 184. Bearings 184 are held in place by the vacuum cover 110. A drive plate 186 is coupled to and rotates with the shaft 183. Drive plate 186 is releasably coupled to a seed disc 120. Seed disc 120 includes apertures 122 and preferably includes drive teeth 121. In operation, the seed disc 120 may be rotated by a driven gear (not shown) coupled to drive teeth 121 (as described further herein) or by a driven shaft (not shown) coupled to an adapter 185 (FIG. 2) mounted to the shaft 183.

[0044] Turning to FIG. 4, the interior of the seed housing 105 is shown with the seed disc 120, drive shaft 183 and drive plate 186 removed. A brush 112 is mounted to seed housing 105 such that its bristles contact the seed-side surface of the seed disc 120. A singulator 130 is mounted to the seed housing 105 (as described further herein) which cooperates with the seed disc 120 to singulate the seeds before they are dispensed through the seed exit 180. The singulator preferably includes multiple singulator surfaces in contact with a seed side surface 140 of the seed disc 120.

[0045] Referring to FIGS. 5, 6, and 13A-C, seeds are communicated into the seed meter 100 beneath a baffle 160 mounted to the seed housing 105. A seed pool area 150 (FIG. 5) is disposed horizontally adjacent to the seed disc 120 near a bottom end of the seed housing 105 for collection of seeds communicated into the seed meter.

[0046] The height of baffle 160 may be adjusted along guides 164 and 166. The baffle 160 is mounted to the seed housing 105 by rivet 162, which extends outside the seed housing 105 (as best seen in FIGS. 9 and 13C) and may be moved vertically by the operator along a notched slot 117 without disassembling the housing. Each notch in slot 117 is sized to hold the rivet 162 in place such that the operator can select the height of baffle 160 by pushing the rivet up and down. As illustrated, visual indicators (e.g., numbers 1 through 4) are preferably located adjacent to the notches for positioning the rivet 162 at corresponding heights of the baffle 160 for ease of reference.

Removable Floating Singulator Embodiments

[0047] Referring to FIGS. 6-8, the singulator 130 is releasably mounted to the seed housing 105 so as to bias the singulator against the seed disc 120 while allowing the singulator to "float" both axially and longitudinally with respect to the axis of rotation of the seed disc. The singulator is releasably coupled to an axial spring 137 by attachment ears 139. The axial spring 137 is preferably made of a material (e.g., spring steel) which is elastically deformable. The axial spring 137 is mounted to bosses 142. The bosses 142 are sized such that the singulator 130 is biased against the face of the seed disc 120 when the seed disc is in its normal position. Thus, when the seed disc 120 is deflected axially away from the vacuum cover 110, the tension in axial spring 137 increases, allowing the singulator to remain in contact with the seed disc without interfering with the rotation of the seed disc. Likewise, when the seed disc is deflected axially toward the vacuum cover 110, the tension in axial spring 137 decreases such that the singulator remains in contact with the seed disc.

[0048] Radial spring 111 is mounted to the seed housing 105 such that in operation, the radial spring biases the singulator radially against the seed disc 120 when the seed disc is in its normal position.

[0049] Referring to FIGS. 12A-D, the singulator 130 is illustrated in detail attached to the axial spring 137. The singulator 130 includes base 133, arms 136, upper lobe plate 134 and lower lobe plate 132. The upper lobe plate 134 includes three singulation lobes, while the lower lobe plate 132 includes two singulation lobes. In operation, attachment ears 139 grasp the base 133. When the axial spring 137 is attached to the singulator 130, the attachment ears 139 extend past and away from the base 133 and are easily manipulated and deflected. It should be appreciated that other configurations of the singulator 130 could be used to achieve the objectives described herein.

[0050] It should be appreciated that the singulator 130 is easily replaceable with another singulator with a different lobe configuration for different seeds or if it is necessary to replace the singular due to wear on the singulator lobes. The singulator 130 is removable by pulling it away from the axial spring 137 with sufficient force that the attachment ears 139 deflect away from each other sufficiently to release the base 133. The attachment ears 139 may also be deflected away from each other with one hand while pulling the singulator 130 away from the axial spring 137 with the other. Likewise, the singulator 130 may be replaced by pressing the base 133 of the singulator between the attachment ears 139 with sufficient force to cause the attachment ears to deflect away from each other to allow the base of the singulator to pass between them. To replace the singulator, the base 133 may be pushed between the ears causing them to deflect away from one

another before returning to the normal position in which the base of the singulator is again secured between the ears. In this way the singulator 130 may be easily removed and replaced by hand without the use of tools and without removing or changing the location of axial spring 137, which remains in the correct location to bias the singulator 130 against the seed disc 120 while allowing the singulator 130 to “float” with deflections or deformations of the seed disc.

[0051] Referring to FIGS. 10 and 11, the seed meter 100 is illustrated with the seed housing 105 and other components removed so that the singulator 130 may be seen in its preferred location biased against the seed-side surface 140 of the seed disc 120. The seed-side surface 140 is preferably normal to the axis of rotation of the seed disc 120. The seed-side surface 140 is also preferably substantially flat with the exception of cavities 128, described in more detail later. For clarity, only the upper and lower lobe plates 132 and 134 are shown in FIG. 11. In operation, the seed disc 120 rotates in the direction indicated by arrow 129 such that the seed apertures 122 travel along a seed aperture path. A portion of the seed aperture path is adjacent to the seed pool area 150. As the seed apertures 122 turn past the seed pool area 150 at the bottom of the seed housing 105, a vacuum side of each seed aperture is placed in fluid communication with the vacuum source such that one or more seeds 42 become entrained over apertures 122. As the seed-bearing apertures rotate between the upper and lower lobe plates 132, 134, the lobes of the lobe plates bump, rotate and position the seeds so that only one seed is firmly entrained over the aperture while the other seeds drop back into the seed pool 150, thereby leaving one seed per aperture. After the apertures 122 rotate past the 3 o'clock position as viewed in FIG. 11, the apertures 122 are no longer in communication with the vacuum source resulting in the seeds being released from the apertures and falling into the seed exit 180.

[0052] Referring to FIGS. 14-16, the vacuum cover 110 includes a continuous mounting groove into which a vacuum seal 190 is press fit. In operation, the vacuum seal 190 is pressed against the vacuum-side of the seed disc 120 and the interior of the vacuum seal is in communication with the vacuum inlet 115 (FIG. 1) such that as the apertures 122 rotate past the perimeter of the vacuum seal 190 toward its interior they are placed in fluid communication with the vacuum source.

Removable Seed Ejector Assemblies

[0053] It has been found that seeds or partial seeds may become lodged in the seed apertures 122 and remain there even after the apertures 122 pass outside of the vacuum seal 190 where no vacuum is imposed. This is undesirable because when the apertures re-enter the seed reservoir an additional seed may not be entrained in an aperture holding a seed or partial seed. Thus, referring again to FIGS. 14-16, a seed ejector assembly 170 is preferably mounted to the vacuum cover 110. The seed ejector assembly 170 includes a shaft 174, a mounting clip 172, a lever arm 175 and an ejector wheel 176 having plungers 177. The ejector wheel 176 is rotatably coupled to the lever arm 175. The lever arm is rotatably coupled to the shaft 174. The shaft is rotatably received within the mounting clip 172. As best seen in FIG. 15, the mounting clip 172 is attached to a mounting port 179, which is preferably formed integrally with the vacuum cover 110. As best seen in FIG. 14, as the seed disc 120 rotates, the ejector wheel 176 rotates and the plungers 177 enter each seed

aperture 122, knocking out any seeds, partial seeds or debris in the seed apertures from the back side or vacuum-side of the seed disc 120.

[0054] As best illustrated in FIGS. 14 and 15, a spring 171 is preferably disposed between the lever arm 175 and the vacuum cover 110. The spring 171 has a first end held in place at a first end by a knob 173 on the lever arm 175 and has a second end held in place by cavity 192 in the vacuum cover 110. It should be appreciated that the spring 171 biases the ejector wheel 176 against the disc and allows the seed ejector assembly 170 to “float” with deflections or deformations of the seed disc 120.

[0055] It should be appreciated that the user may wish to remove the seed ejector assembly 170 or replace it due to wear on the ejector wheel 176, to install a differently configured seed ejector assembly, or for other reasons. As illustrated in FIGS. 16, 17A and 17B, the mounting clip 172 may be easily removed from and reattached to the mounting port 179 without the use of tools. The mounting port 179 includes apertures 196 and a tab 195. Mounting clip 172 includes rigid hooks 197 and resilient hook 198. During installation, the user first inserts rigid hooks 197 into apertures 196, then preferably presses mounting clip 172 against vacuum cover 110 such that resilient hook 198 deflects around tab 195 and returns to a relaxed state secured around tab 195. It should be appreciated that in addition to deflection of resilient hook 198 with respect to mounting clip 172, the mounting clip 172 also preferably deflects to allow resilient hook 198 to deflect around the tab 195. After attachment, the mounting clip 172 is secured against mounting port 179 until the user removes the mounting clip by bending the mounting clip to release the resilient hook 198 from tab 195 and then moving the rigid hooks 197 free of the apertures 196.

Alternative Ejector Wheel and Disc Embodiments

[0056] Turning to FIGS. 18A-18D, a modified seed ejector assembly 270 is illustrated in cooperation with a modified seed disc 220. The seed disc 220 includes an array 224 of apertures 222. The seed disc 220 further includes an array 234 of guide cavities 232. The guide cavity array 234 is preferably substantially concentric with the seed aperture array 224.

[0057] The seed ejector assembly 270 includes a lever arm 275. The lever arm 275 is preferably pivotally biased toward the seed disc 220 as described herein with respect to the lever arm 175. As best illustrated in FIG. 18B, the seed ejector assembly 270 also includes an ejector wheel 276 pivotally mounted to the lever arm 275 and a guide wheel 286 pivotally mounted to the lever arm 275. Continuing to refer to FIG. 18B, the ejector wheel 276 and the guide wheel 286 are preferably pivotally mounted to the lever arm by a retaining pin 272 extending through central apertures in the ejector wheel and guide wheel. The retaining pin 272 preferably allows the ejector wheel 276 and the guide wheel to translate slightly toward and away from the lever arm 275 such that the ejector wheel and guide wheel are allowed to translate radially toward and away from the center of the seed disc 220. As best illustrated in FIGS. 18C and 18D, the ejector wheel 276 includes radially arranged plungers 278 and the guide wheel 286 includes radially arranged guide teeth 288. The seed ejector assembly preferably includes more guide teeth 288 than plungers 278, and preferably includes three guide teeth per plunger. The ejector wheel 276 is preferably fixed to the guide wheel 286 such that the ejector wheel is constrained to rotate synchronously with the guide wheel. Each plunger 278

is preferably aligned with one of the guide teeth 288. For example, as shown in FIG. 18D, the upper and lower plungers 278 are aligned with upper and lower guide teeth along a plane A1 and the left and right plungers 278 are aligned with left and right guide teeth along a plane A2.

[0058] In some embodiments of the ejector wheel 276, the plungers 278 include tips 277. In some embodiments of the seed disc 220, the apertures 222 are tapered to small openings 223 (FIG. 18A). The tips 277 are preferably sized to fit within the small openings 223. It should be appreciated that in such embodiments, more precise alignment of the ejector wheel 276 with respect to the seed disc 220 is necessary in order to knock seeds or debris from the small openings 223 without interference between the ejector wheel and seed disc.

[0059] In operation, as the disc rotates, the guide teeth 288 sequentially engage the guide cavities 232. The plungers 278 sequentially engage the seed apertures 222. Referring to FIG. 18A, the guide cavity array 234 is aligned with the seed aperture array 224 such that each seed aperture 222 is aligned with a guide cavity 232 along a plane (e.g., plane A3) intersecting the center of the seed disc 220. It should be appreciated that guide teeth 288 engage guide cavities 232 when the plungers 278 are not engaging the seed apertures 222, thus moving the ejector wheel 286 to the proper angular position to successfully engage each seed aperture. Additionally, it should be appreciated that as the ejector wheel translates with respect to the retaining pin 272, the guide teeth 232 likewise retain the ejector wheel 286 at the proper radial distance from the center of the seed disc 220 such that the ejector wheel can successfully engage each seed aperture 222.

Seed Disc Cavities

[0060] Referring to FIGS. 19A-19C, the seed disc 120 preferably includes seed disc cavities 128 disposed near the radial edge of the seed disc. The cavities 128 are preferably disposed to pass adjacent to the seed pool area 150. Each cavity 128 is preferably disposed forward of an adjacent seed aperture 122 along the direction of travel of the seed aperture path. The cavities 128 are preferably disposed between each pair of seed apertures 122. Seed apertures 122 are preferably substantially normal to the surface 140 of the seed disc 120; i.e., a central axis of each seed aperture 122 is preferably substantially normal to the surface 140 of the seed disc 120. Raised surfaces 123 with respect to the bottom of the associated cavity 128 are preferably disposed between each aperture 122 and the adjacent cavity 128. The upper surface of the raised surfaces 123 are preferably co-planar with the surface 140 of the seed disc 120.

[0061] Each cavity 128 preferably comprises an agitation cavity sized to agitate the seeds in the seed pool area 150. Thus the cavities 128 are preferably sized to allow significant movement of seeds 42 into and out of the cavities as each cavity moves adjacent to the seed pool 150. The outer perimeter of the cavity 128 is preferably larger than the outer perimeter of the adjacent seed aperture 122. The area of an intersection between the surface 140 of the seed disc 120 and each cavity 128 is preferably greater than the area of an intersection between the surface 140 and each seed aperture 122. It should be appreciated that each seed aperture is sized to allow limited movement of seeds 42 into the seed aperture. Moreover, the cavities 128 are preferably wider than the average size of seeds 42 to be planted using the seed disc 120. Moreover, the depth D (FIG. 19B) of the cavities 128 is preferably greater than 0.05 inches.

[0062] Referring to FIG. 10 in combination with FIG. 19, each cavity 128 preferably has an inner sidewall 242 and an outer sidewall 240 located at distances R_i , R_o respectively from the center C (i.e., the central or rotational axis) of the disc. The difference between the radii R_o and R_i is preferably greater than the diameter of the seed apertures 122. The radius R_o is preferably larger than the distance between the seed aperture and the center of the seed disc 120. The radius R_o is preferably larger than the radius R_a between a distal end of said seed aperture 122 and the center of the disc 120.

[0063] In operation, as the seed disc 120 rotates through the seed pool area 150 located to the side of the seed disc (as best illustrated in FIG. 11), seeds move in and out of the cavities 128 such that the seed pool is stirred or agitated. This agitation improves the successful loading of seeds on the seed apertures 122, particularly at relatively high planting speeds which correspond to faster seed disc rotation speeds.

[0064] Each cavity 128 preferably includes a sidewall 124 oriented to face the seed pool area 150 as the cavity rotates into the seed pool area. The sidewall 124 is preferably substantially vertical (FIG. 19B), i.e., substantially normal to the surface 140 of the seed disc 120. As viewed along the rotational axis of the seed disc (FIG. 19A), the sidewall 124 is preferably curved, and preferably is semicircular. In operation, the sidewalls 124 sequentially enter the seed pool area 150 and push the seeds such that the seed pool is stirred and agitated.

[0065] The cavities 128 preferably include a bevel 126 oriented to face away from the seed pool as the disc 120 rotates into the seed pool area 150. An angle A (FIG. 19B) between bevel 126 and the surface 140 of the seed disc 120 is preferably between 15 and 35 degrees with respect to the surface of the disc. In operation, when seeds are released from the disc (at approximately the 3 o'clock position on the view of FIG. 11), seeds occasionally fall toward the disc and into the cavity 128 located below the seed aperture 122. In such instances, the seed bounces or slides against the bevel 126, smoothly transitioning the seed back out of the cavity 128 and increasing consistency between seed fall times.

[0066] Although a seed disc 120 is disclosed herein including series of seed apertures 122 and cavities 128 having the same radial distance from the center of the seed disc, other embodiments include rows of seed cavities

[0067] Referring to FIGS. 20A-20D, an alternative seed disc 320 is illustrated having cavities 328 disposed between seed apertures 322. Each cavity 328 preferably includes vertical sidewalls 324 and bevels 326. Each cavity 328 preferably includes a beveled inner sidewall 342 and a beveled outer sidewall 340. The beveled sidewalls 342, 340 reduce the interior volume of the cavity 328 and allow seeds to smoothly transition out of the cavity 328 while the seeds are being agitated in the seed pool area 150. Thus each beveled sidewall 342, 340 discourages entrapment of seeds in the cavities 328, particularly smaller seed varieties.

[0068] Although the various improvements described herein are illustrated with respect to a vacuum-type seed meter, they would be equally applicable to other seed singulating meters, including positive-air meters such as that disclosed in U.S. Pat. No. 4,450,979 to Deckler, incorporated herein in its entirety by reference.

[0069] The foregoing description is presented to enable one of ordinary skill in the art to make and use the invention and is provided in the context of a patent application and its requirements. Various modifications to the preferred embodi-

ment of the apparatus, and the general principles and features of the system and methods described herein will be readily apparent to those of skill in the art. Thus, the present invention is not to be limited to the embodiments of the apparatus, system and methods described above and illustrated in the drawing figures, but is to be accorded the widest scope consistent with the spirit and scope of the appended claims.

1. A seed distribution element for precision pneumatic seed drills, comprising:

- a sowing disc which is rotated by a motor-driven transmission drive shaft at controlled speed;
- a housing with a fixed portion and a portion which is movable relative to the fixed portion and can be closed against the fixed portion;
- a seed collection chamber being defined in the fixed portion;
- a pneumatic suction chamber being defined in the movable portion;
- the sowing disc being interposed between the fixed and movable portions and having opposed surfaces delimiting the chambers;
- the sowing disc having at least one ring of selector holes extending between the opposed surfaces; and
- a seal which is arranged on the movable portion and is capable of sliding contact with the facing surface of the disc when the fixed and movable portions are closed against one another;
- wherein a pressure differential is provided between the opposed surfaces in the region of a circumferential segment of the ring of holes;
- wherein the seed distribution element further comprises a thrust-bearing element of the sowing disc, which thrust-bearing element is supported rotatably in the movable portion in order to withstand at least some of the axial load produced by the disc on the seal.

2. The seed distribution element according to claim 1, wherein the thrust-bearing element is rotated with the disc when the fixed and movable portions are closed against one another.

3. The seed distribution element according to claim 1, wherein the thrust-bearing element comprises a thrust-bearing plate which can bear on that surface of the sowing disc which faces the seal, in a zone radially inside of the ring of holes.

4. The seed distribution element according to claim 3, wherein the thrust-bearing element comprises a drive element which is fixed for rotation with the plate and can be coupled with the drive shaft of the disc when the fixed and movable portions are closed against one another.

5. The seed distribution element according to claim 4, wherein the drive element is self-centring relative to the drive shaft.

6. The seed distribution element according to claim 4, wherein the drive element comprises a coupling member which rotates jointly with the thrust-bearing plate but has radial and/or circumferential clearance so as to be self-centred during rotational coupling with the drive shaft of the disc.

7. The seed distribution element according to claim 1, wherein the movable portion is hinged to the fixed portion.

8. A sowing element for precision seed drills comprising a frame on which a seed distribution element according to claim 1 is mounted.

9. A seed drill comprising a supporting structure on which a plurality of sowing elements according to claim 8 are mounted.

10. A kit for the retrofitting of seed distribution elements of precision pneumatic seed drills wherein the distribution elements are of the type including:

- a sowing disc which is rotated by a motor-driven transmission drive shaft at controlled speed;
- a housing with a fixed portion and a portion which is movable relative to the fixed portion and can be closed against the fixed portion;
- a seed collection chamber being defined in the fixed portion;
- a pneumatic suction chamber being defined in the movable portion;
- the sowing disc being interposed between the fixed and movable portions and having opposed surfaces delimiting the chambers;
- the sowing disc having at least one ring of selector holes extending between the opposed surfaces; and
- a seal which is arranged on the movable portion and is capable of sliding contact with the facing surface of the disc when the portions are closed against one another;
- wherein a pressure differential is provided between the opposed surfaces in the region of a circumferential segment of the ring of holes;
- wherein the kit comprises the movable portion pre-assembled with a thrust-bearing element of the sowing disc, which thrust-bearing element is supported rotatably in the movable portion in order to withstand at least some of the axial load produced by the disc on the seal.

11. The kit according to claim 10 wherein the movable portion and the thrust-bearing element comprise at least one feature according to claim 2.

12. The kit according to claim 10 wherein the movable portion and the thrust-bearing element comprise at least one feature according to claim 3.

13. The kit according to claim 10 wherein the movable portion and the thrust-bearing element comprise at least one feature according to claim 4.

14. The kit according to claim 10 wherein the movable portion and the thrust-bearing element comprise at least one feature according to claim 5.

15. The kit according to claim 10 wherein the movable portion and the thrust-bearing element comprise at least one feature according to claim 6.

16. The kit according to claim 10 wherein the movable portion and the thrust-bearing element comprise at least one feature according to claim 7.

17. A seed meter for an agricultural planter, said seed meter comprising:

- a seed disc which is rotated by a motor-driven shaft at controlled speed;
- a meter housing with a fixed portion and a portion which is movable relative to the fixed portion and can be closed against the fixed portion;
- a seed pool area being defined in the fixed portion;
- a vacuum area defined in the movable portion;
- the seed disc being interposed between the fixed and movable portions and having opposed surfaces delimiting the seed pool area from the vacuum area;
- the seed disc having at least one ring of seed apertures extending between the opposed surfaces; and

a seal which is arranged on the movable portion and is capable of sliding contact with the facing surface of the disc when the fixed and movable portions are closed against one another

wherein a pressure differential is provided between the opposed surfaces in the region of a circumferential segment of the ring of seed apertures;

wherein the seed meter further comprises a thrust-bearing element of the seed disc, which thrust-bearing element is supported rotatably in the movable portion in order to withstand at least some of the axial load produced by the disc on the seal.

18. The seed meter according to claim **17**, wherein the thrust-bearing element is rotated with the disc when the fixed and movable portions are closed against one another.

19. The seed meter according to claim **17**, wherein the thrust-bearing element comprises a thrust-bearing plate which can bear on that surface of the seed disc which faces the seal, in a zone radially inside of the ring of seed apertures.

20. The seed meter according to claim **19**, wherein the thrust-bearing element comprises a drive element which is fixed for rotation with the plate and can be coupled with the shaft of the disc when the fixed and movable portions are closed against one another.

21. The seed meter according to claim **20**, wherein the drive element is centered relative to the shaft.

22. The seed meter according to claim **20**, wherein the drive element comprises a coupling member which rotates jointly with the thrust-bearing plate.

23. The seed meter according to claim **17**, wherein the movable portion is mechanically coupled to the fixed portion.

24. An agricultural planter comprising a frame on which a seed meter according to claim **17** is mounted.

25. An agricultural planter including a supporting structure on which a plurality of seed meters according to claim **24** are mounted.

26. An assembly for a seed meter of an agricultural planter wherein the seed meter is of the type including:

a seed disc which is rotated by a motor-driven shaft at controlled speed;

a meter housing with a fixed portion and a portion which is movable relative to the fixed portion and can be closed against the fixed portion;

a seed pool area being defined in the fixed portion;

a vacuum area defined in the movable portion;

the seed disc being interposed between the fixed and movable portions and having opposed surfaces delimiting the seed pool area from the vacuum area;

the seed disc having at least one ring of seed apertures extending between the opposed surfaces; and

a seal which is arranged on the movable portion and is capable of sliding contact with the facing surface of the disc when the fixed and movable portions are closed against one another;

wherein a pressure differential is provided between the opposed surfaces in the region of a circumferential segment of the ring of seed apertures;

wherein the assembly comprises, in said movable portion, a thrust-bearing element of the seed disc, which thrust-bearing element is supported rotatably in the movable portion in order to withstand at least some of the axial load produced by the disc on the seal.

27. The assembly according to claim **26** wherein the thrust-bearing element is rotated with the disc when the fixed and movable portions are closed against one another.

28. The assembly according to claim **26** wherein the thrust-bearing element comprises a thrust-bearing plate which can bear on that surface of the seed disc which faces the seal, in a zone radially inside of the ring of seed apertures.

29. The assembly according to claim **26** wherein the thrust-bearing element comprises a drive element which is fixed for rotation with the plate and can be coupled with the shaft of the disc when the fixed and movable portions are closed against one another.

30. The assembly according to claim **29** wherein the drive element is centered relative to the shaft.

31. The assembly according to claim **29** wherein the drive element comprises a coupling member which rotates jointly with the thrust-bearing plate.

32. The assembly according to claim **26** wherein the movable portion is mechanically coupled to the fixed portion.

* * * * *

Appendix B2



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A01C 7/10 (2006.01)

A01C 7/08 (2006.01)

(72) Inventor: **Derek Sauder**, Tremont, IL (US)

A01C 7/04 (2006.01)

A01C 7/16 (2006.01)

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(22) Filed: **Jul. 18, 2017**

(52) **U.S. Cl.**

CPC *A01C 7/046* (2013.01); *A01C 7/16*

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(2013.01); *A01C 7/04* (2013.01); *A01C 7/105*

(2013.01); *A01C 7/084* (2013.01); *A01C 7/044*

(2013.01); *A01C 7/12* (2013.01)

Related U.S. Application Data

(63) Continuation of application No. 14/793,360, filed on Jul. 7, 2015, now abandoned, which is a continuation of application No. 14/006,569, filed on Sep. 20, 2013, now Pat. No. 9,351,440, filed as application No. PCT/US2012/030192 on Mar. 22, 2012.

(60) Provisional application No. 61/466,047, filed on Mar. 22, 2011.

Publication Classification

(51) **Int. Cl.**

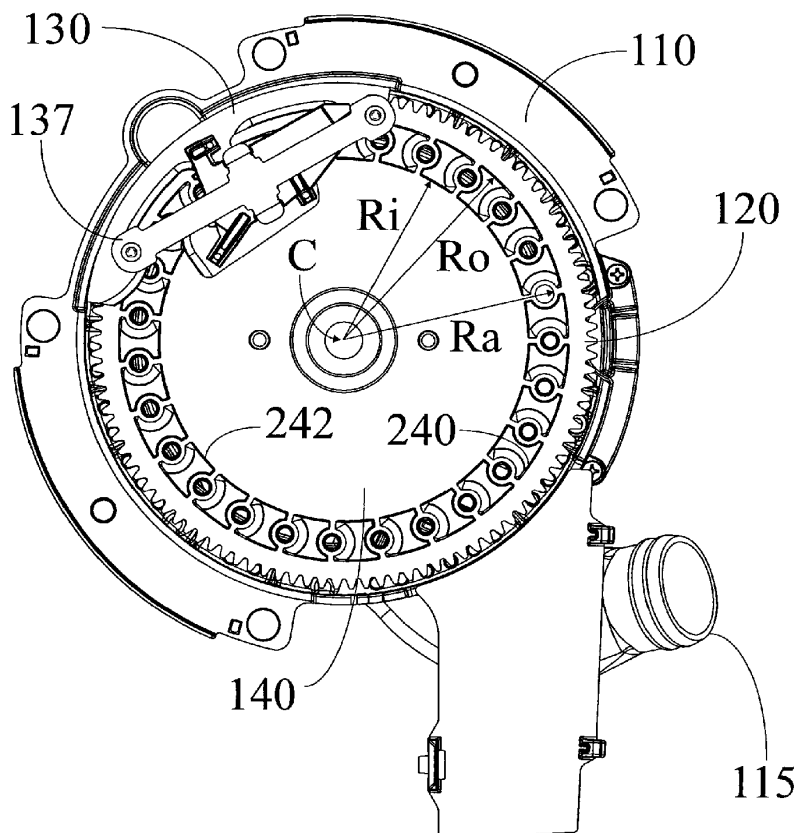
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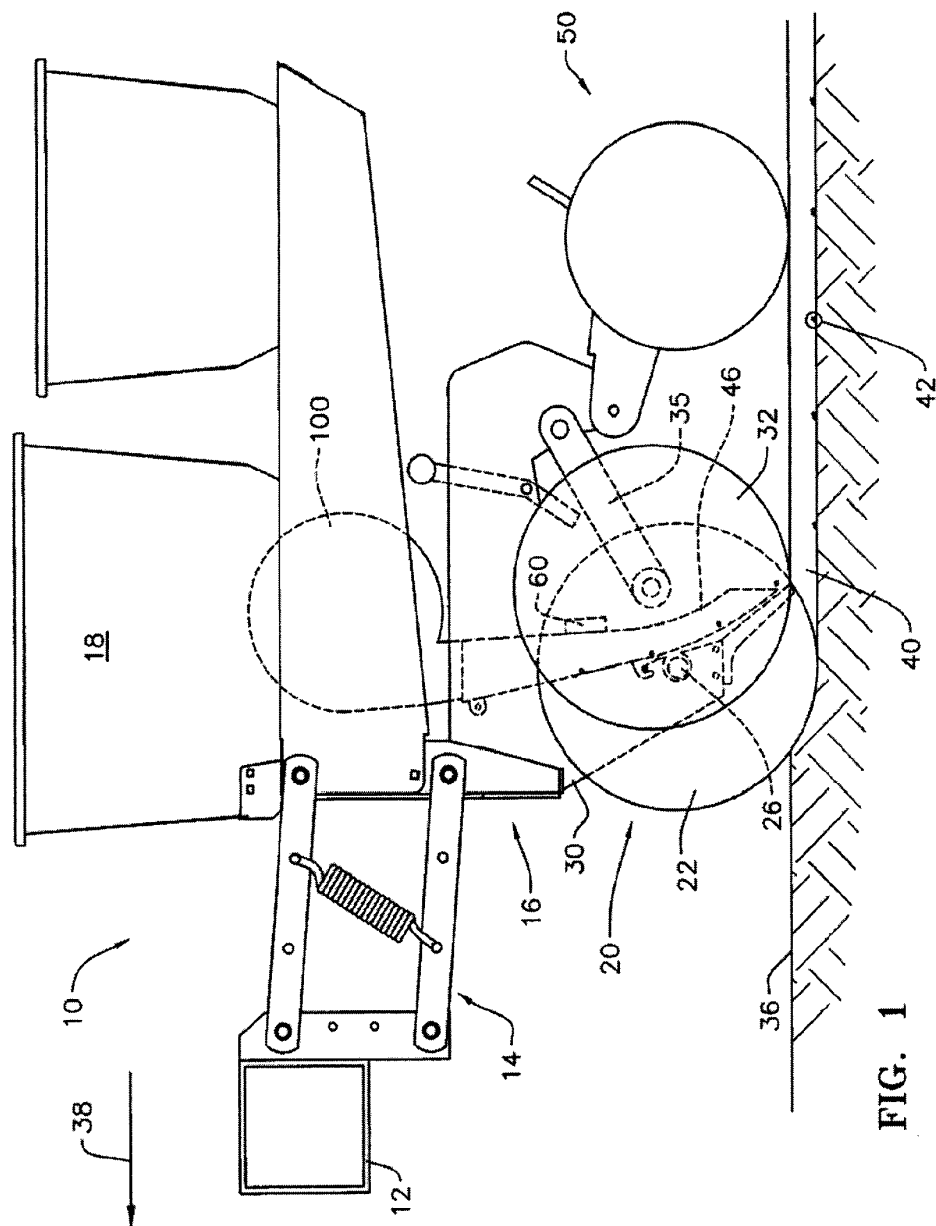
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(57)

ABSTRACT

A seed meter for an agricultural planter in which the seed disc is rotatably mounted within a seed meter housing. As the seed disc rotates, the apertures in the disc rotate along a seed aperture path through a horizontally adjacent seed pool area. The seed disc includes cavities disposed along the seed aperture path to agitate the seeds in the seed pool area. A singulator having multiple co-planar singulator surfaces is biased against the seed side surface of the seed disc.





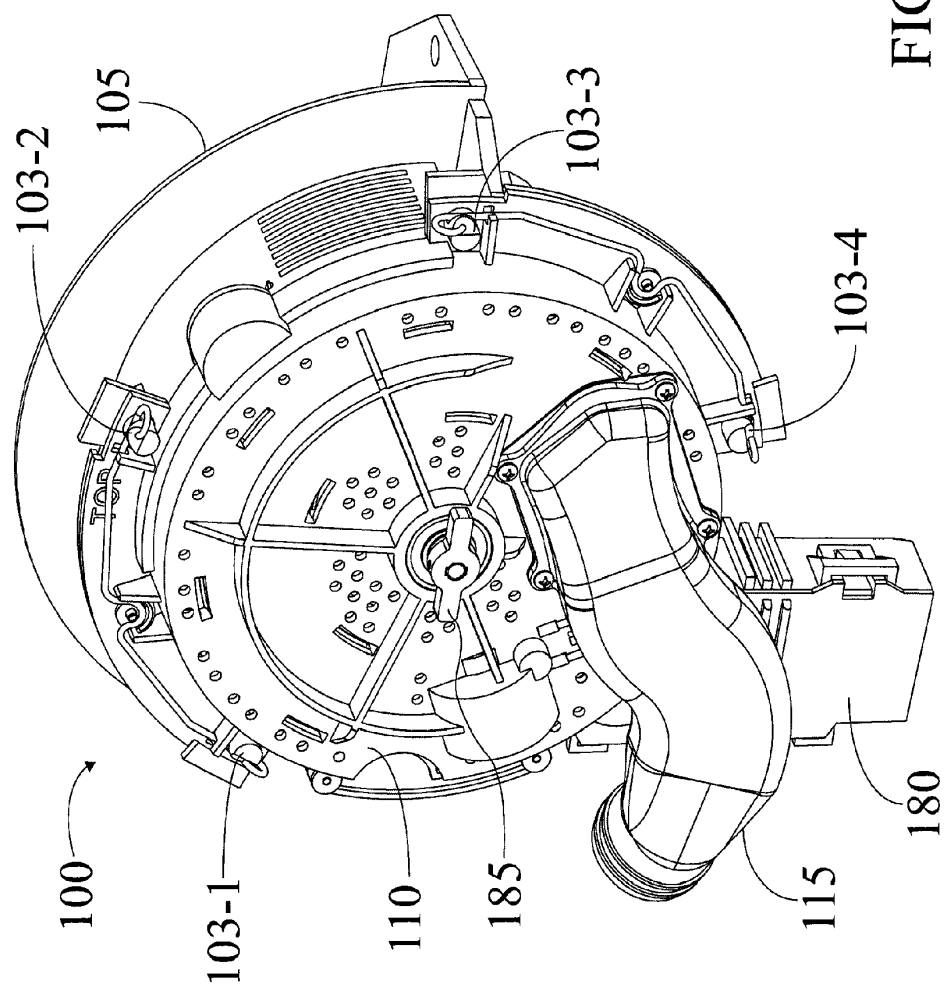


FIG. 2

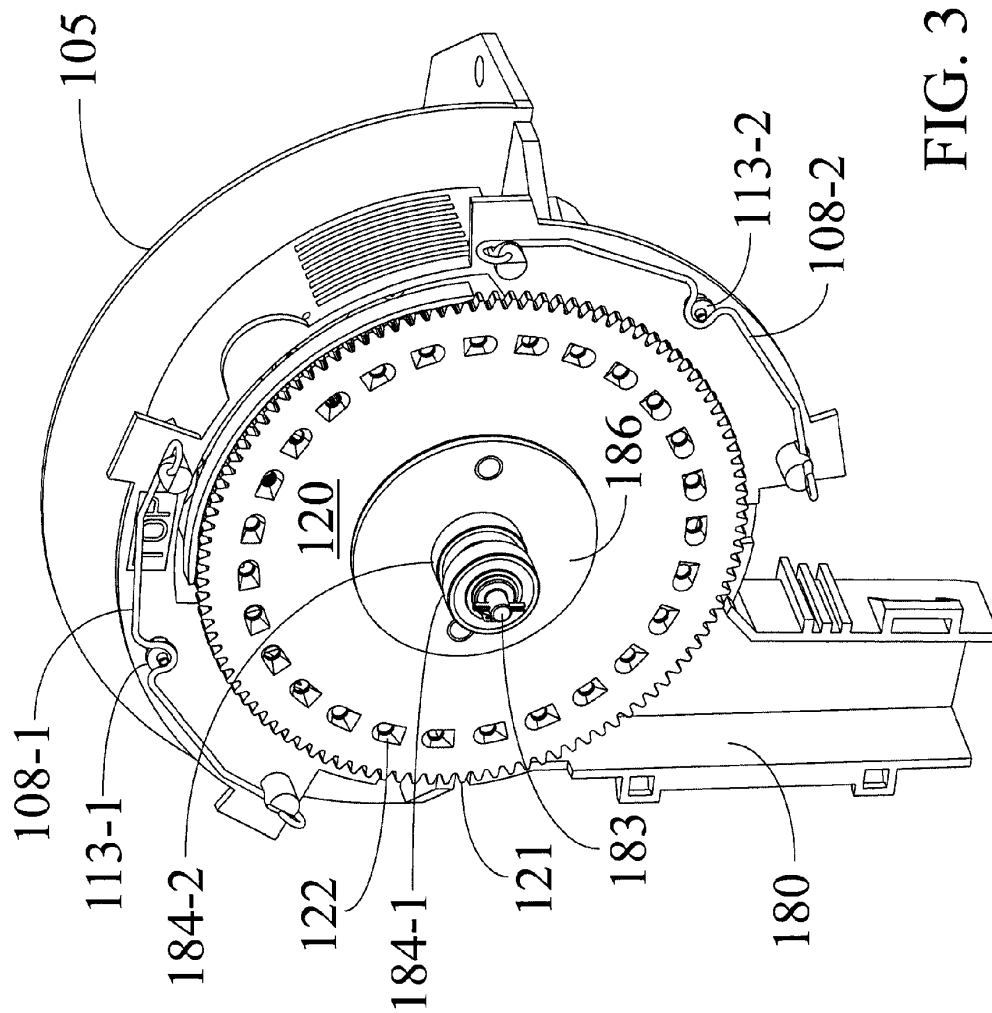
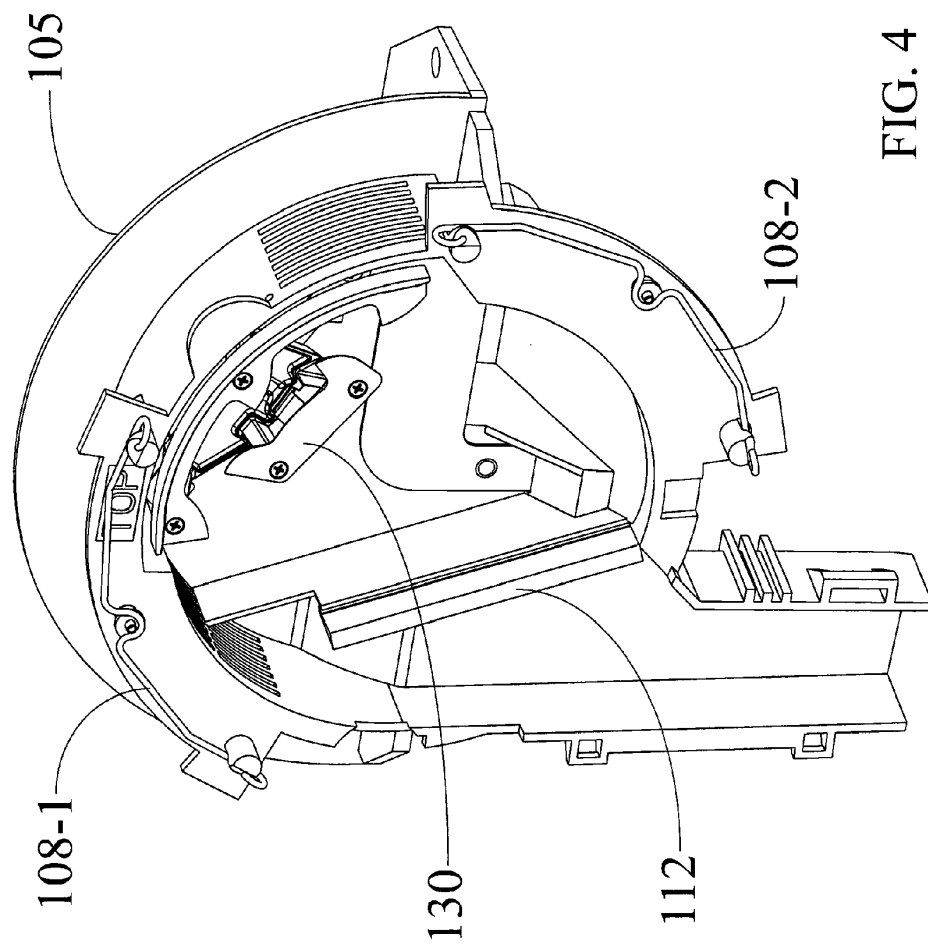
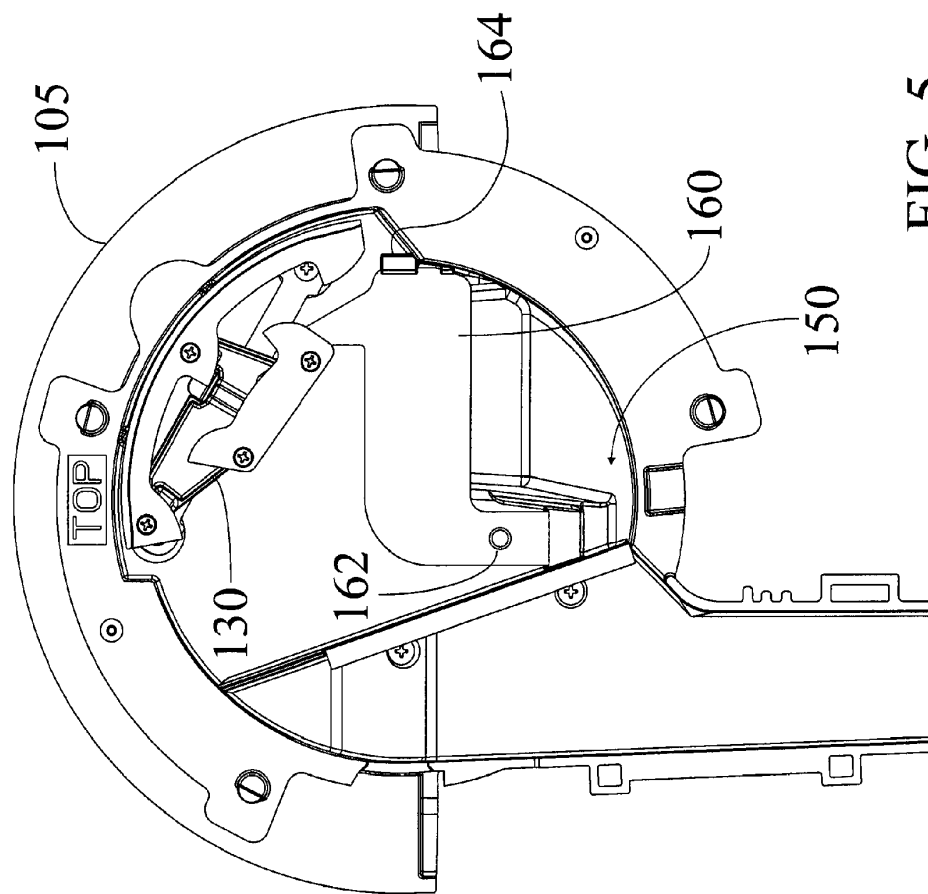
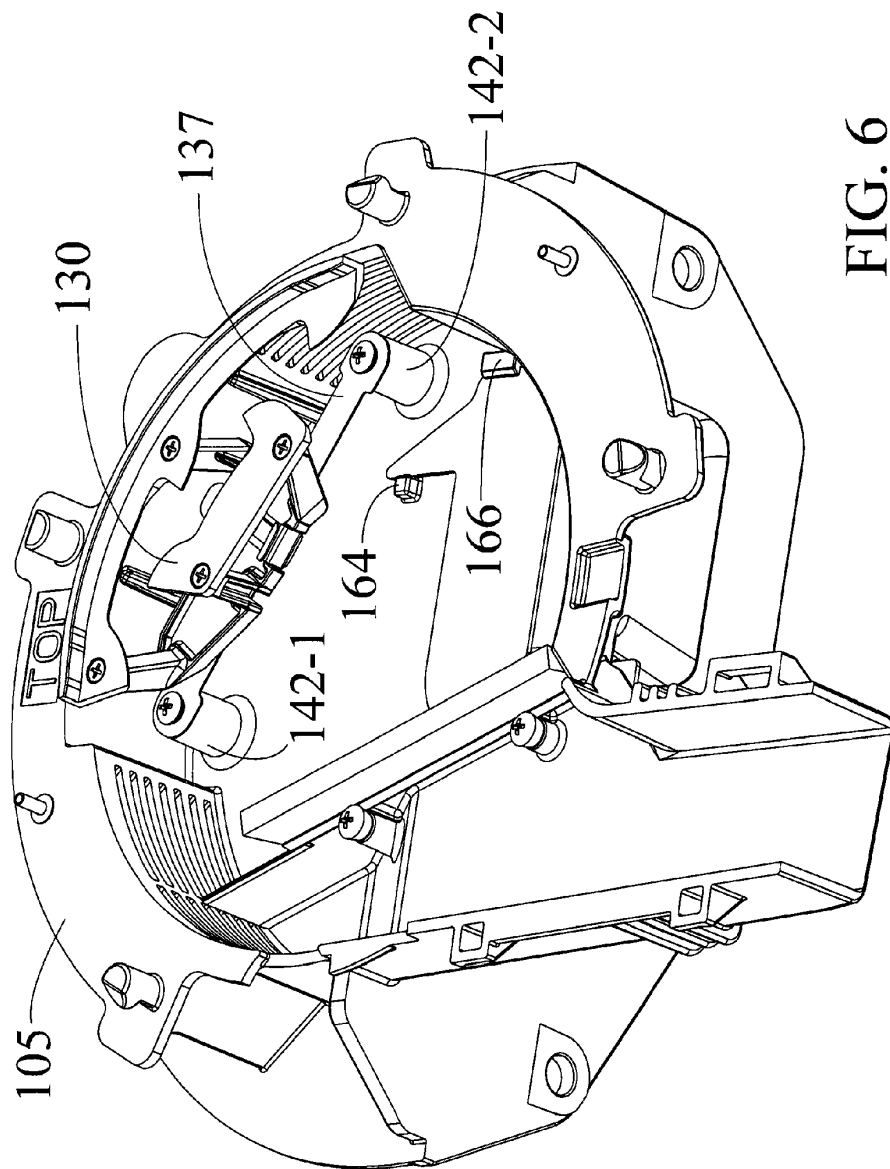


FIG. 3







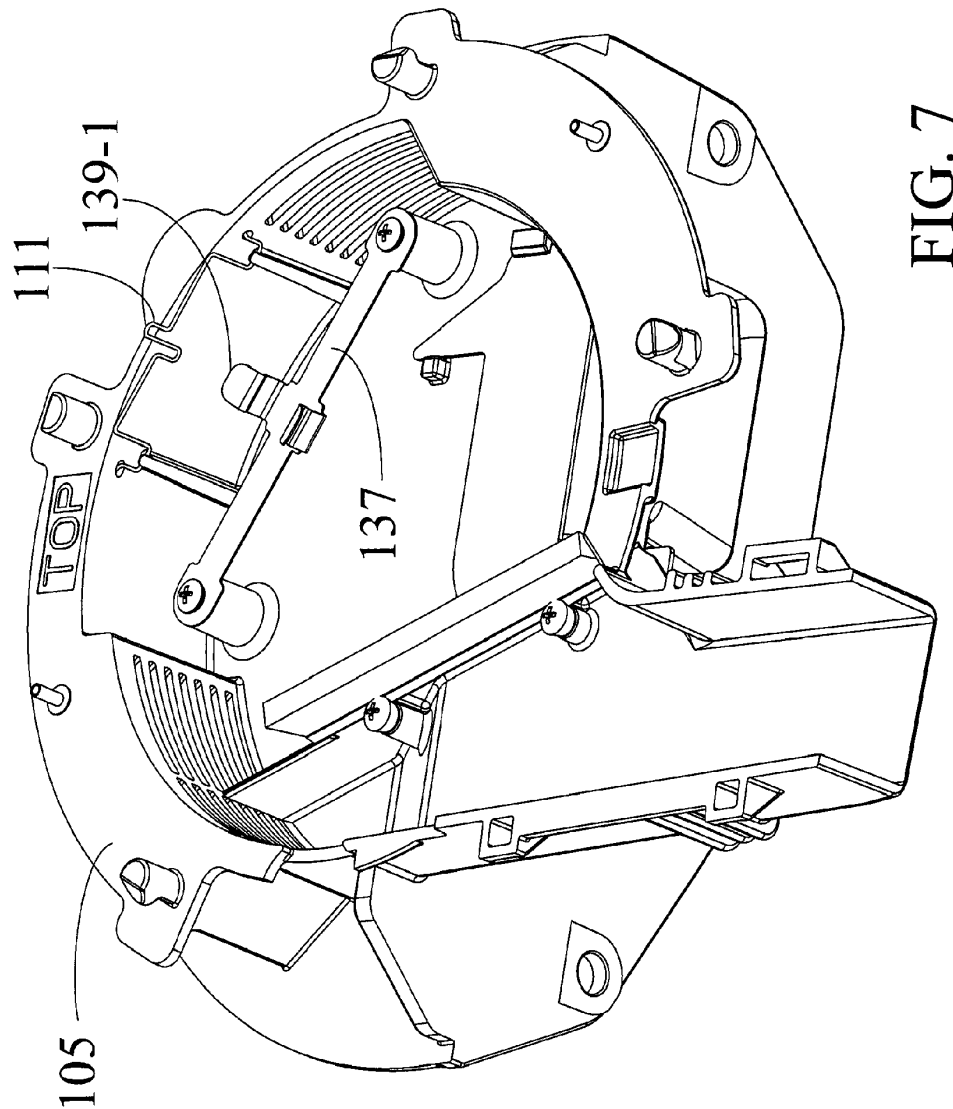


FIG. 7

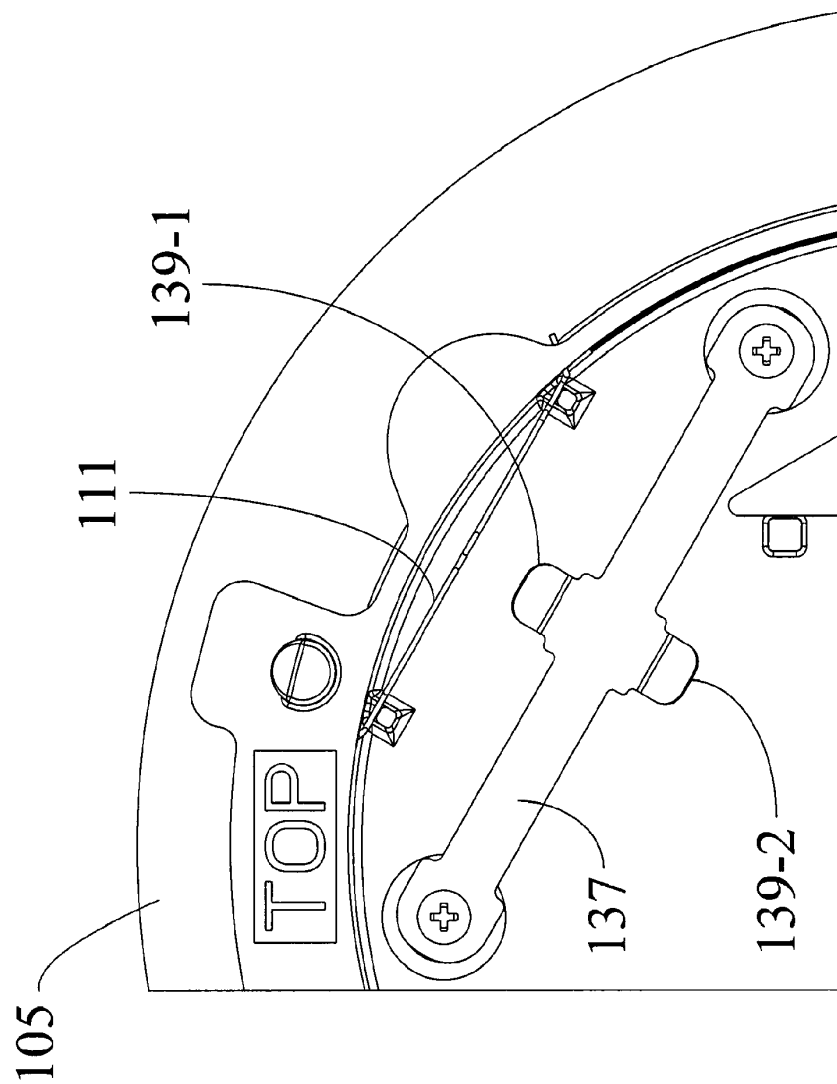
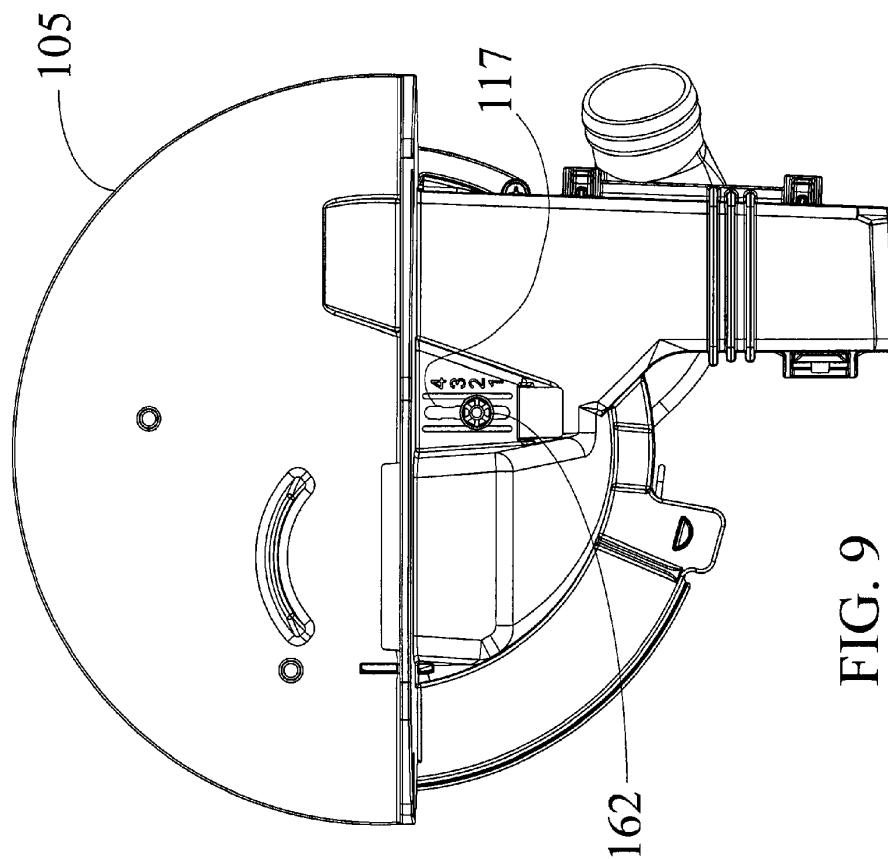
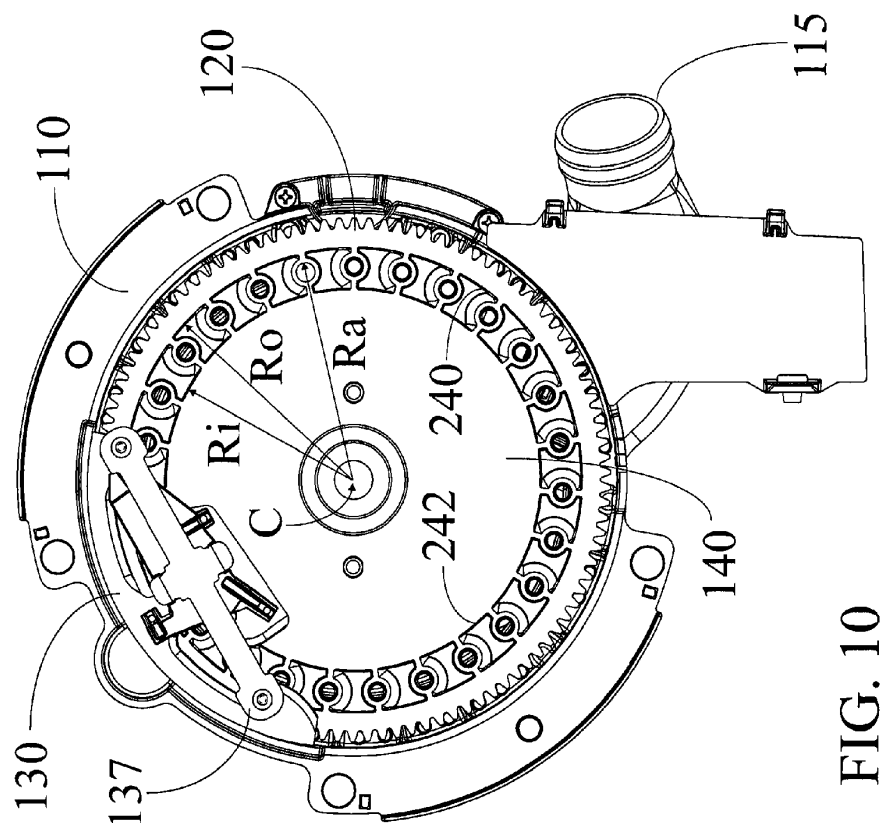


FIG. 8





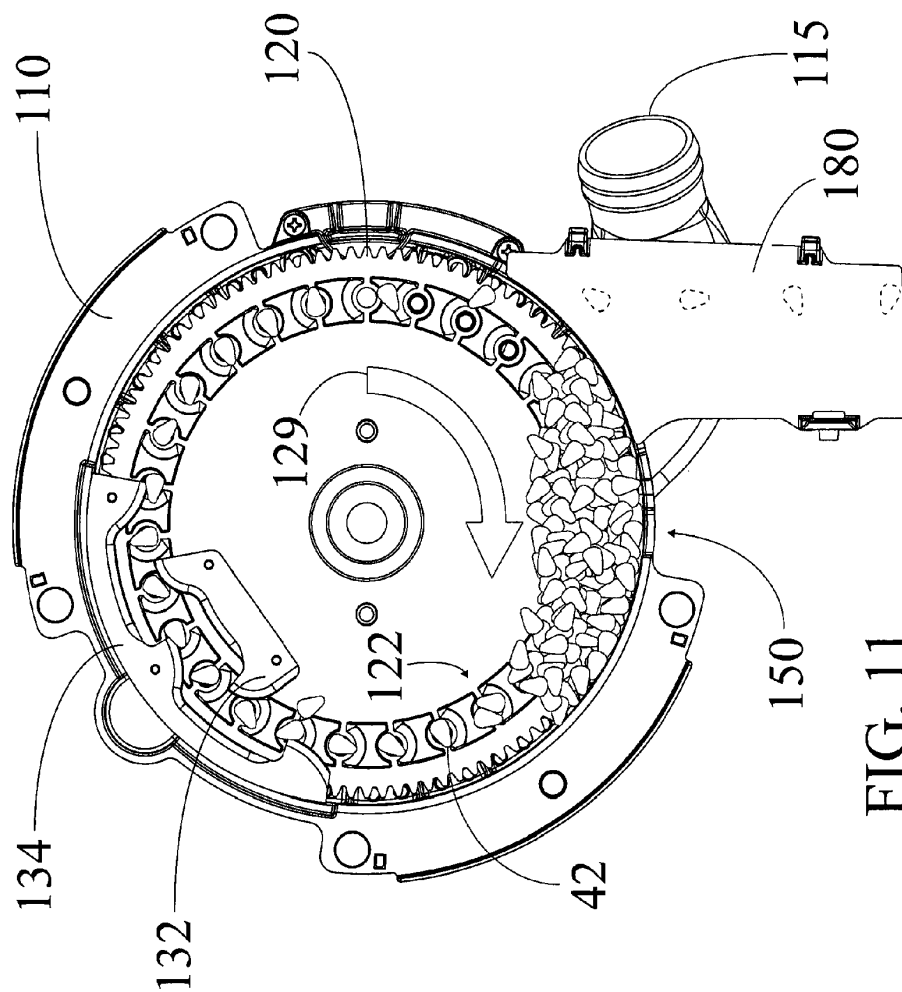


FIG. 11

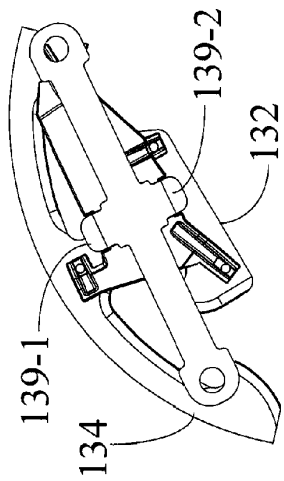


FIG. 12B

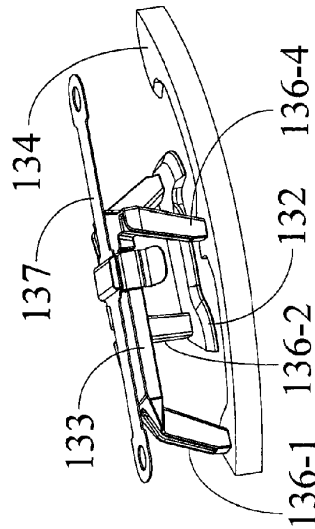


FIG. 12D

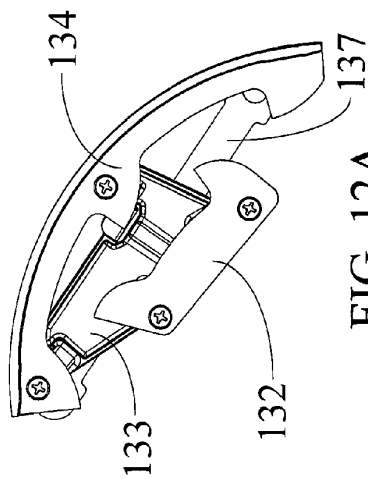


FIG. 12A

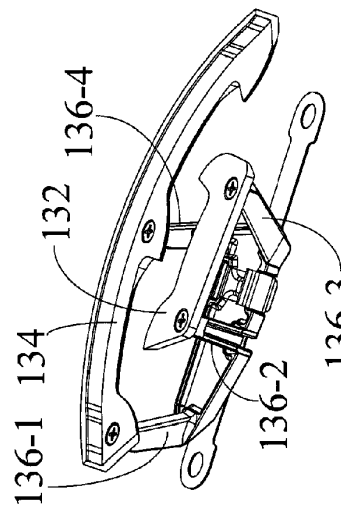


FIG. 12C

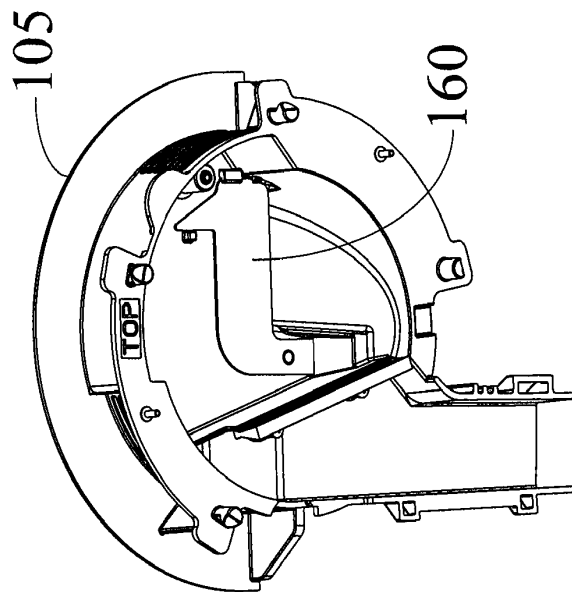


FIG. 13B

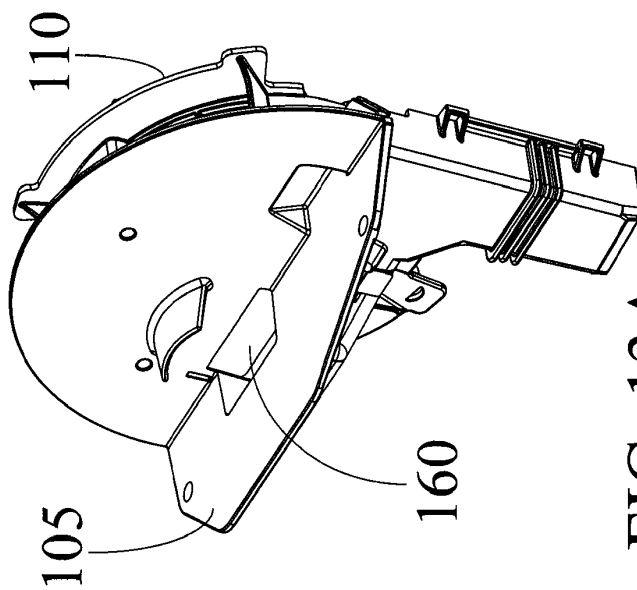
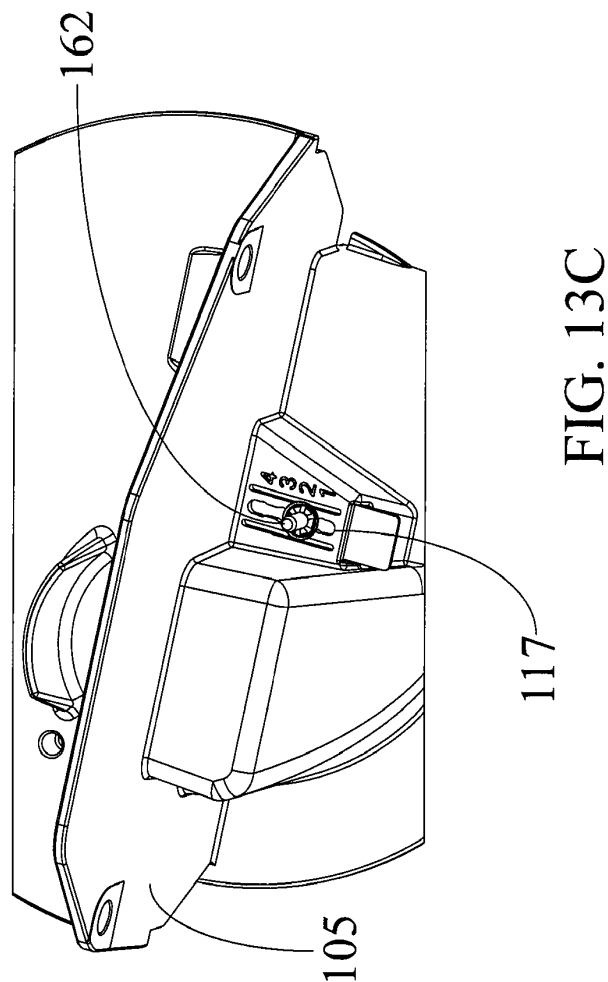


FIG. 13A



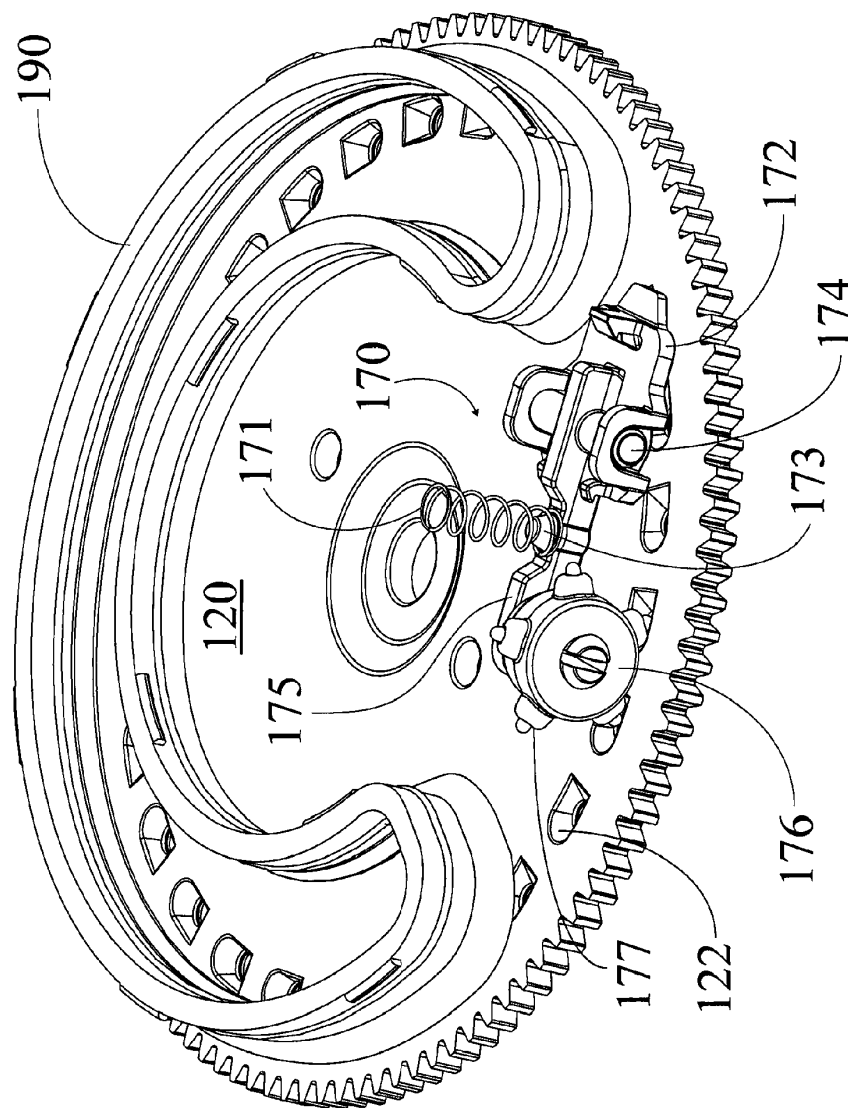


FIG. 14

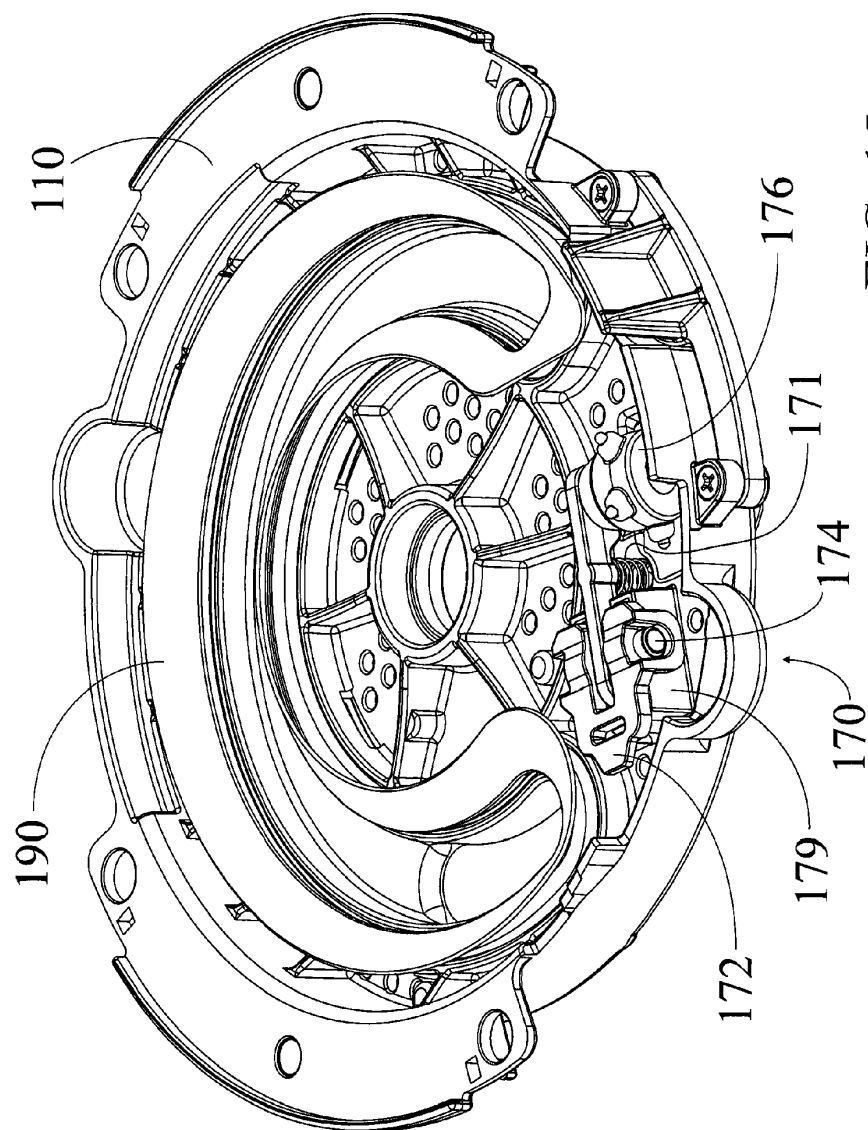
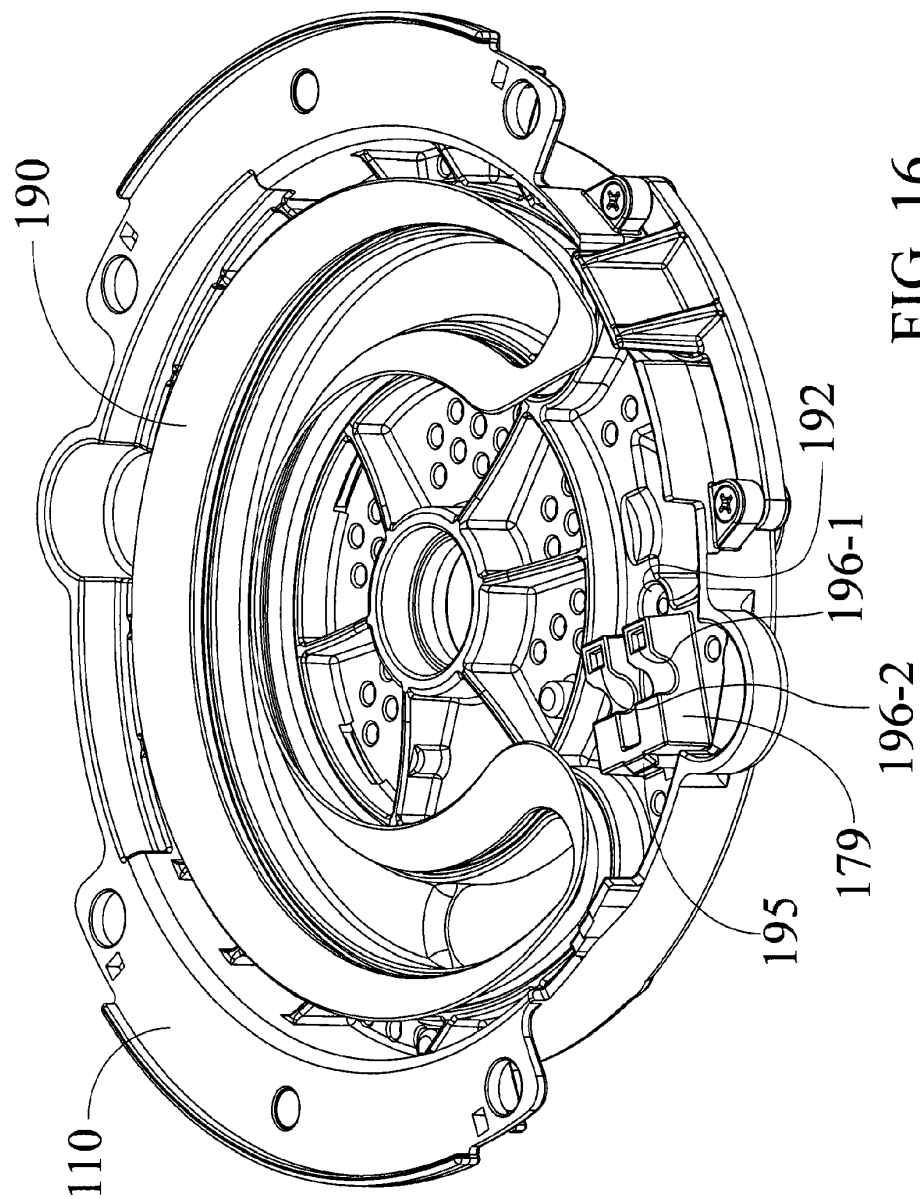


FIG. 15



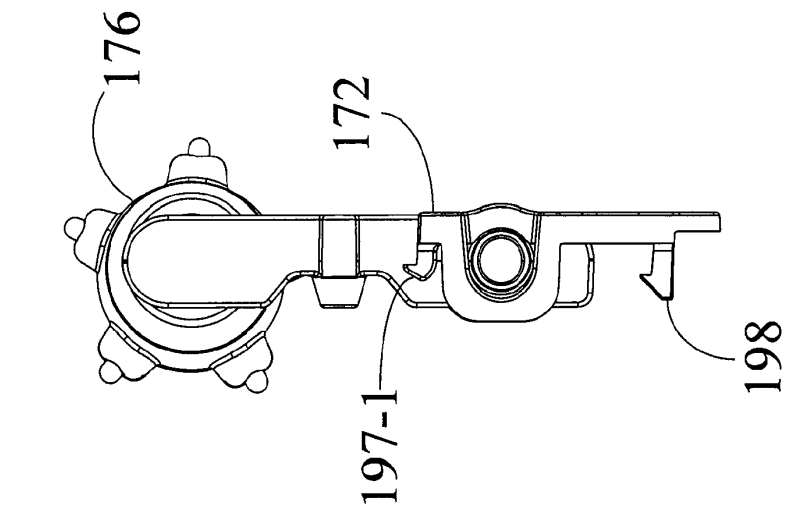


FIG. 17B

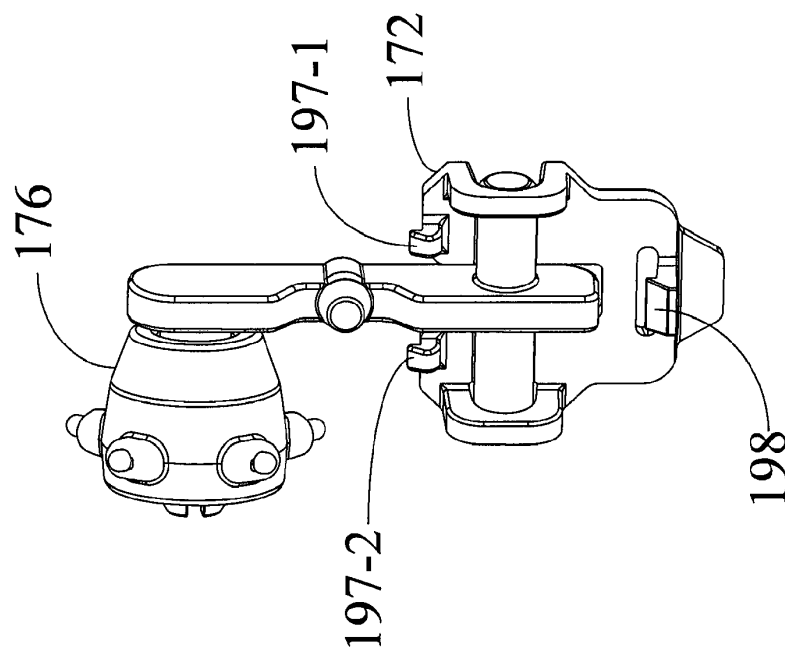
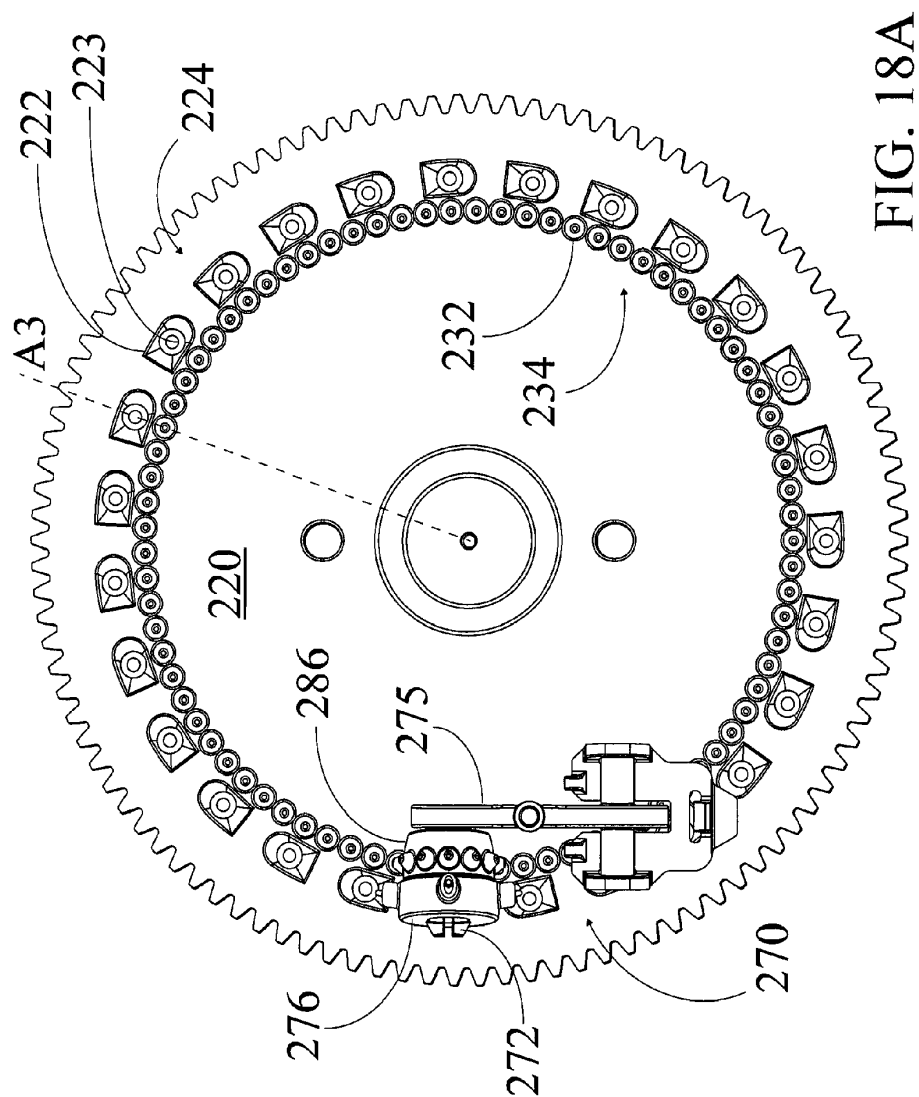


FIG. 17A



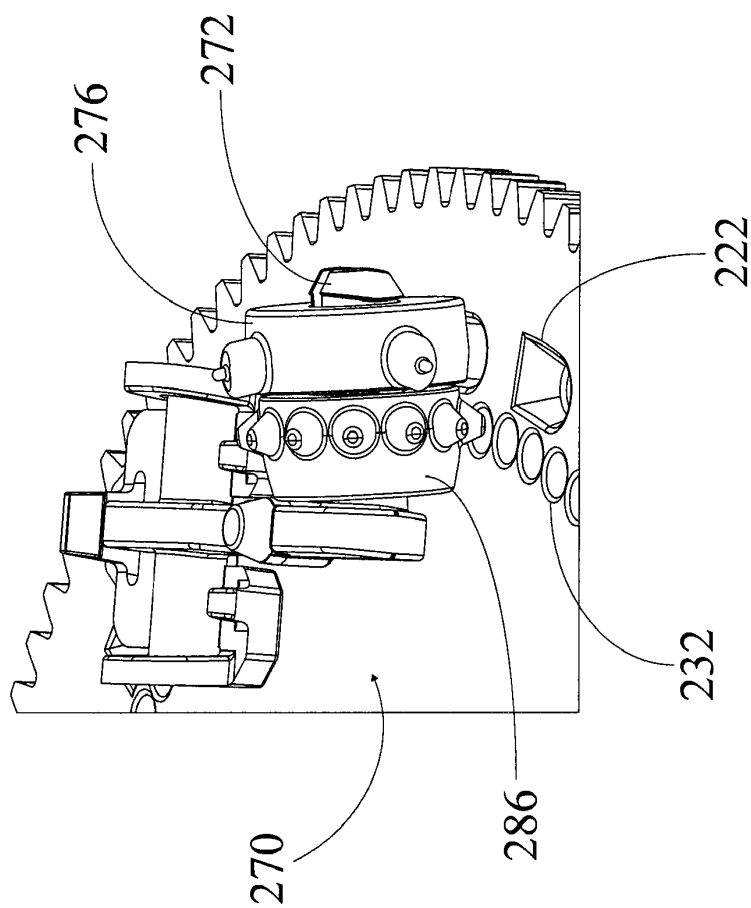


FIG. 18B

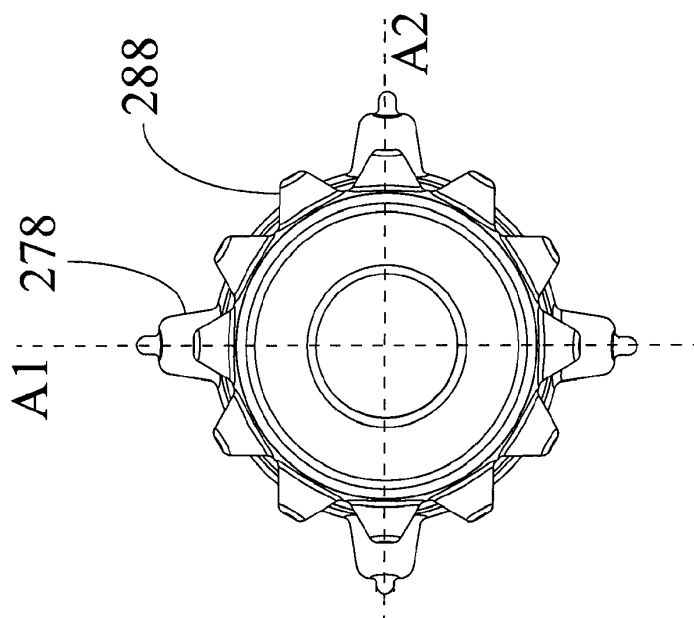


FIG. 18D

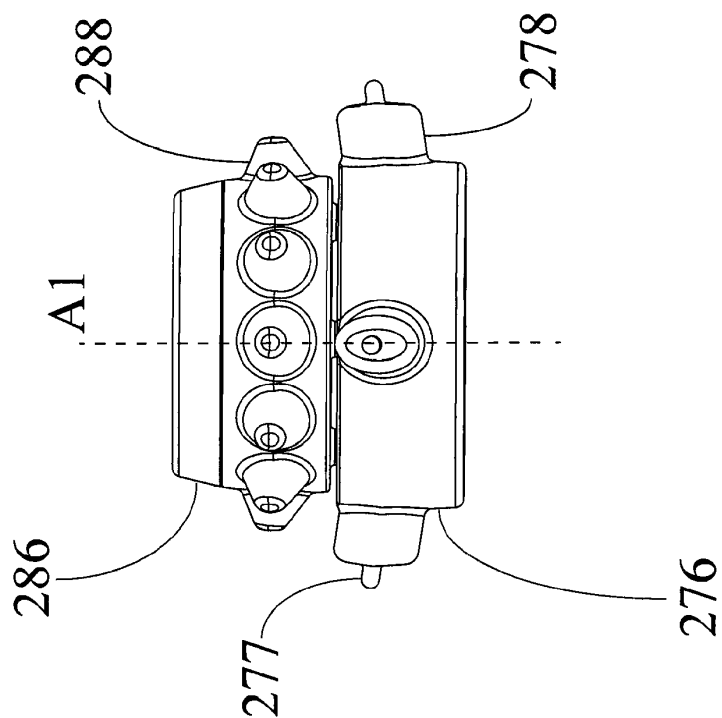
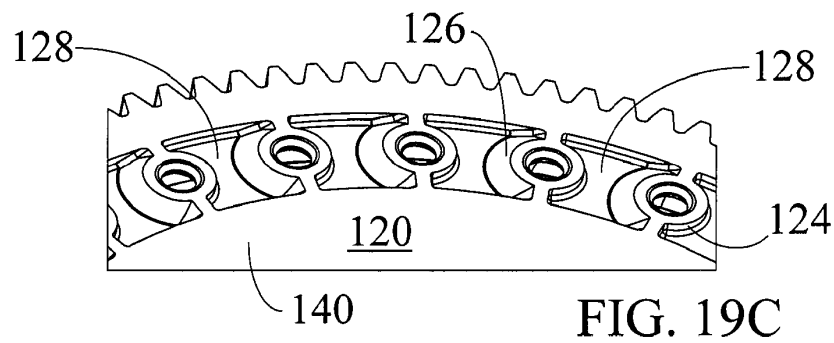
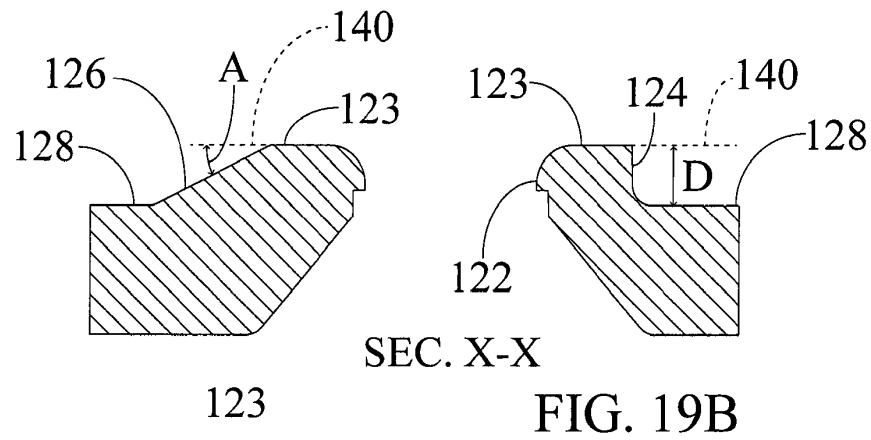
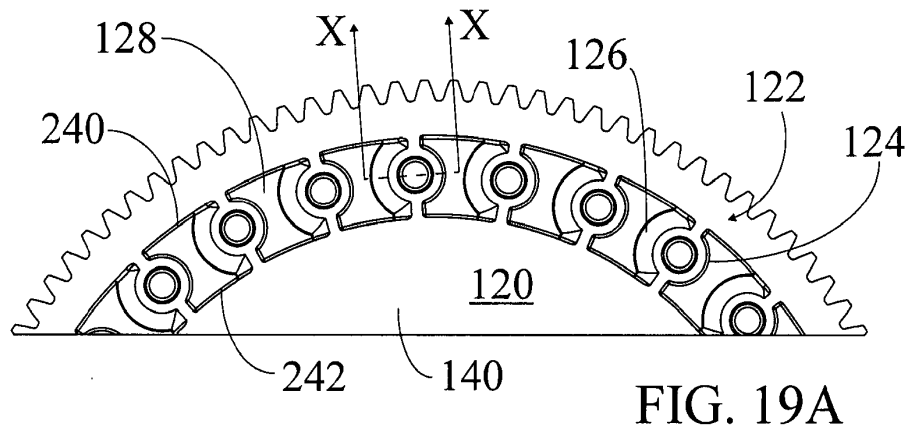


FIG. 18C



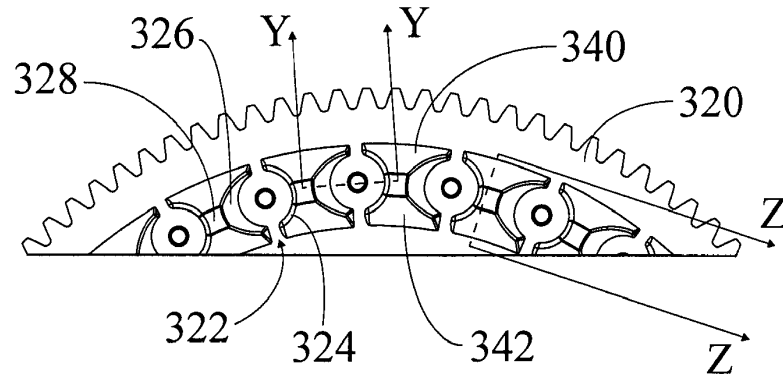


FIG. 20A

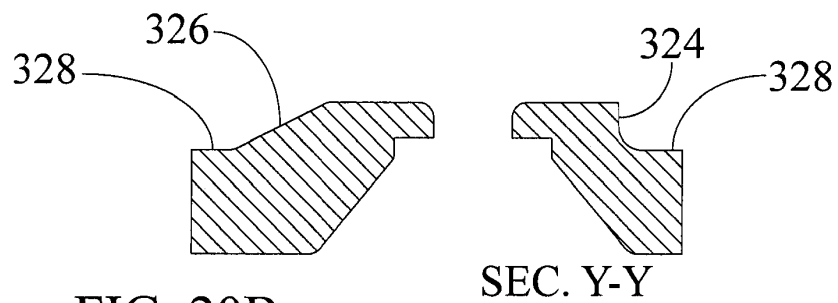


FIG. 20B

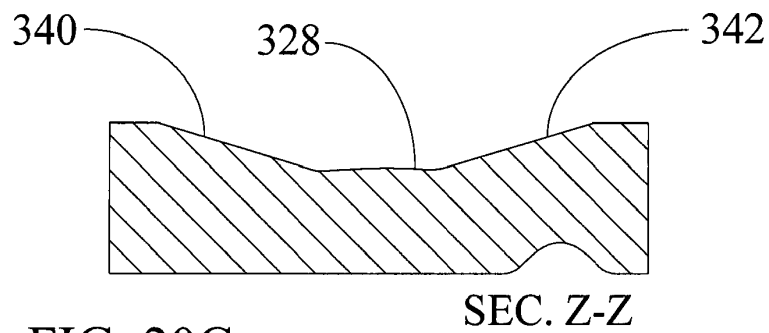


FIG. 20C

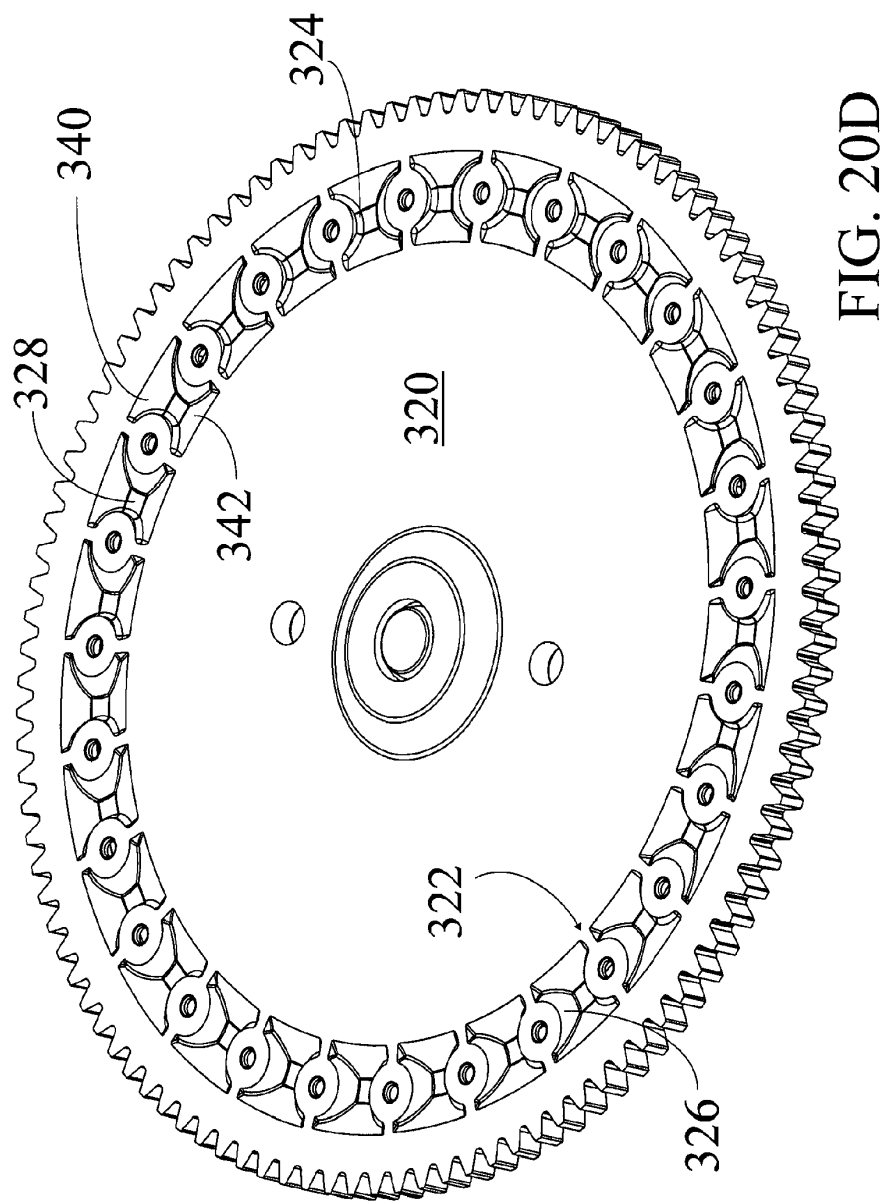


FIG. 20D

SEED METER

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application is a continuation of U.S. application Ser. No. 14/793,360, filed Jul. 7, 2015, which is a continuation of U.S. application Ser. No. 14/006,569 filed Sep. 20, 2013, which is the National Stage of International Application No. PCT/US2012/030192 filed Mar. 22, 2012, which claims the benefit of U.S. Provisional Application No. 61/466,047, filed Mar. 22, 2011.

BACKGROUND

[0002] In recent years, growers of corn and other crops have come to recognize the importance of planting individual seeds at the appropriate spacing due to increased seed and crop input prices, but also because they have the ability to monitor the economic impact of skips, doubles or misplaced seeds using modern planter monitors. For these reasons modern seed meters have been developed that include features which improve the singulation of seeds. However, each added feature increases the amount of time that the grower must spend replacing wear parts or making other adjustments prior to or during planting operations. Due to weather and other factors, the available time to plant corn and other crops is often extremely limited, with each planter required to cover hundreds of acres while limited in speed due to reduced seed meter performance at higher planting speeds.

[0003] Thus, there is a need for a seed meter having improved singulation and seed spacing capability at higher speeds and which is also easily repairable and modifiable.

BRIEF DESCRIPTION OF THE DRAWINGS

[0004] FIG. 1 illustrates a side elevation view of a single row unit of a conventional row crop planter.

[0005] FIG. 2 is a perspective view of an embodiment of a seed meter.

[0006] FIG. 3 is a partial perspective view of an embodiment of a seed meter.

[0007] FIG. 4 is another partial perspective view of an embodiment of a seed meter.

[0008] FIG. 5 is a partial side elevation view of an embodiment of a seed meter.

[0009] FIG. 6 is another partial perspective view of an embodiment of a seed meter.

[0010] FIG. 7 is another partial perspective view of an embodiment of a seed meter.

[0011] FIG. 8 is another side elevation view of an embodiment of a seed meter.

[0012] FIG. 9 is another side elevation view of an embodiment of a seed meter.

[0013] FIG. 10 is a partial side elevation view of an embodiment of a seed meter.

[0014] FIG. 11 is a partial side elevation view of an embodiment of a seed meter.

[0015] FIG. 12A is a perspective view of an embodiment of a seed singulator and an embodiment of an axial spring.

[0016] FIG. 12B is another perspective view of an embodiment of a seed singulator and an embodiment of an axial spring.

[0017] FIG. 12C is another perspective view of an embodiment of a seed singulator and an embodiment of an axial spring.

[0018] FIG. 12D is another perspective view of an embodiment of a seed singulator and an embodiment of an axial spring.

[0019] FIG. 13A is another perspective view of an embodiment of a seed meter.

[0020] FIG. 13B is another partial perspective view of an embodiment of a seed meter.

[0021] FIG. 13C is a partial perspective view of an embodiment of a seed meter.

[0022] FIG. 14 is a perspective view of a seed disc, vacuum seal and an embodiment of an ejector wheel assembly.

[0023] FIG. 15 is a perspective view of a vacuum cover, a vacuum seal, and an embodiment of an ejector wheel assembly.

[0024] FIG. 16 is a perspective view of a vacuum cover and vacuum seal.

[0025] FIG. 17A is a perspective view of an embodiment of an ejector wheel assembly.

[0026] FIG. 17B is a side elevation view of an embodiment of an ejector wheel assembly.

[0027] FIG. 18A is a side elevation view of another embodiment of a seed disc and another embodiment of an ejector wheel assembly.

[0028] FIG. 18B is a side elevation view of an embodiment of a seed disc and an embodiment of an ejector wheel assembly.

[0029] FIG. 18C is a side elevation view of an embodiment of an ejector wheel.

[0030] FIG. 18D is a top view of an embodiment of an ejector wheel.

[0031] FIG. 19A is a partial side elevation view of an embodiment of seed disc.

[0032] FIG. 19B is a cross-sectional view of a seed disc along the section X-X of FIG. 19A.

[0033] FIG. 19C is a partial perspective view of an embodiment of a seed disc.

[0034] FIG. 20A is a partial side elevation view of another embodiment of a seed disc.

[0035] FIG. 20B is a cross-sectional view of a seed disc along the section Y-Y of FIG. 20A.

[0036] FIG. 20C is a cross-sectional view of a seed disc along the section Z-Z of FIG. 20B.

[0037] FIG. 20D is a perspective view of an embodiment of a seed disc.

DESCRIPTION

[0038] Referring now to the drawings, wherein like reference numerals designate identical or corresponding parts throughout the several views, FIG. 1 illustrates a single row unit 10 of a conventional row crop planter. As is well known in the art, the row units 10 are mounted in spaced relation along the length of a transverse toolbar 12 by a parallel linkage 14 which permits each row unit 10 to move vertically independently of the toolbar and the other spaced row units in order to accommodate changes in terrain or upon the row unit encountering a rock or other obstruction as the planter is drawn through the field. Each row unit 10 includes a frame 16 which operably supports a seed hopper 18, a furrow opening assembly 20, a seed meter 100, a seed tube 46 and a furrow closing assembly 50.

[0039] The furrow opening assembly 20 comprises a pair of furrow opening discs 22 which are rotatably mounted on shafts 26 secured to a shank 30 comprising a part of the row unit frame 16. The furrow opening assembly 20 further comprises a pair of gauge wheels 32 rotatably supported by gauge wheel arms 35 also secured to the frame 16. As the planter is drawn through the field, the rotating furrow opening discs 22 cut a V-shaped furrow 40 through the soil surface 36. The egress end of the seed tube 46 is disposed between the rearwardly diverging furrow opening discs 22.

[0040] In operation, as the planter is drawn through the field along the direction of travel as indicated by the arrow 38, the seed hopper 18 communicates a constant supply of seeds 42 to the seed meter 100. The seed meter 100 meters or dispenses individual or “singulated” seeds 42 at regularly spaced intervals into the seed tube 46. The seed tube 46 directs the seeds downwardly and rearwardly between the diverging furrow opening discs 22 before depositing the seeds into the V-shaped furrow 40. The seeds are then covered with soil by the furrow closing assembly 50. A seed sensor 60 detects the passage of seeds through the seed tube 46 as is known in the art.

Novel Seed Meter Embodiments

[0041] Embodiments of a novel seed meter 100 are illustrated in FIGS. 2-20. Referring to FIGS. 2 and 3, the seed meter 100 includes a housing comprised of a vacuum cover 110 and a seed housing 105. As described further herein, the seed meter 100 functions by selecting one seed at a time from seeds communicated into the seed housing 105 and dispensing each seed through the seed exit 180. A vacuum inlet 115 is coupled to the vacuum cover 110. Vacuum hoses or tubes (not shown) connect the vacuum inlet 115 to a vacuum source (not shown) such as a vacuum impeller.

[0042] The seed housing 105 includes pivots 113 (FIG. 3) and tabs 103 (FIG. 2). When assembled, the tabs 103 extend through holes in the vacuum cover 110 such that retaining springs 108 may be biased against pivots 113 and tabs 103 to retain the seed housing 105 in position against the vacuum cover 110.

[0043] Referring to FIG. 3, the seed meter 100 is shown with the vacuum cover 110 and other components removed for clarity. A shaft 183 is rotatably coupled to bearings 184. Bearings 184 are held in place by the vacuum cover 110. A drive plate 186 is coupled to and rotates with the shaft 183. Drive plate 186 is releasably coupled to a seed disc 120. Seed disc 120 includes apertures 122 and preferably includes drive teeth 121. In operation, the seed disc 120 may be rotated by a driven gear (not shown) coupled to drive teeth 121 (as described further herein) or by a driven shaft (not shown) coupled to an adapter 185 (FIG. 2) mounted to the shaft 183.

[0044] Turning to FIG. 4, the interior of the seed housing 105 is shown with the seed disc 120, drive shaft 183 and drive plate 186 removed. A brush 112 is mounted to seed housing 105 such that its bristles contact the seed-side surface of the seed disc 120. A singulator 130 is mounted to the seed housing 105 (as described further herein) which cooperates with the seed disc 120 to singulate the seeds before they are dispensed through the seed exit 180. The singulator preferably includes multiple singulator surfaces in contact with a seed side surface 140 of the seed disc 120.

[0045] Referring to FIGS. 5, 6, and 13A-C, seeds are communicated into the seed meter 100 beneath a baffle 160

mounted to the seed housing 105. A seed pool area 150 (FIG. 5) is disposed horizontally adjacent to the seed disc 120 near a bottom end of the seed housing 105 for collection of seeds communicated into the seed meter.

[0046] The height of baffle 160 may be adjusted along guides 164 and 166. The baffle 160 is mounted to the seed housing 105 by rivet 162, which extends outside the seed housing 105 (as best seen in FIGS. 9 and 13C) and may be moved vertically by the operator along a notched slot 117 without disassembling the housing. Each notch in slot 117 is sized to hold the rivet 162 in place such that the operator can select the height of baffle 160 by pushing the rivet up and down. As illustrated, visual indicators (e.g., numbers 1 through 4) are preferably located adjacent to the notches for positioning the rivet 162 at corresponding heights of the baffle 160 for ease of reference.

Removable Floating Singulator Embodiments

[0047] Referring to FIGS. 6-8, the singulator 130 is releasably mounted to the seed housing 105 so as to bias the singulator against the seed disc 120 while allowing the singulator to “float” both axially and longitudinally with respect to the axis of rotation of the seed disc. The singulator is releasably coupled to an axial spring 137 by attachment ears 139. The axial spring 137 is preferably made of a material (e.g., spring steel) which is elastically deformable. The axial spring 137 is mounted to bosses 142. The bosses 142 are sized such that the singulator 130 is biased against the face of the seed disc 120 when the seed disc is in its normal position. Thus, when the seed disc 120 is deflected axially away from the vacuum cover 110, the tension in axial spring 137 increases, allowing the singulator to remain in contact with the seed disc without interfering with the rotation of the seed disc. Likewise, when the seed disc is deflected axially toward the vacuum cover 110, the tension in axial spring 137 decreases such that the singulator remains in contact with the seed disc.

[0048] Radial spring 111 is mounted to the seed housing 105 such that in operation, the radial spring biases the singulator radially against the seed disc 120 when the seed disc is in its normal position.

[0049] Referring to FIGS. 12A-D, the singulator 130 is illustrated in detail attached to the axial spring 137. The singulator 130 includes base 133, arms 136, upper lobe plate 134 and lower lobe plate 132. The upper lobe plate 134 includes three singulation lobes, while the lower lobe plate 132 includes two singulation lobes. In operation, attachment ears 139 grasp the base 133. When the axial spring 137 is attached to the singulator 130, the attachment ears 139 extend past and away from the base 133 and are easily manipulated and deflected. It should be appreciated that other configurations of the singulator 130 could be used to achieve the objectives described herein.

[0050] It should be appreciated that the singulator 130 is easily replaceable with another singulator with a different lobe configuration for different seeds or if it is necessary to replace the singular due to wear on the singulator lobes. The singulator 130 is removable by pulling it away from the axial spring 137 with sufficient force that the attachment ears 139 deflect away from each other sufficiently to release the base 133. The attachment ears 139 may also be deflected away from each other with one hand while pulling the singulator 130 away from the axial spring 137 with the other. Likewise, the singulator 130 may be replaced by pressing the base 133

of the singulator between the attachment ears 139 with sufficient force to cause the attachment ears to deflect away from each other to allow the base of the singulator to pass between them. To replace the singulator, the base 133 may be pushed between the ears causing them to deflect away from one another before returning to the normal position in which the base of the singulator is again secured between the ears. In this way the singulator 130 may be easily removed and replaced by hand without the use of tools and without removing or changing the location of axial spring 137, which remains in the correct location to bias the singulator 130 against the seed disc 120 while allowing the singulator 130 to “float” with deflections or deformations of the seed disc.

[0051] Referring to FIGS. 10 and 11, the seed meter 100 is illustrated with the seed housing 105 and other components removed so that the singulator 130 may be seen in its preferred location biased against the seed-side surface 140 of the seed disc 120. The seed-side surface 140 is preferably normal to the axis of rotation of the seed disc 120. The seed-side surface 140 is also preferably substantially flat with the exception of cavities 128, described in more detail later. For clarity, only the upper and lower lobe plates 132 and 134 are shown in FIG. 11. In operation, the seed disc 120 rotates in the direction indicated by arrow 129 such that the seed apertures 122 travel along a seed aperture path. A portion of the seed aperture path is adjacent to the seed pool area 150. As the seed apertures 122 turn past the seed pool area 150 at the bottom of the seed housing 105, a vacuum side of each seed aperture is placed in fluid communication with the vacuum source such that one or more seeds 42 become entrained over apertures 122. As the seed-bearing apertures rotate between the upper and lower lobe plates 132, 134, the lobes of the lobe plates bump, rotate and position the seeds so that only one seed is firmly entrained over the aperture while the other seeds drop back into the seed pool 150, thereby leaving one seed per aperture. After the apertures 122 rotate past the 3 o’clock position as viewed in FIG. 11, the apertures 122 are no longer in communication with the vacuum source resulting in the seeds being released from the apertures and falling into the seed exit 180.

[0052] Referring to FIGS. 14-16, the vacuum cover 110 includes a continuous mounting groove into which a vacuum seal 190 is press fit. In operation, the vacuum seal 190 is pressed against the vacuum-side of the seed disc 120 and the interior of the vacuum seal is in communication with the vacuum inlet 115 (FIG. 1) such that as the apertures 122 rotate past the perimeter of the vacuum seal 190 toward its interior they are placed in fluid communication with the vacuum source.

Removable Seed Ejector Assemblies

[0053] It has been found that seeds or partial seeds may become lodged in the seed apertures 122 and remain there even after the apertures 122 pass outside of the vacuum seal 190 where no vacuum is imposed. This is undesirable because when the apertures re-enter the seed reservoir an additional seed may not be entrained in an aperture holding a seed or partial seed. Thus, referring again to FIGS. 14-16, a seed ejector assembly 170 is preferably mounted to the vacuum cover 110. The seed ejector assembly 170 includes a shaft 174, a mounting clip 172, a lever arm 175 and an ejector wheel 176 having plungers 177. The ejector wheel 176 is rotatably coupled to the lever arm 175. The lever arm

is rotatably coupled to the shaft 174. The shaft is rotatably received within the mounting clip 172. As best seen in FIG. 15, the mounting clip 172 is attached to a mounting port 179, which is preferably formed integrally with the vacuum cover 110. As best seen in FIG. 14, as the seed disc 120 rotates, the ejector wheel 176 rotates and the plungers 177 enter each seed aperture 122, knocking out any seeds, partial seeds or debris in the seed apertures from the back side or vacuum-side of the seed disc 120.

[0054] As best illustrated in FIGS. 14 and 15, a spring 171 is preferably disposed between the lever arm 175 and the vacuum cover 110. The spring 171 has a first end held in place at a first end by a knob 173 on the lever arm 175 and has a second end held in place by cavity 192 in the vacuum cover 110. It should be appreciated that the spring 171 biases the ejector wheel 176 against the disc and allows the seed ejector assembly 170 to “float” with deflections or deformations of the seed disc 120.

[0055] It should be appreciated that the user may wish to remove the seed ejector assembly 170 or replace it due to wear on the ejector wheel 176, to install a differently configured seed ejector assembly, or for other reasons. As illustrated in FIGS. 16, 17A and 17B, the mounting clip 172 may be easily removed from and reattached to the mounting port 179 without the use of tools. The mounting port 179 includes apertures 196 and a tab 195. Mounting clip 172 includes rigid hooks 197 and resilient hook 198. During installation, the user first inserts rigid hooks 197 into apertures 196, then preferably presses mounting clip 172 against vacuum cover 110 such that resilient hook 198 deflects around tab 195 and returns to a relaxed state secured around tab 195. It should be appreciated that in addition to deflection of resilient hook 198 with respect to mounting clip 172, the mounting clip 172 also preferably deflects to allow resilient hook 198 to deflect around the tab 195. After attachment, the mounting clip 172 is secured against mounting port 179 until the user removes the mounting clip by bending the mounting clip to release the resilient hook 198 from tab 195 and then moving the rigid hooks 197 free of the apertures 196.

Alternative Ejector Wheel and Disc Embodiments

[0056] Turning to FIGS. 18A-18D, a modified seed ejector assembly 270 is illustrated in cooperation with a modified seed disc 220. The seed disc 220 includes an array 224 of apertures 222. The seed disc 220 further includes an array 234 of guide cavities 232. The guide cavity array 234 is preferably substantially concentric with the seed aperture array 224.

[0057] The seed ejector assembly 270 includes a lever arm 275. The lever arm 275 is preferably pivotally biased toward the seed disc 220 as described herein with respect to the lever arm 175. As best illustrated in FIG. 18B, the seed ejector assembly 270 also includes an ejector wheel 276 pivotally mounted to the lever arm 275 and a guide wheel 286 pivotally mounted to the lever arm 275. Continuing to refer to FIG. 18B, the ejector wheel 276 and the guide wheel 286 are preferably pivotally mounted to the lever arm by a retaining pin 272 extending through central apertures in the ejector wheel and guide wheel. The retaining pin 272 preferably allows the ejector wheel 276 and the guide wheel to translate slightly toward and away from the lever arm 275 such that the ejector wheel and guide wheel are allowed to translate radially toward and away from the center of the

seed disc 220. As best illustrated in FIGS. 18C and 18D, the ejector wheel 276 includes radially arranged plungers 278 and the guide wheel 286 includes radially arranged guide teeth 288. The seed ejector assembly preferably includes more guide teeth 288 than plungers 278, and preferably includes three guide teeth per plunger. The ejector wheel 276 is preferably fixed to the guide wheel 286 such that the ejector wheel is constrained to rotate synchronously with the guide wheel. Each plunger 278 is preferably aligned with one of the guide teeth 288. For example, as shown in FIG. 18D, the upper and lower plungers 278 are aligned with upper and lower guide teeth along a plane A1 and the left and right plungers 278 are aligned with left and right guide teeth along a plane A2.

[0058] In some embodiments of the ejector wheel 276, the plungers 278 include tips 277. In some embodiments of the seed disc 220, the apertures 222 are tapered to small openings 223 (FIG. 18A). The tips 277 are preferably sized to fit within the small openings 223. It should be appreciated that in such embodiments, more precise alignment of the ejector wheel 276 with respect to the seed disc 220 is necessary in order to knock seeds or debris from the small openings 223 without interference between the ejector wheel and seed disc.

[0059] In operation, as the disc rotates, the guide teeth 288 sequentially engage the guide cavities 232. The plungers 278 sequentially engage the seed apertures 222. Referring to FIG. 18A, the guide cavity array 234 is aligned with the seed aperture array 224 such that each seed aperture 222 is aligned with a guide cavity 232 along a plane (e.g., plane A3) intersecting the center of the seed disc 220. It should be appreciated that guide teeth 288 engage guide cavities 232 when the plungers 278 are not engaging the seed apertures 222, thus moving the ejector wheel 286 to the proper angular position to successfully engage each seed aperture. Additionally, it should be appreciated that as the ejector wheel translates with respect to the retaining pin 272, the guide teeth 232 likewise retain the ejector wheel 286 at the proper radial distance from the center of the seed disc 220 such that the ejector wheel can successfully engage each seed aperture 222.

Seed Disc Cavities

[0060] Referring to FIGS. 19A-19C, the seed disc 120 preferably includes seed disc cavities 128 disposed near the radial edge of the seed disc. The cavities 128 are preferably disposed to pass adjacent to the seed pool area 150. Each cavity 128 is preferably disposed forward of an adjacent seed aperture 122 along the direction of travel of the seed aperture path. The cavities 128 are preferably disposed between each pair of seed apertures 122. Seed apertures 122 are preferably substantially normal to the surface 140 of the seed disc 120; i.e., a central axis of each seed aperture 122 is preferably substantially normal to the surface 140 of the seed disc 120. Raised surfaces 123 with respect to the bottom of the associated cavity 128 are preferably disposed between each aperture 122 and the adjacent cavity 128. The upper surface of the raised surfaces 123 are preferably co-planar with the surface 140 of the seed disc 120.

[0061] Each cavity 128 preferably comprises an agitation cavity sized to agitate the seeds in the seed pool area 150. Thus the cavities 128 are preferably sized to allow significant movement of seeds 42 into and out of the cavities as each cavity moves adjacent to the seed pool 150. The outer

perimeter of the cavity 128 is preferably larger than the outer perimeter of the adjacent seed aperture 122. The area of an intersection between the surface 140 of the seed disc 120 and each cavity 128 is preferably greater than the area of an intersection between the surface 140 and each seed aperture 122. It should be appreciated that each seed aperture is sized to allow limited movement of seeds 42 into the seed aperture. Moreover, the cavities 128 are preferably wider than the average size of seeds 42 to be planted using the seed disc 120. Moreover, the depth D (FIG. 19B) of the cavities 128 is preferably greater than 0.05 inches.

[0062] Referring to FIG. 10 in combination with FIG. 19, each cavity 128 preferably has an inner sidewall 242 and an outer sidewall 240 located at distances Ri, Ro respectively from the center C (i.e., the central or rotational axis) of the disc. The difference between the radii Ro and Ri is preferably greater than the diameter of the seed apertures 122. The radius Ro is preferably larger than the distance between the seed aperture and the center of the seed disc 120. The radius Ri is preferably larger than the radius Ra between a distal end of said seed aperture 122 and the center of the disc 120.

[0063] In operation, as the seed disc 120 rotates through the seed pool area 150 located to the side of the seed disc (as best illustrated in FIG. 11), seeds move in and out of the cavities 128 such that the seed pool is stirred or agitated. This agitation improves the successful loading of seeds on the seed apertures 122, particularly at relatively high planting speeds which correspond to faster seed disc rotation speeds.

[0064] Each cavity 128 preferably includes a sidewall 124 oriented to face the seed pool area 150 as the cavity rotates into the seed pool area. The sidewall 124 is preferably substantially vertical (FIG. 19B), i.e., substantially normal to the surface 140 of the seed disc 120. As viewed along the rotational axis of the seed disc (FIG. 19A), the sidewall 124 is preferably curved, and preferably is semicircular. In operation, the sidewalls 124 sequentially enter the seed pool area 150 and push the seeds such that the seed pool is stirred and agitated.

[0065] The cavities 128 preferably include a bevel 126 oriented to face away from the seed pool as the disc 120 rotates into the seed pool area 150. An angle A (FIG. 19B) between bevel 126 and the surface 140 of the seed disc 120 is preferably between 15 and 35 degrees with respect to the surface of the disc. In operation, when seeds are released from the disc (at approximately the 3 o'clock position on the view of FIG. 11), seeds occasionally fall toward the disc and into the cavity 128 located below the seed aperture 122. In such instances, the seed bounces or slides against the bevel 126, smoothly transitioning the seed back out of the cavity 128 and increasing consistency between seed fall times.

[0066] Although a seed disc 120 is disclosed herein including series of seed apertures 122 and cavities 128 having the same radial distance from the center of the seed disc, other embodiments include rows of seed cavities

[0067] Referring to FIGS. 20A-20D, an alternative seed disc 320 is illustrated having cavities 328 disposed between seed apertures 322. Each cavity 328 preferably includes vertical sidewalls 324 and bevels 326. Each cavity 328 preferably includes a beveled inner sidewall 342 and a beveled outer sidewall 340. The beveled sidewalls 342, 340 reduce the interior volume of the cavity 328 and allow seeds to smoothly transition out of the cavity 328 while the seeds are being agitated in the seed pool area 150. Thus each

beveled sidewall 342, 340 discourages entrapment of seeds in the cavities 328, particularly smaller seed varieties.

[0068] Although the various improvements described herein are illustrated with respect to a vacuum-type seed meter, they would be equally applicable to other seed singulating meters, including positive-air meters such as that disclosed in U.S. Pat. No. 4,450,979 to Deckler, incorporated herein in its entirety by reference.

[0069] The foregoing description is presented to enable one of ordinary skill in the art to make and use the invention and is provided in the context of a patent application and its requirements. Various modifications to the preferred embodiment of the apparatus, and the general principles and features of the system and methods described herein will be readily apparent to those of skill in the art. Thus, the present invention is not to be limited to the embodiments of the apparatus, system and methods described above and illustrated in the drawing figures, but is to be accorded the widest scope consistent with the spirit and scope of the appended claims.

1. A seed distribution element for precision pneumatic seed drills, comprising:

- a sowing disc which is rotated by a motor-driven transmission drive shaft at controlled speed;
- a housing with a fixed portion and a portion which is movable relative to the fixed portion and can be closed against the fixed portion;
- a seed collection chamber being defined in the fixed portion;
- a pneumatic suction chamber being defined in the movable portion;
- the sowing disc being interposed between the fixed and movable portions and having opposed surfaces delimiting the chambers;
- the sowing disc having at least one ring of selector holes extending between the opposed surfaces; and
- a seal which is arranged on the movable portion and is capable of sliding contact with the facing surface of the disc when the fixed and movable portions are closed against one another;

wherein a pressure differential is provided between the opposed surfaces in the region of a circumferential segment of the ring of holes;

wherein the seed distribution element further comprises a thrust-bearing element of the sowing disc, which thrust-bearing element is supported rotatably in the movable portion in order to withstand at least some of the axial load produced by the disc on the seal.

2. The seed distribution element according to claim 1, wherein the thrust-bearing element is rotated with the disc when the fixed and movable portions are closed against one another.

3. The seed distribution element according to claim 1, wherein the thrust-bearing element comprises a thrust-bearing plate which can bear on that surface of the sowing disc which faces the seal, in a zone radially inside of the ring of holes.

4. The seed distribution element according to claim 3, wherein the thrust-bearing element comprises a drive element which is fixed for rotation with the plate and can be coupled with the drive shaft of the disc when the fixed and movable portions are closed against one another.

5. The seed distribution element according to claim 4, wherein the drive element is self-centring relative to the drive shaft.

6. The seed distribution element according to claim 4, wherein the drive element comprises a coupling member which rotates jointly with the thrust-bearing plate but has radial and/or circumferential clearance so as to be self-centred during rotational coupling with the drive shaft of the disc.

7. The seed distribution element according to claim 1, wherein the movable portion is hinged to the fixed portion.

8. A sowing element for precision seed drills comprising a frame on which a seed distribution element according to claim 1 is mounted.

9. A seed drill comprising a supporting structure on which a plurality of sowing elements according to claim 8 are mounted.

10. A kit for the retrofitting of seed distribution elements of precision pneumatic seed drills wherein the distribution elements are of the type including:

- a sowing disc which is rotated by a motor-driven transmission drive shaft at controlled speed;
 - a housing with a fixed portion and a portion which is movable relative to the fixed portion and can be closed against the fixed portion;
 - a seed collection chamber being defined in the fixed portion;
 - a pneumatic suction chamber being defined in the movable portion;
 - the sowing disc being interposed between the fixed and movable portions and having opposed surfaces delimiting the chambers;
 - the sowing disc having at least one ring of selector holes extending between the opposed surfaces; and
 - a seal which is arranged on the movable portion and is capable of sliding contact with the facing surface of the disc when the portions are closed against one another; wherein a pressure differential is provided between the opposed surfaces in the region of a circumferential segment of the ring of holes;
- wherein the kit comprises the movable portion pre-assembled with a thrust-bearing element of the sowing disc, which thrust-bearing element is supported rotatably in the movable portion in order to withstand at least some of the axial load produced by the disc on the seal.

11. The kit according to claim 10 wherein the movable portion and the thrust-bearing element comprise at least one feature according to claim 2.

12. The kit according to claim 10 wherein the movable portion and the thrust-bearing element comprise at least one feature according to claim 3.

13. The kit according to claim 10 wherein the movable portion and the thrust-bearing element comprise at least one feature according to claim 4.

14. The kit according to claim 10 wherein the movable portion and the thrust-bearing element comprise at least one feature according to claim 5.

15. The kit according to claim 10 wherein the movable portion and the thrust-bearing element comprise at least one feature according to claim 6.

16. The kit according to claim 10 wherein the movable portion and the thrust-bearing element comprise at least one feature according to claim 7.

17. A seed meter for an agricultural planter, said seed meter comprising:

- a seed disc which is rotated by a motor-driven shaft at controlled speed;
- a meter housing with a fixed portion and a portion which is movable relative to the fixed portion and can be closed against the fixed portion;
- a seed pool area being defined in the fixed portion;
- a vacuum area defined in the movable portion;
- the seed disc being interposed between the fixed and movable portions and having opposed surfaces delimiting the seed pool area from the vacuum area;
- the seed disc having at least one ring of seed apertures extending between the opposed surfaces; and
- a seal which is arranged on the movable portion and is capable of sliding contact with the facing surface of the disc when the fixed and movable portions are closed against one another

wherein a pressure differential is provided between the opposed surfaces in the region of a circumferential segment of the ring of seed apertures;

wherein the seed meter further comprises a thrust-bearing element of the seed disc, which thrust-bearing element is supported rotatably in the movable portion in order to withstand at least some of the axial load produced by the disc on the seal.

18. The seed meter according to claim 17, wherein the thrust-bearing element is rotated with the disc when the fixed and movable portions are closed against one another.

19. The seed meter according to claim 17, wherein the thrust-bearing element comprises a thrust-bearing plate which can bear on that surface of the seed disc which faces the seal, in a zone radially inside of the ring of seed apertures.

20. The seed meter according to claim 19, wherein the thrust-bearing element comprises a drive element which is fixed for rotation with the plate and can be coupled with the shaft of the disc when the fixed and movable portions are closed against one another.

21. The seed meter according to claim 20, wherein the drive element is centered relative to the shaft.

22. The seed meter according to claim 20, wherein the drive element comprises a coupling member which rotates jointly with the thrust-bearing plate.

23. The seed meter according to claim 17, wherein the movable portion is mechanically coupled to the fixed portion.

24. An agricultural planter comprising a frame on which a seed meter according to claim 17 is mounted.

25. An agricultural planter including a supporting structure on which a plurality of seed meters according to claim 24 are mounted.

26. An assembly for a seed meter of an agricultural planter wherein the seed meter is of the type including:

- a seed disc which is rotated by a motor-driven shaft at controlled speed;
- a meter housing with a fixed portion and a portion which is movable relative to the fixed portion and can be closed against the fixed portion;
- a seed pool area being defined in the fixed portion;
- a vacuum area defined in the movable portion;
- the seed disc being interposed between the fixed and movable portions and having opposed surfaces delimiting the seed pool area from the vacuum area;
- the seed disc having at least one ring of seed apertures extending between the opposed surfaces; and
- a seal which is arranged on the movable portion and is capable of sliding contact with the facing surface of the disc when the fixed and movable portions are closed against one another;

wherein a pressure differential is provided between the opposed surfaces in the region of a circumferential segment of the ring of seed apertures;

wherein the assembly comprises, in said movable portion, a thrust-bearing element of the seed disc, which thrust-bearing element is supported rotatably in the movable portion in order to withstand at least some of the axial load produced by the disc on the seal.

27. The assembly according to claim 26 wherein the thrust-bearing element is rotated with the disc when the fixed and movable portions are closed against one another.

28. The assembly according to claim 26 wherein the thrust-bearing element comprises a thrust-bearing plate which can bear on that surface of the seed disc which faces the seal, in a zone radially inside of the ring of seed apertures.

29. The assembly according to claim 26 wherein the thrust-bearing element comprises a drive element which is fixed for rotation with the plate and can be coupled with the shaft of the disc when the fixed and movable portions are closed against one another.

30. The assembly according to claim 29 wherein the drive element is centered relative to the shaft.

31. The assembly according to claim 29 wherein the drive element comprises a coupling member which rotates jointly with the thrust-bearing plate.

32. The assembly according to claim 26 wherein the movable portion is mechanically coupled to the fixed portion.

* * * * *

Appendix B3



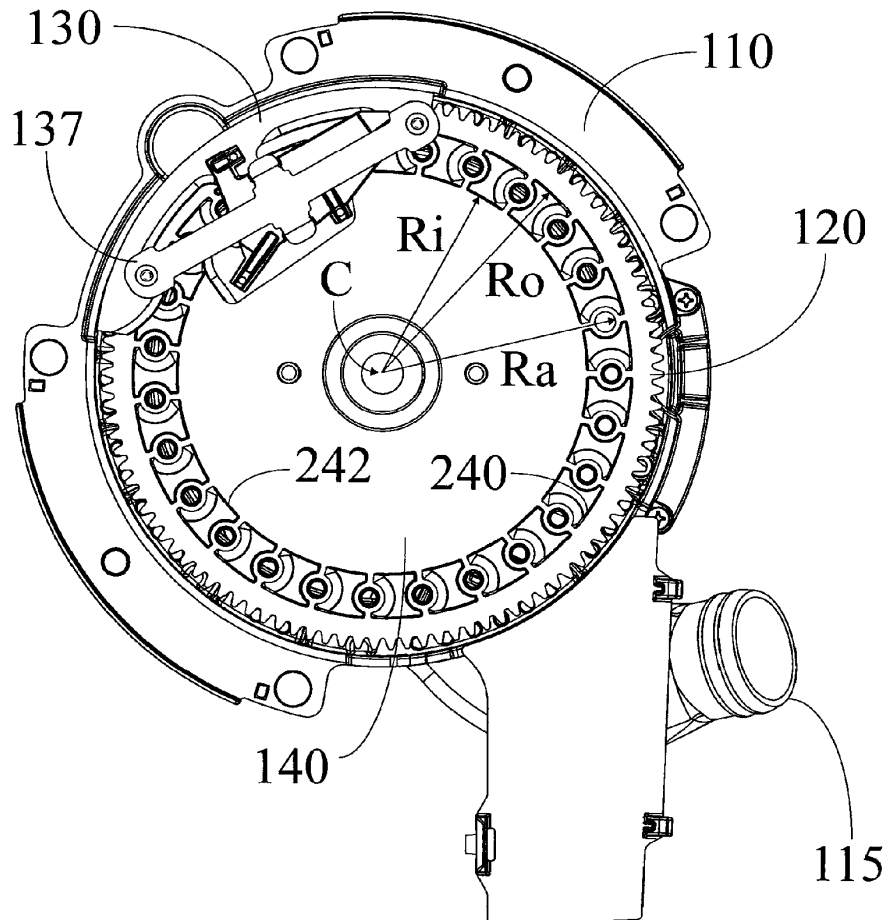
US 20200296881A1

(19) **United States**(12) **Patent Application Publication**
Sauder (deceased)(10) **Pub. No.: US 2020/0296881 A1**(43) **Pub. Date: Sep. 24, 2020**(54) **SEED METER****Publication Classification**(71) Applicant: **Precision Planting LLC**, Tremont, IL
(US)(72) Inventor: **Derek Sauder (deceased)**, Tremont, IL
(US)(21) Appl. No.: **16/694,471**(22) Filed: **Nov. 25, 2019**(51) **Int. Cl.****A01C 7/04** (2006.01)**A01C 7/12** (2006.01)**A01C 7/08** (2006.01)**A01C 7/10** (2006.01)**A01C 7/16** (2006.01)(52) **U.S. Cl.**CPC **A01C 7/046** (2013.01); **A01C 7/044**
(2013.01); **A01C 7/128** (2013.01); **A01C 7/04**
(2013.01); **A01C 7/16** (2013.01); **A01C 7/12**
(2013.01); **A01C 7/105** (2013.01); **A01C 7/123**
(2013.01); **A01C 7/084** (2013.01)**Related U.S. Application Data**(63) Continuation of application No. 15/653,496, filed on
Jul. 18, 2017, now abandoned, which is a continu-
ation of application No. 14/793,360, filed on Jul. 7,
2015, now abandoned, which is a continuation of
application No. 14/006,569, filed on Sep. 20, 2013,
now Pat. No. 9,351,440, filed as application No.
PCT/US2012/030192 on Mar. 22, 2012.(60) Provisional application No. 61/466,047, filed on Mar.
22, 2011.

(57)

ABSTRACT

A seed meter for an agricultural planter in which the seed disc is rotatably mounted within a seed meter housing. As the seed disc rotates, the apertures in the disc rotate along a seed aperture path through a horizontally adjacent seed pool area. The seed disc includes cavities disposed along the seed aperture path to agitate the seeds in the seed pool area. A singulator having multiple co-planar singulator surfaces is biased against the seed side surface of the seed disc.



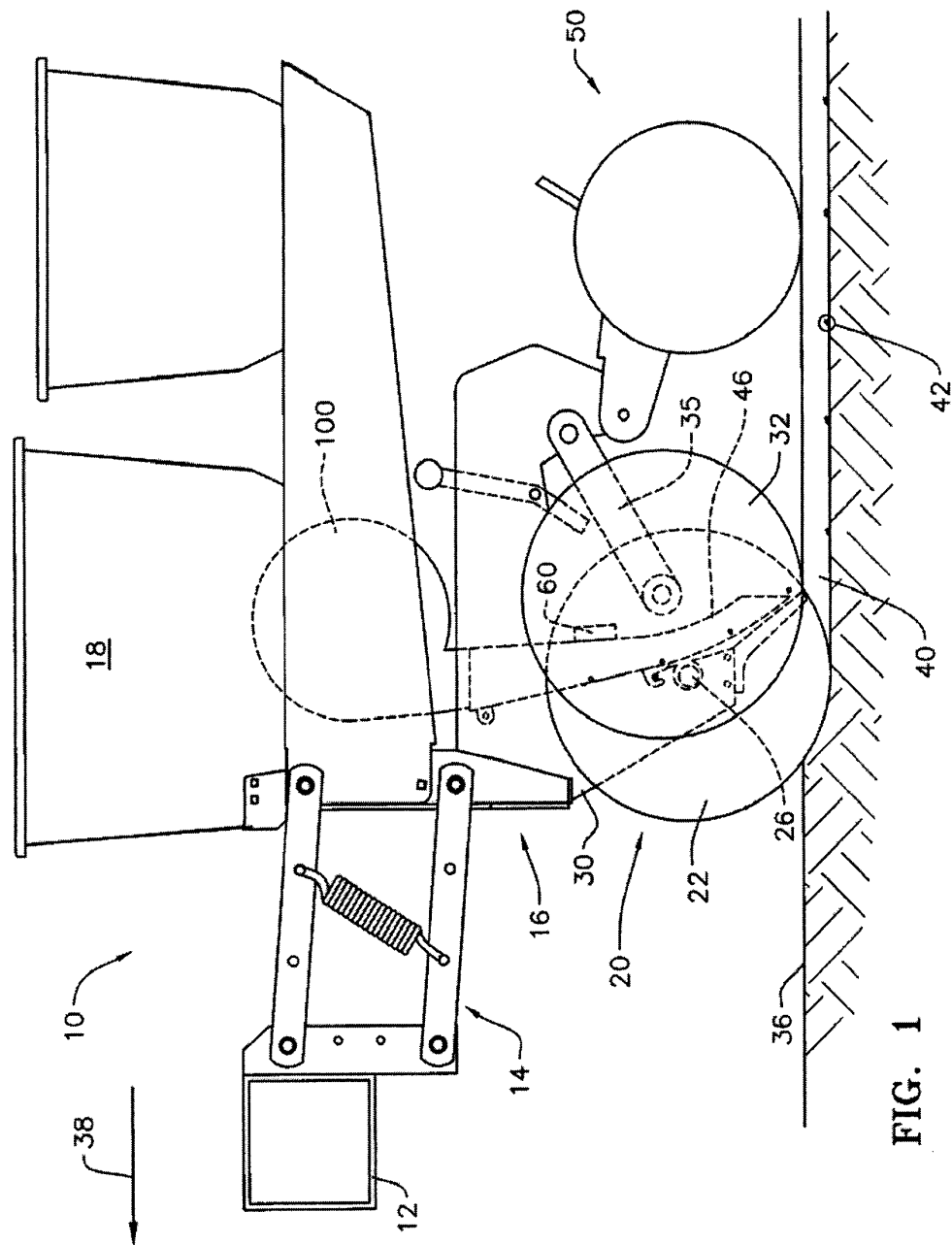


FIG. 1

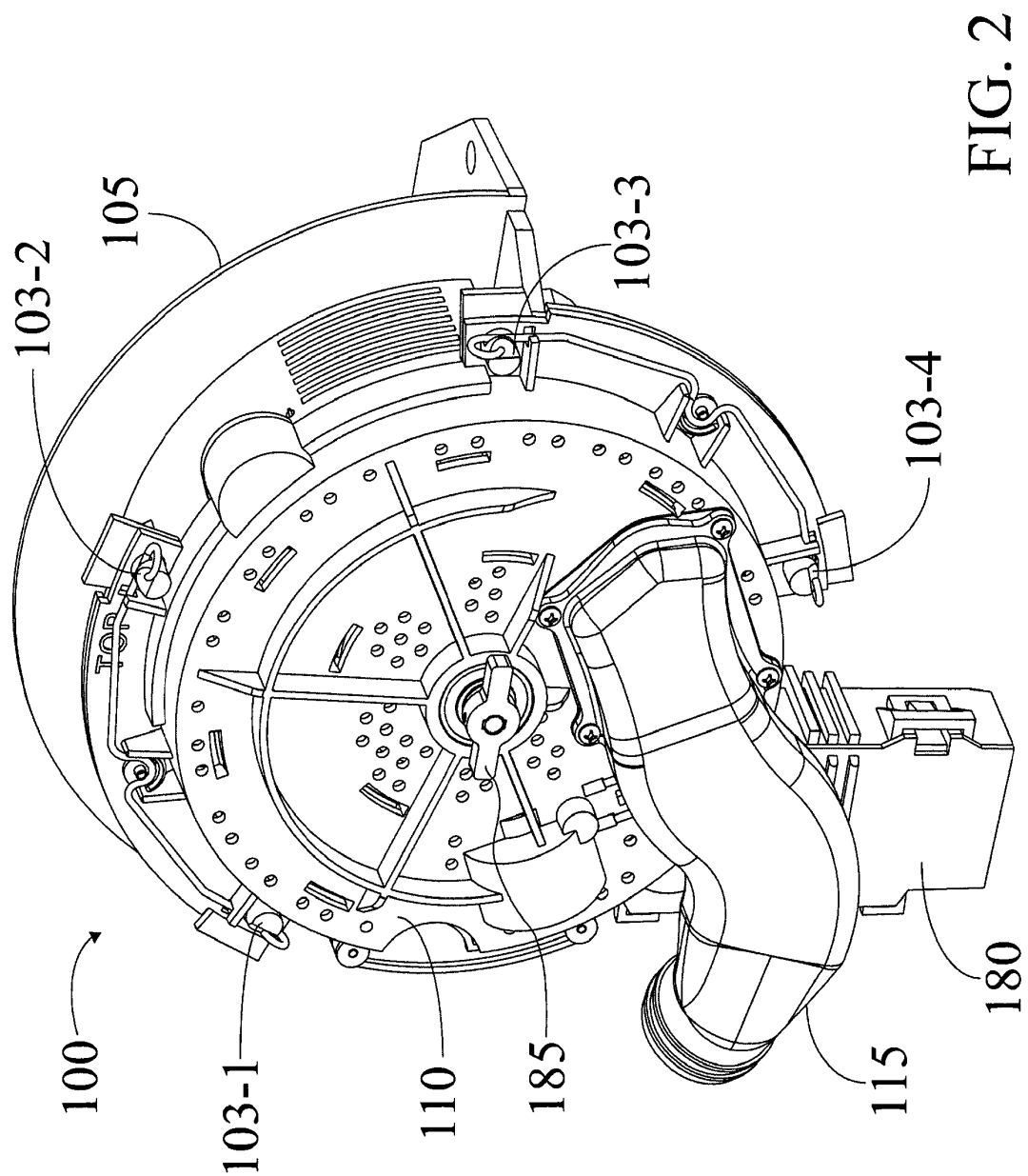


FIG. 2

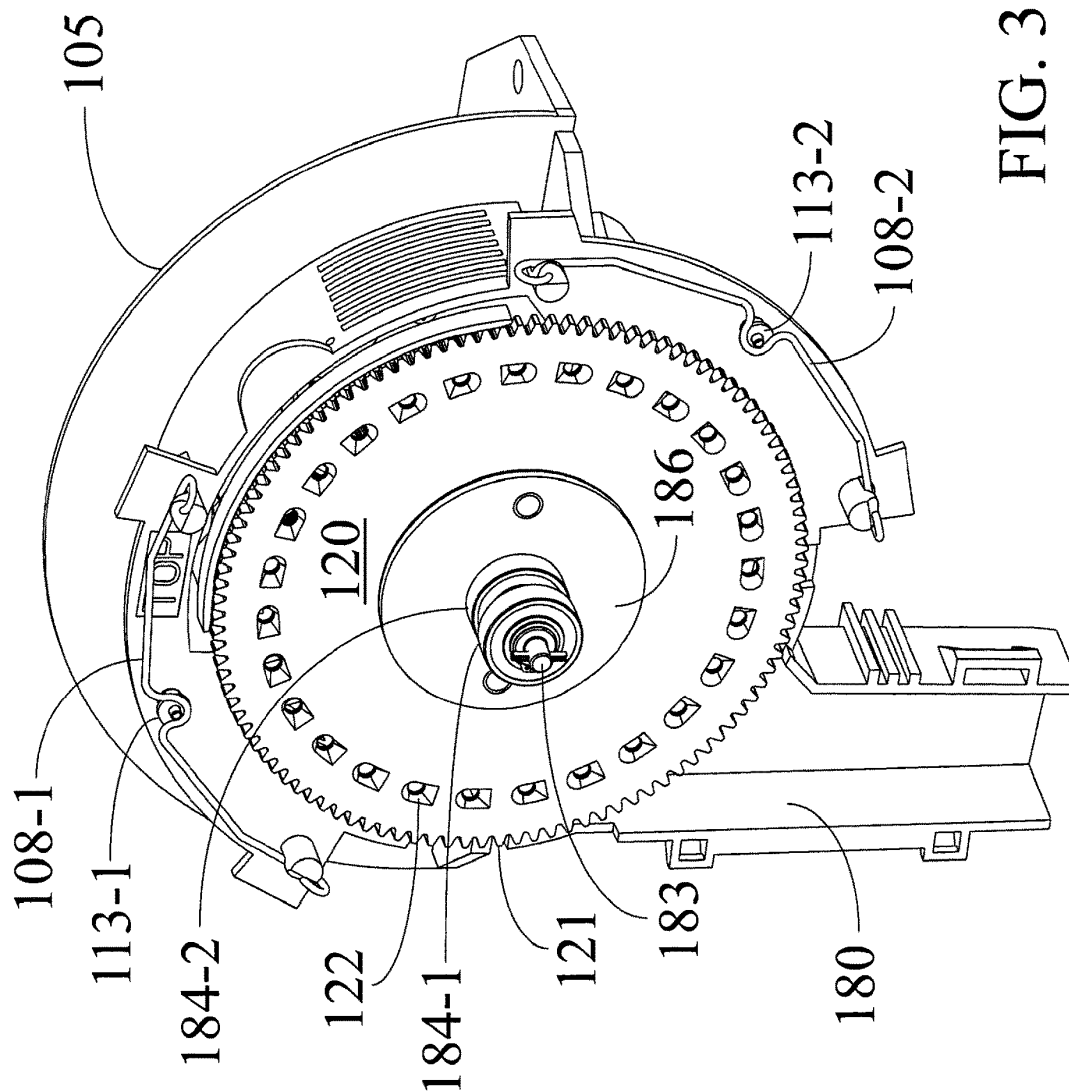
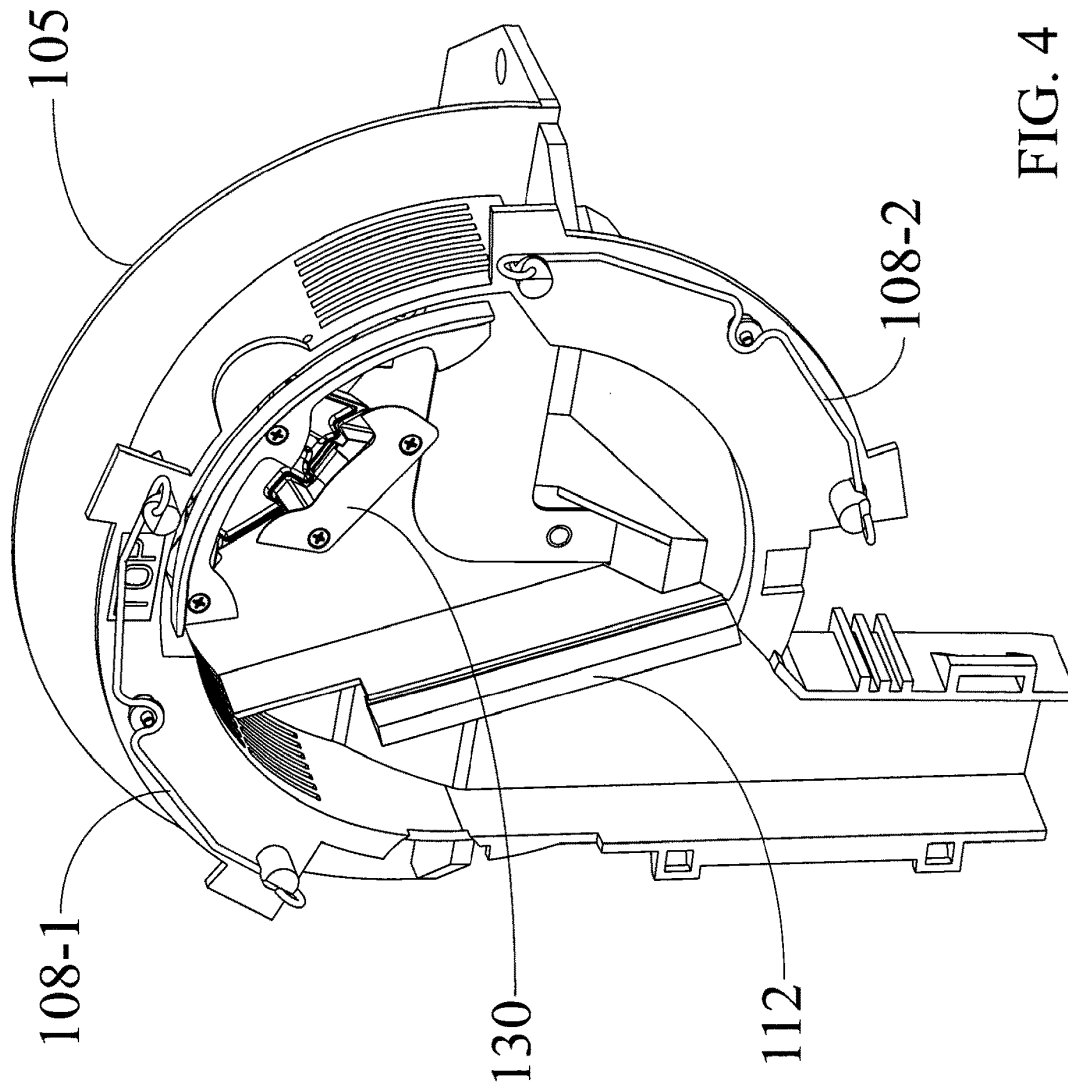


FIG. 3



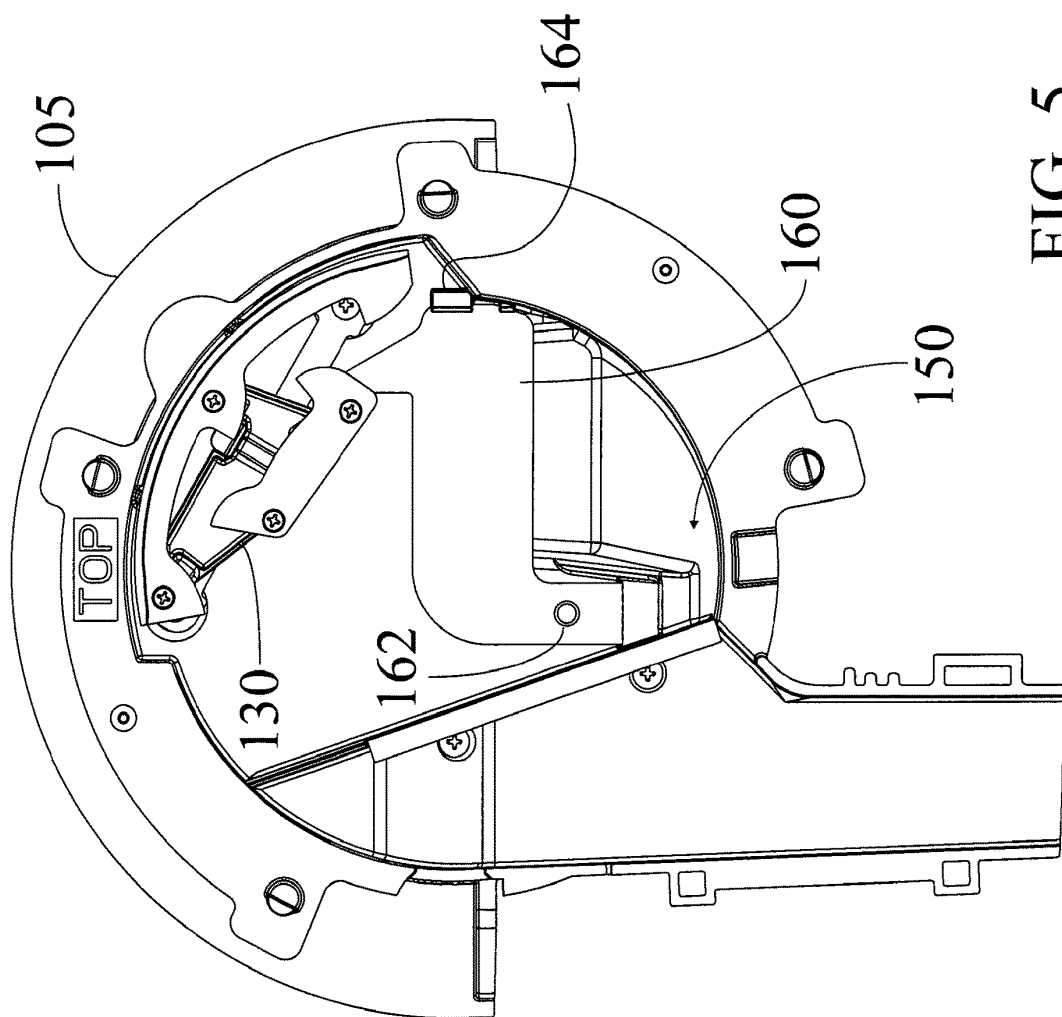


FIG. 5

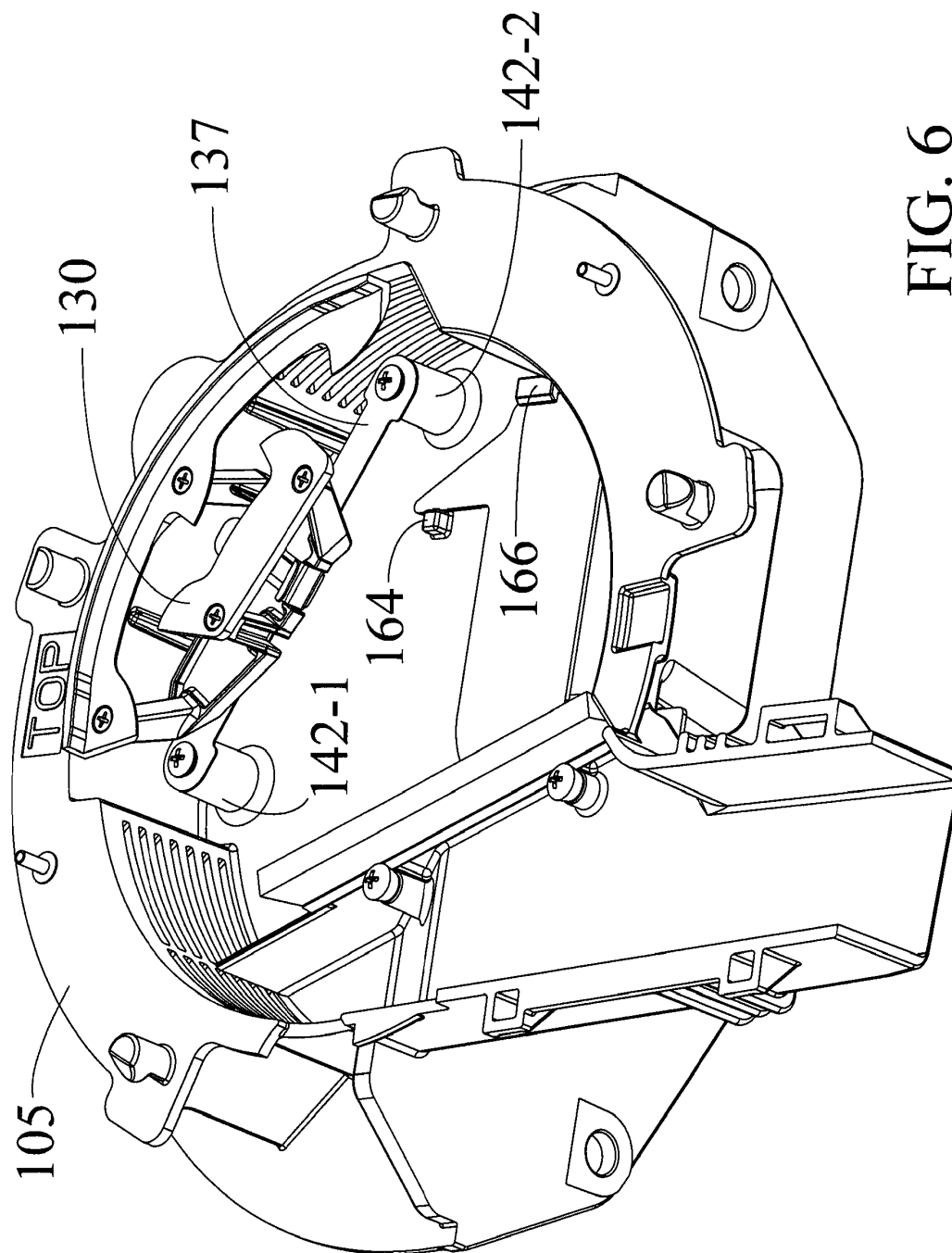
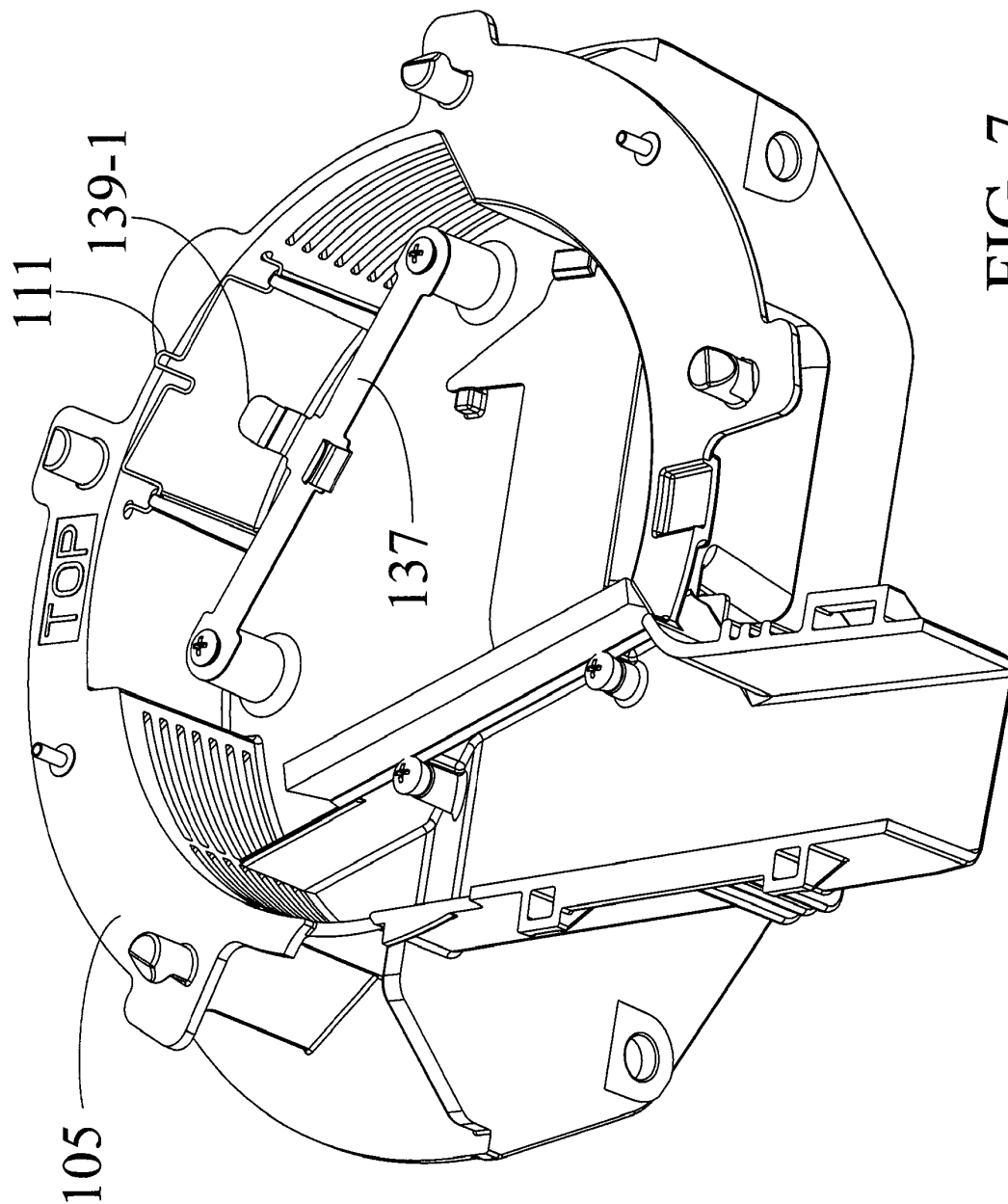


FIG. 6



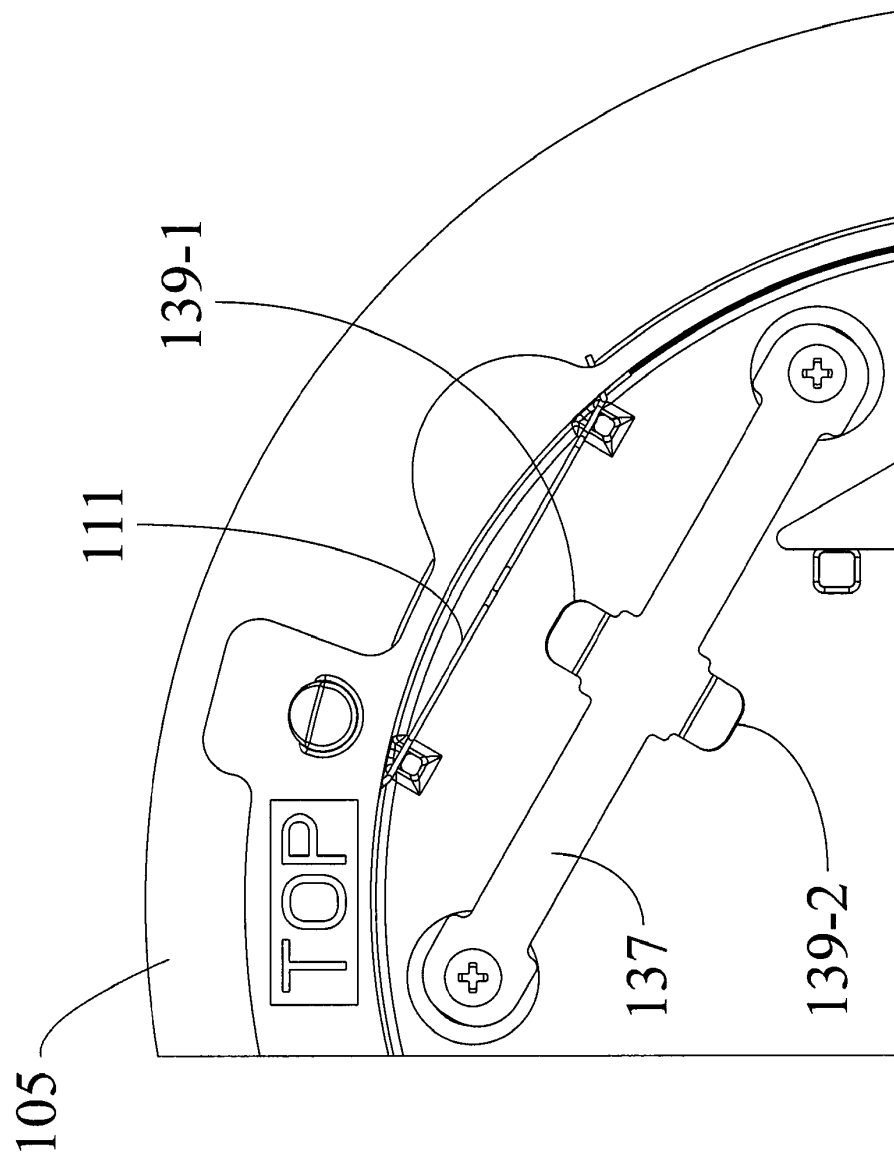


FIG. 8

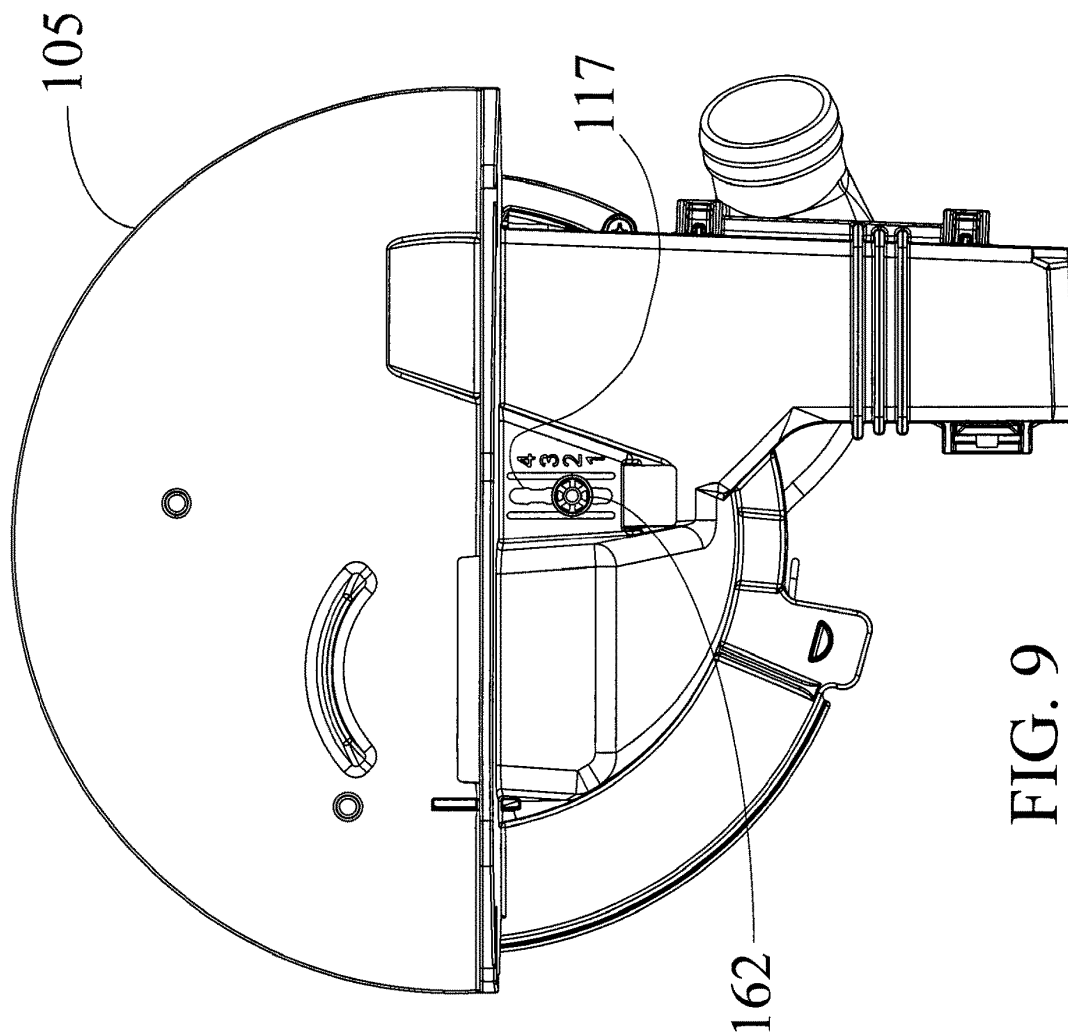


FIG. 9

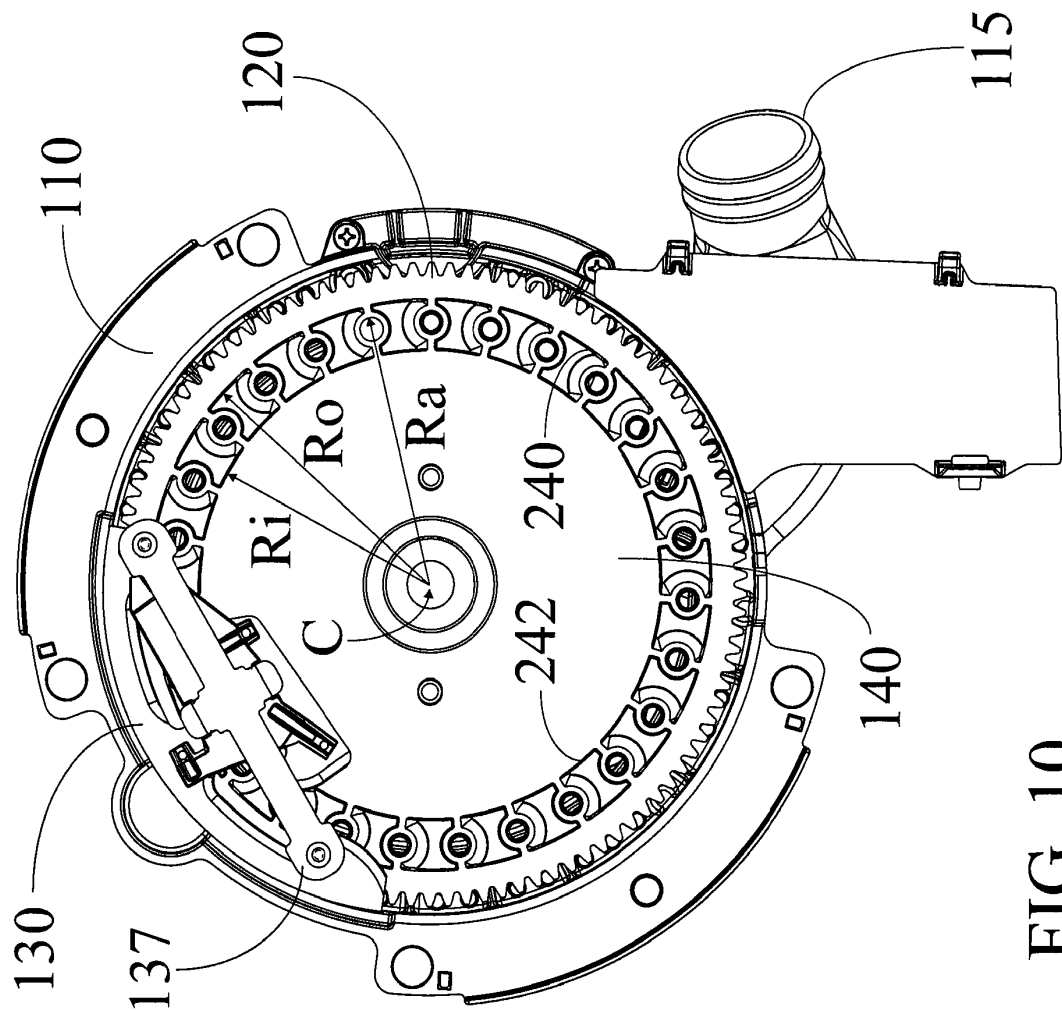


FIG. 10

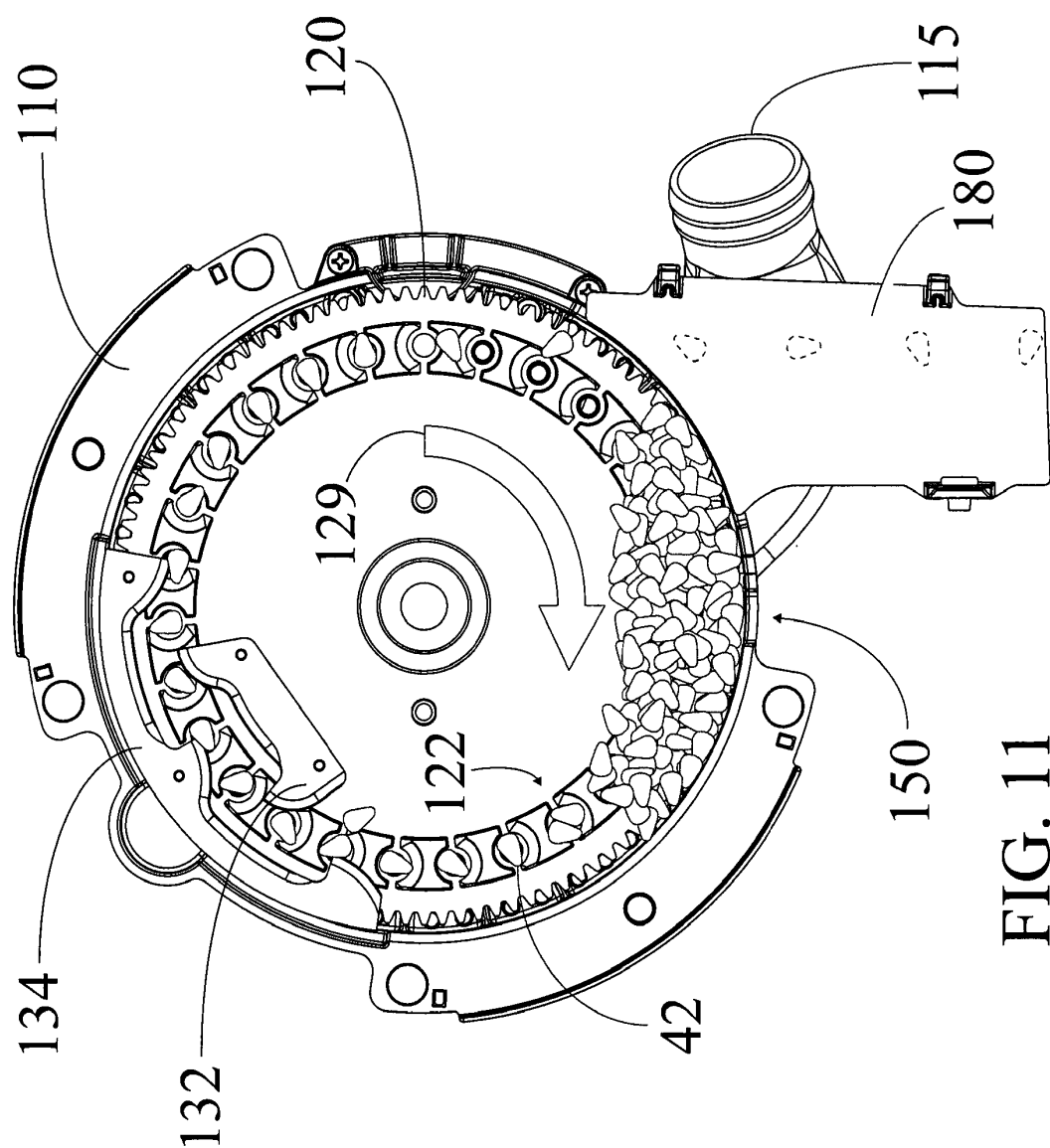


FIG. 11

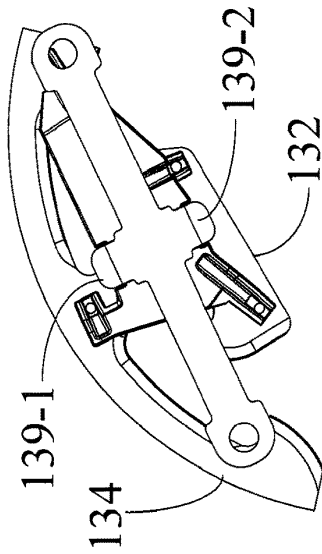


FIG. 12B

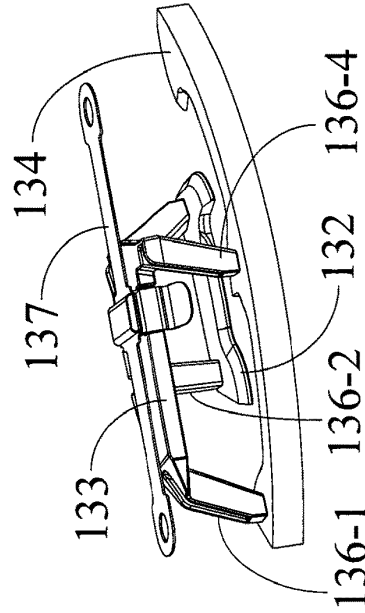


FIG. 12D

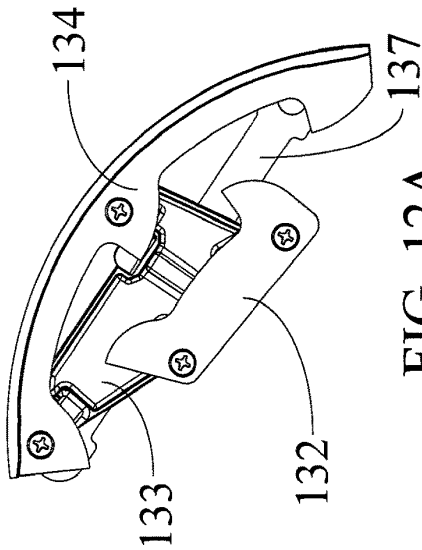


FIG. 12A

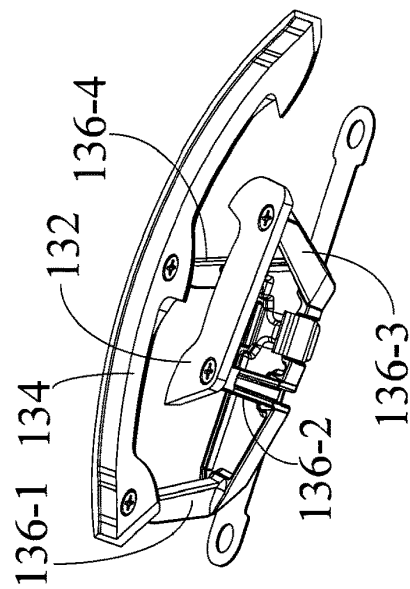


FIG. 12C

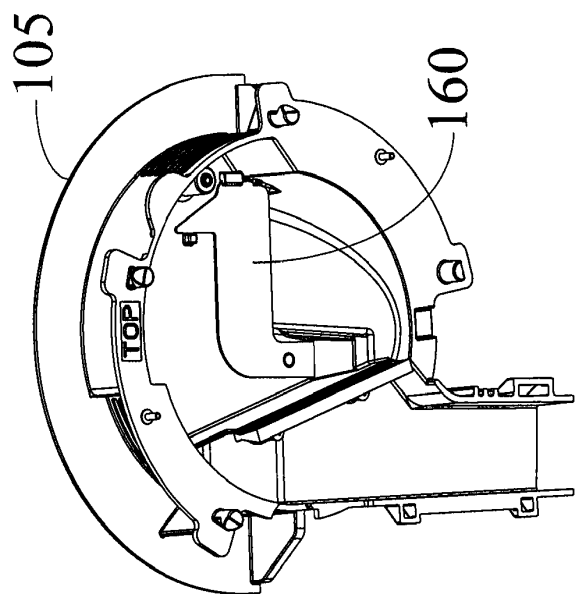


FIG. 13B

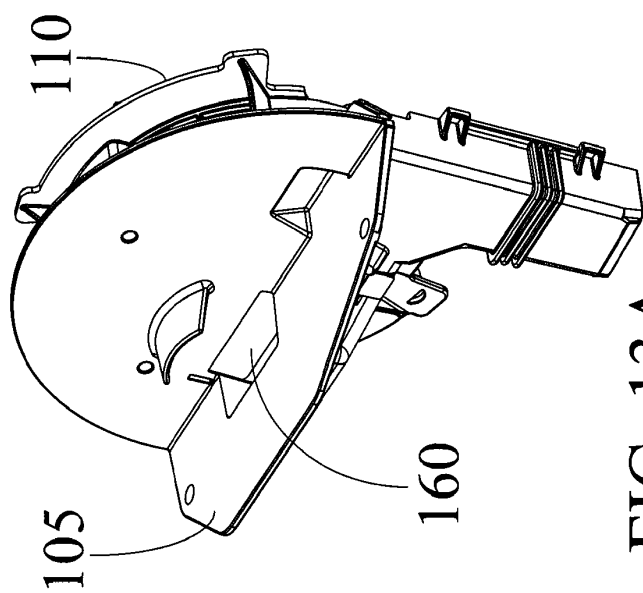


FIG. 13A

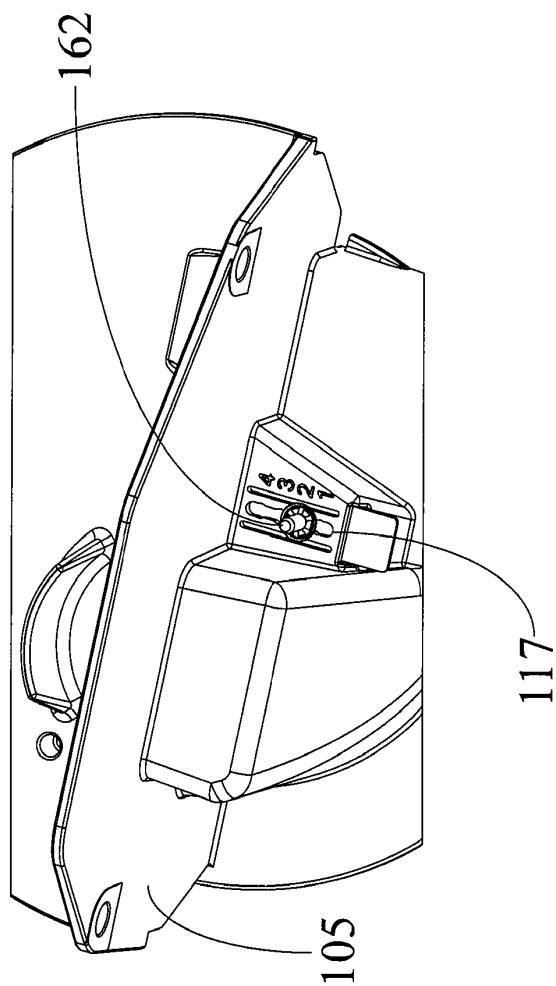


FIG. 13C

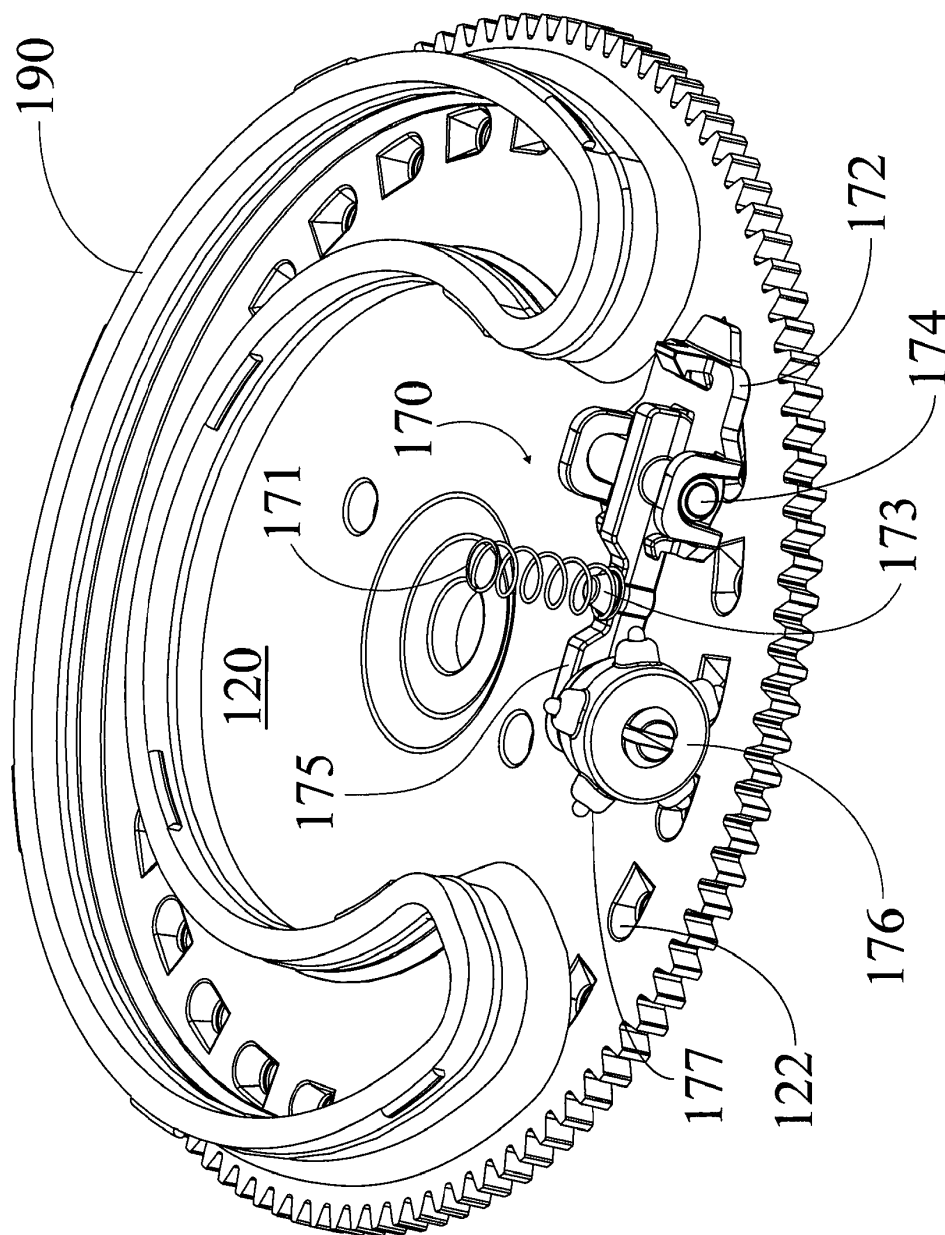


FIG. 14

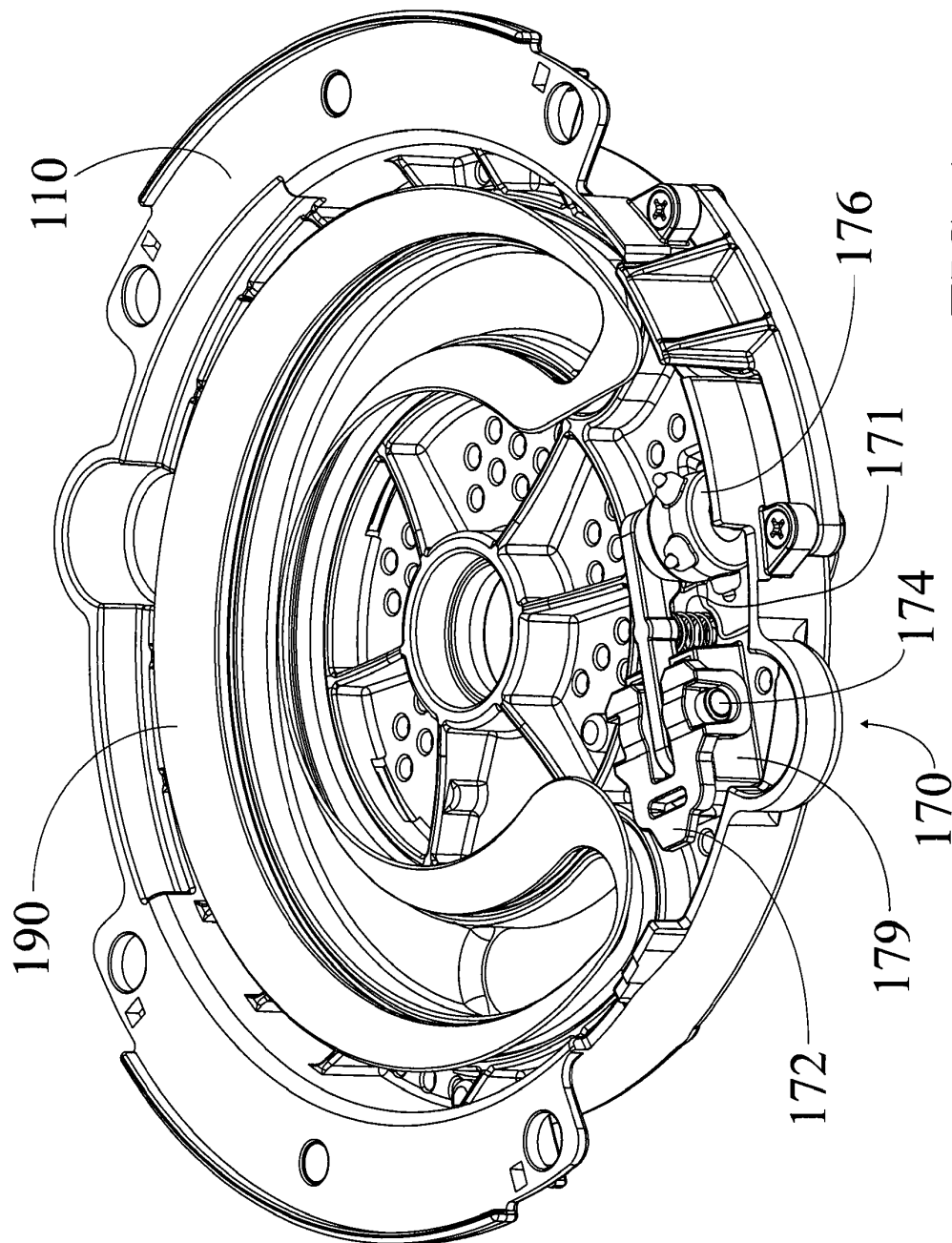


FIG. 15

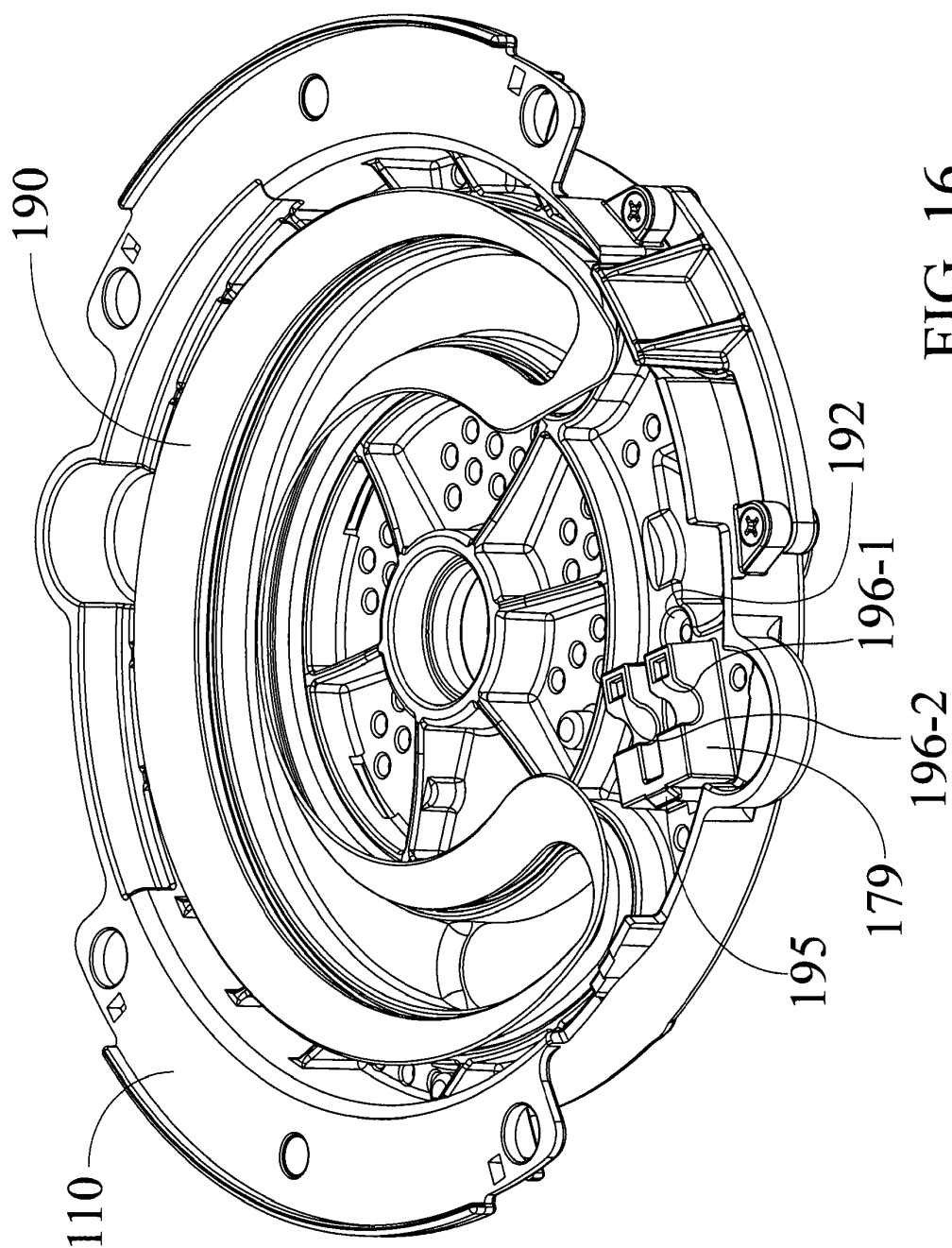


FIG. 16

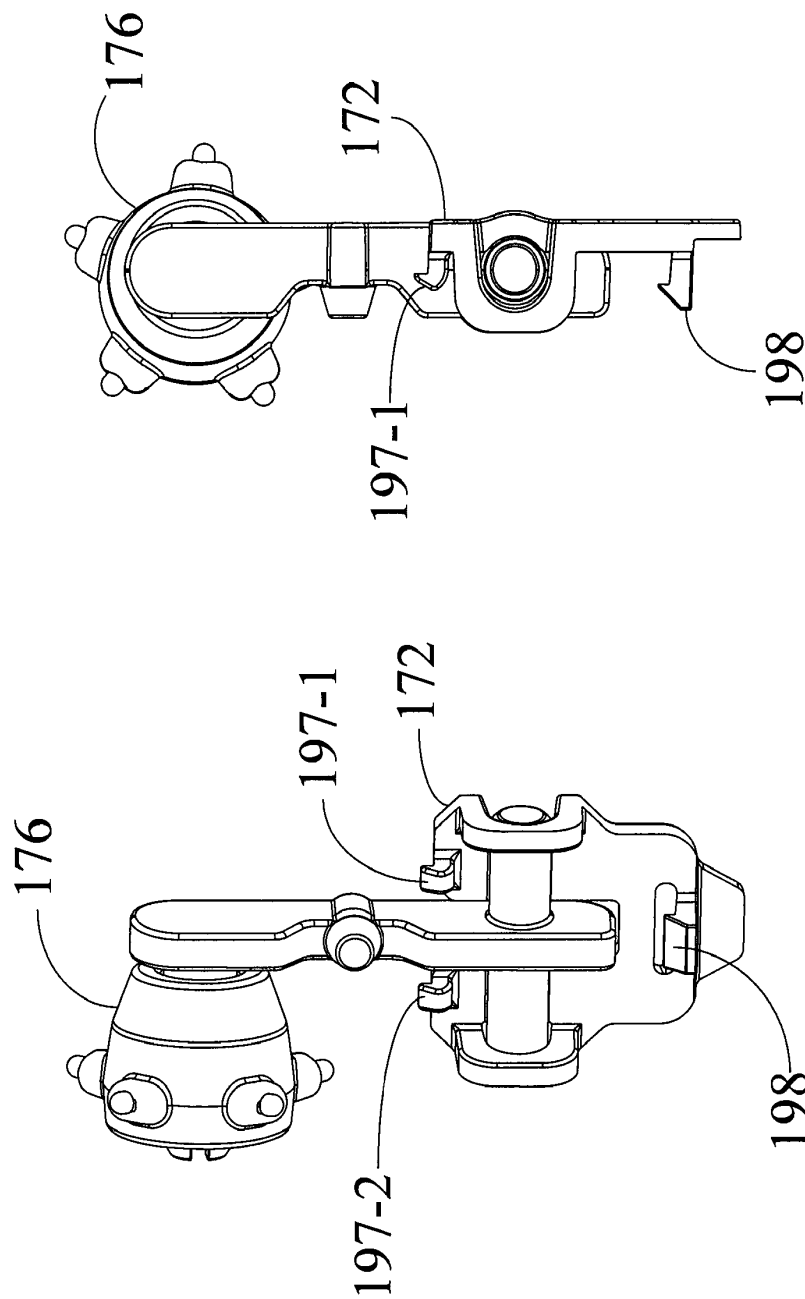
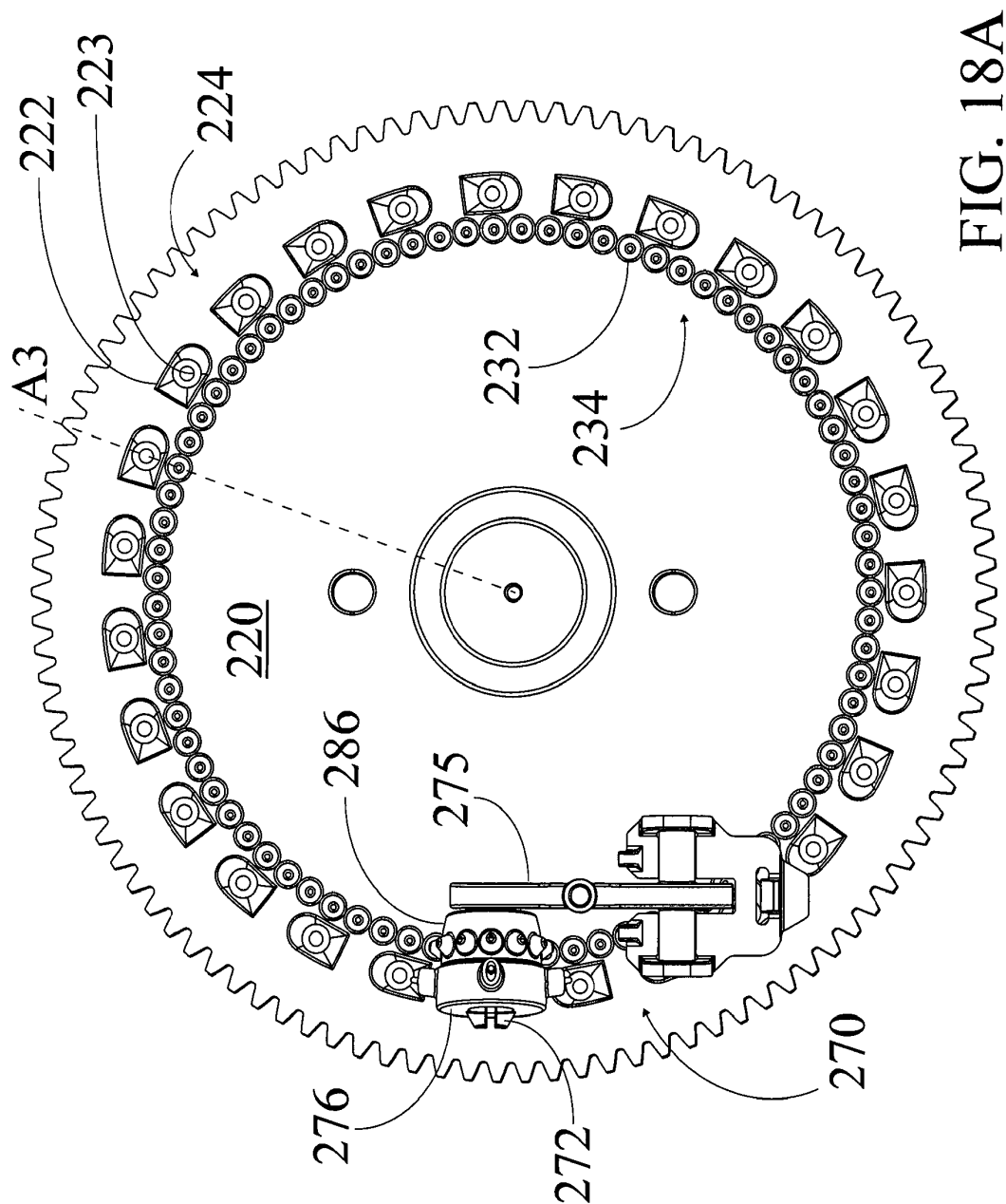


FIG. 17B

FIG. 17A



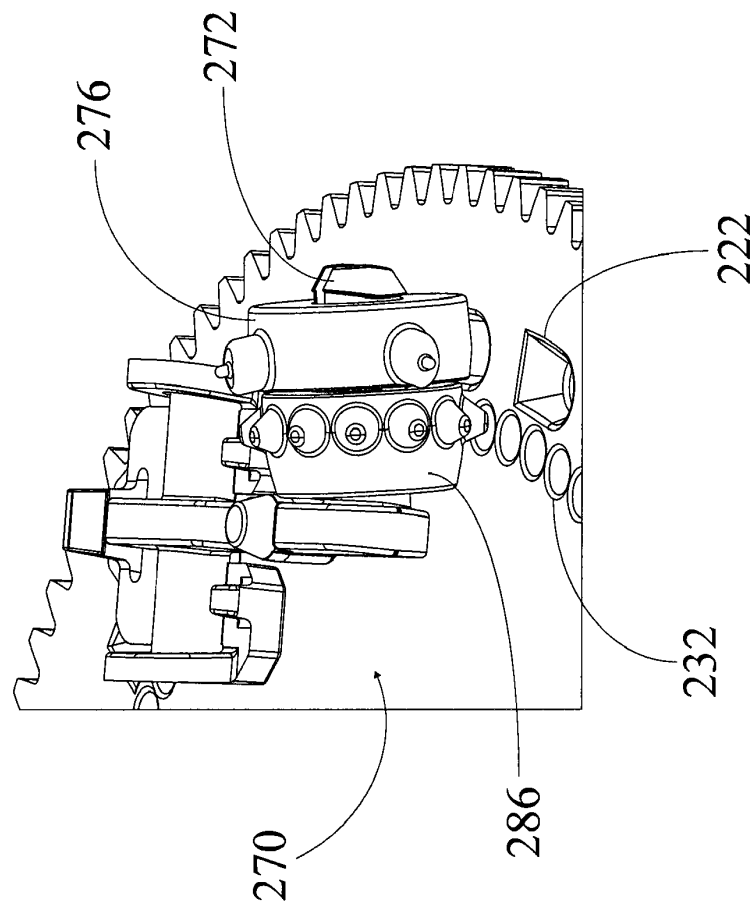


FIG. 18B

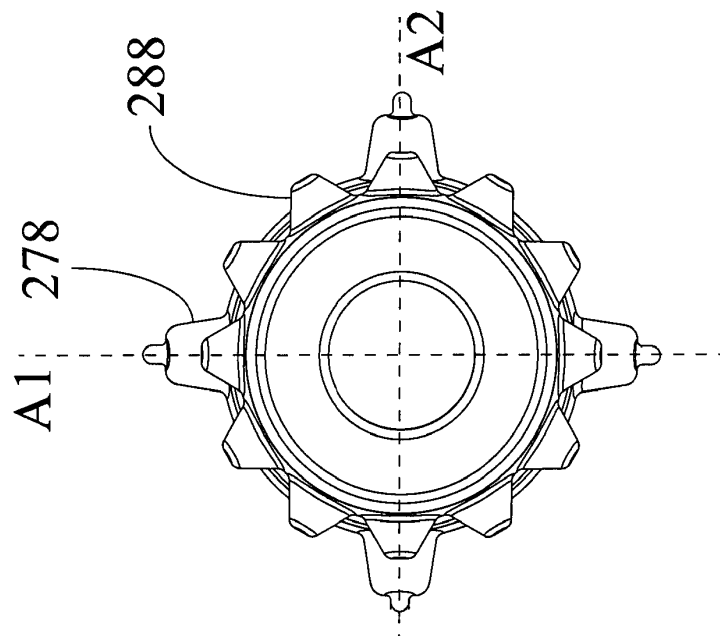


FIG. 18D

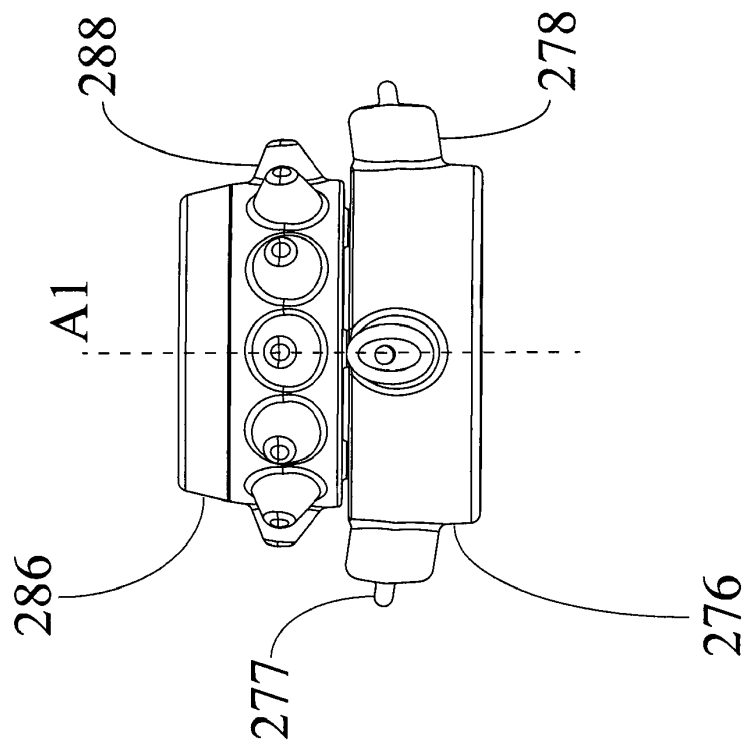
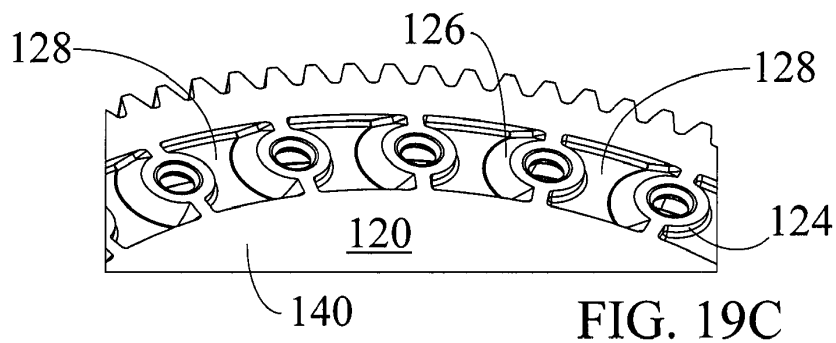
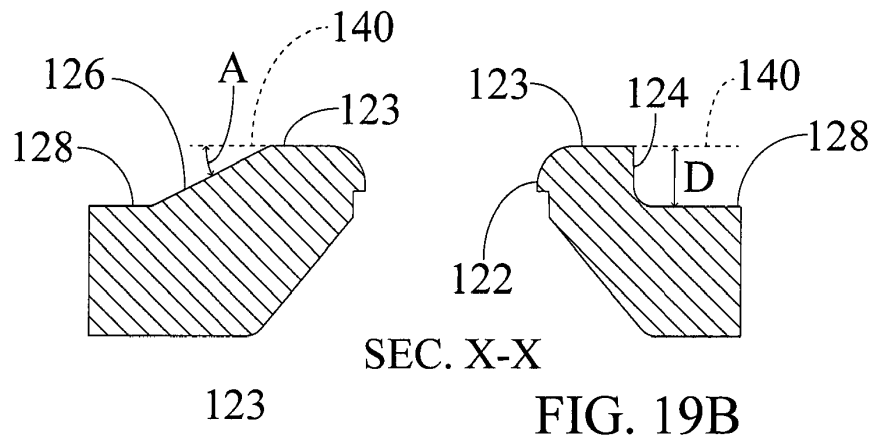
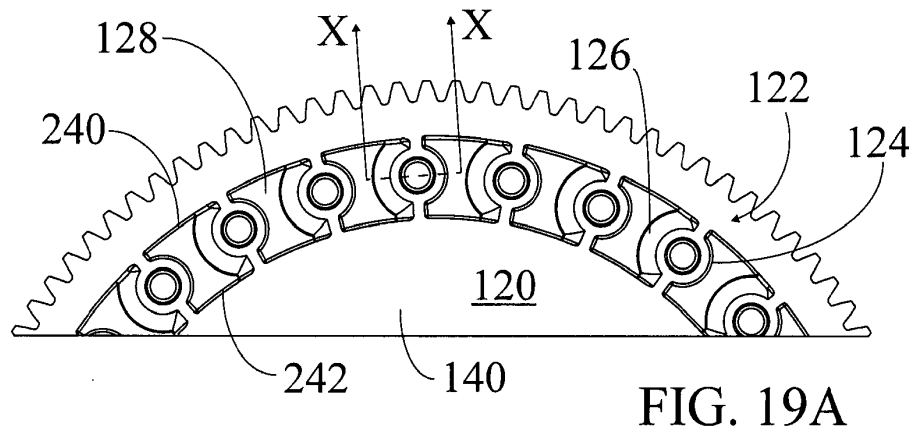


FIG. 18C



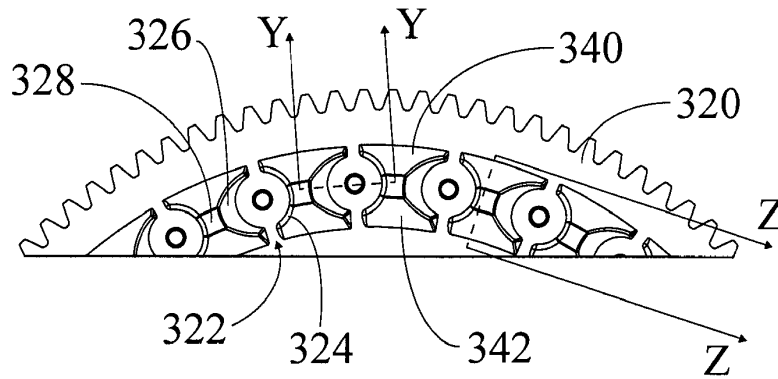


FIG. 20A

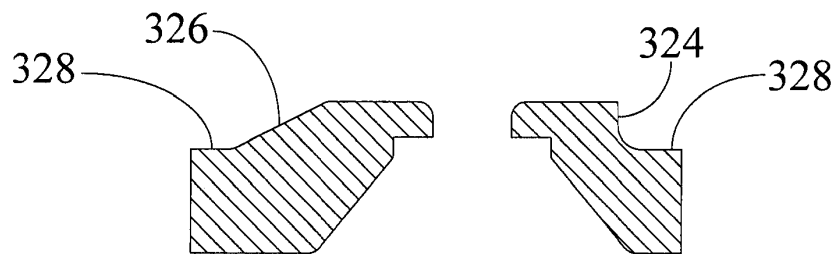


FIG. 20B

SEC. Y-Y

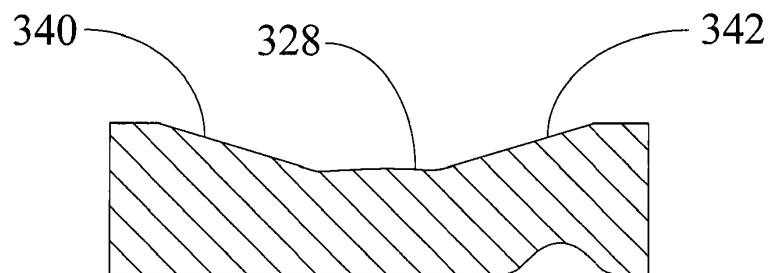


FIG. 20C

SEC. Z-Z

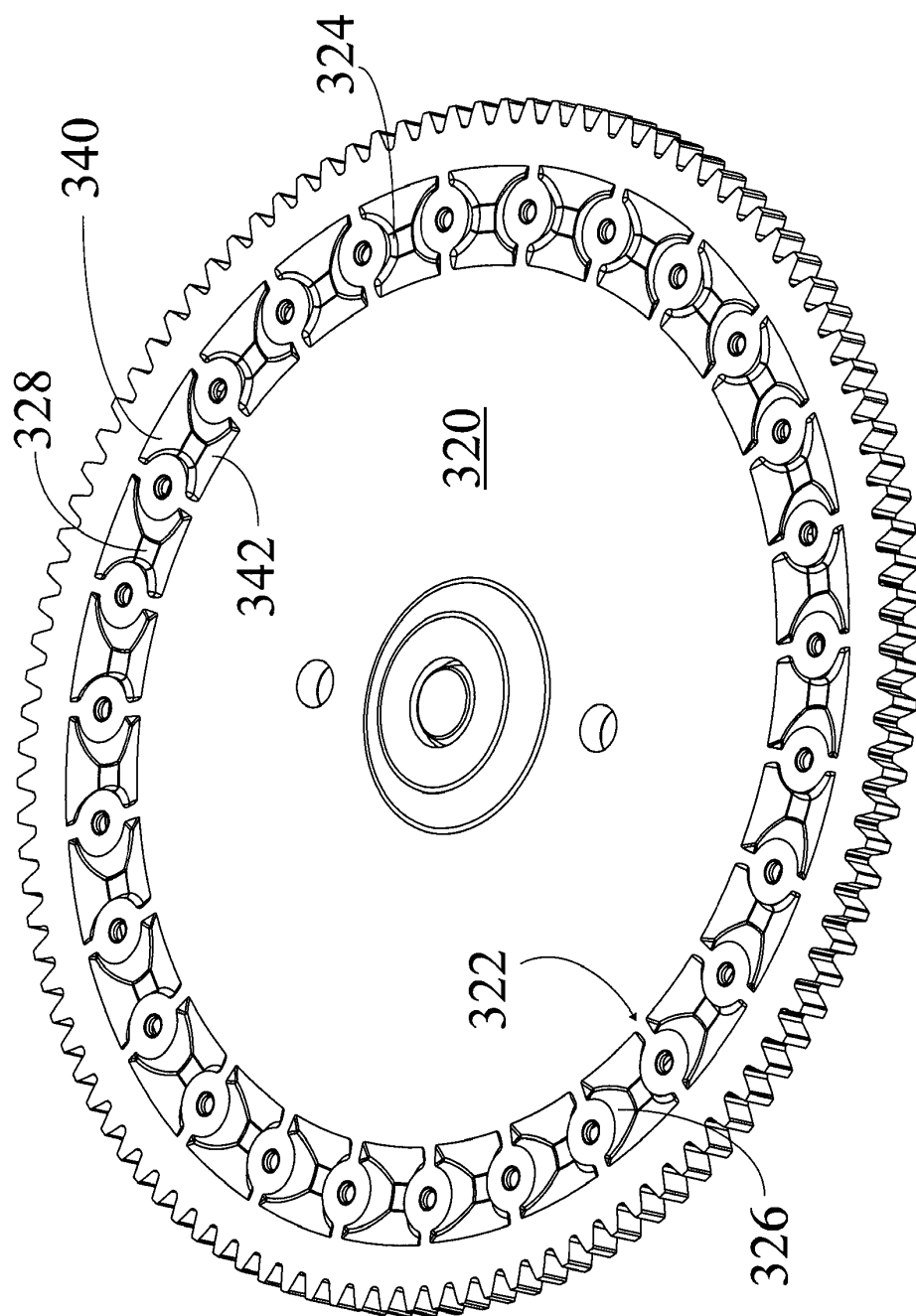


FIG. 20D

SEED METER

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application is a continuation of U.S. application Ser. No. 15/653496, filed Jul. 18, 2017 which is a continuation of U.S. application Ser. No. 14/793360, filed Jul. 7, 2015, which is a continuation of U.S. application Ser. No. 14/006,569 filed Sep. 20, 2013, which is the National Stage of International Application No. PCT/US2012/030192 filed Mar. 22, 2012, which claims the benefit of U.S. Provisional Application No. 61/466,047, filed Mar. 22, 2011.

BACKGROUND

[0002] In recent years, growers of corn and other crops have come to recognize the importance of planting individual seeds at the appropriate spacing due to increased seed and crop input prices, but also because they have the ability to monitor the economic impact of skips, doubles or misplaced seeds using modern planter monitors. For these reasons modern seed meters have been developed that include features which improve the singulation of seeds. However, each added feature increases the amount of time that the grower must spend replacing wear parts or making other adjustments prior to or during planting operations. Due to weather and other factors, the available time to plant corn and other crops is often extremely limited, with each planter required to cover hundreds of acres while limited in speed due to reduced seed meter performance at higher planting speeds.

[0003] Thus, there is a need for a seed meter having improved singulation and seed spacing capability at higher speeds and which is also easily repairable and modifiable.

BRIEF DESCRIPTION OF THE DRAWINGS

[0004] FIG. 1 illustrates a side elevation view of a single row unit of a conventional row crop planter.

[0005] FIG. 2 is a perspective view of an embodiment of a seed meter.

[0006] FIG. 3 is a partial perspective view of an embodiment of a seed meter.

[0007] FIG. 4 is another partial perspective view of an embodiment of a seed meter.

[0008] FIG. 5 is a partial side elevation view of an embodiment of a seed meter.

[0009] FIG. 6 is another partial perspective view of an embodiment of a seed meter.

[0010] FIG. 7 is another partial perspective view of an embodiment of a seed meter.

[0011] FIG. 8 is another side elevation view of an embodiment of a seed meter.

[0012] FIG. 9 is another side elevation view of an embodiment of a seed meter.

[0013] FIG. 10 is a partial side elevation view of an embodiment of a seed meter.

[0014] FIG. 11 is a partial side elevation view of an embodiment of a seed meter.

[0015] FIG. 12A is a perspective view of an embodiment of a seed singulator and an embodiment of an axial spring.

[0016] FIG. 12B is another perspective view of an embodiment of a seed singulator and an embodiment of an axial spring.

[0017] FIG. 12C is another perspective view of an embodiment of a seed singulator and an embodiment of an axial spring.

[0018] FIG. 12D is another perspective view of an embodiment of a seed singulator and an embodiment of an axial spring.

[0019] FIG. 13A is another perspective view of an embodiment of a seed meter.

[0020] FIG. 13B is another partial perspective view of an embodiment of a seed meter.

[0021] FIG. 13C is a partial perspective view of an embodiment of a seed meter.

[0022] FIG. 14 is a perspective view of a seed disc, vacuum seal and an embodiment of an ejector wheel assembly.

[0023] FIG. 15 is a perspective view of a vacuum cover, a vacuum seal, and an embodiment of an ejector wheel assembly.

[0024] FIG. 16 is a perspective view of a vacuum cover and vacuum seal.

[0025] FIG. 17A is a perspective view of an embodiment of an ejector wheel assembly.

[0026] FIG. 17B is a side elevation view of an embodiment of an ejector wheel assembly.

[0027] FIG. 18A is a side elevation view of another embodiment of a seed disc and another embodiment of an ejector wheel assembly.

[0028] FIG. 18B is a side elevation view of an embodiment of a seed disc and an embodiment of an ejector wheel assembly.

[0029] FIG. 18C is a side elevation view of an embodiment of an ejector wheel.

[0030] FIG. 18D is a top view of an embodiment of an ejector wheel.

[0031] FIG. 19A is a partial side elevation view of an embodiment of seed disc.

[0032] FIG. 19B is a cross-sectional view of a seed disc along the section X-X of FIG. 19A.

[0033] FIG. 19C is a partial perspective view of an embodiment of a seed disc.

[0034] FIG. 20A is a partial side elevation view of another embodiment of a seed disc.

[0035] FIG. 20B is a cross-sectional view of a seed disc along the section Y-Y of FIG. 20A.

[0036] FIG. 20C is a cross-sectional view of a seed disc along the section Z-Z of FIG. 20B.

[0037] FIG. 20D is a perspective view of an embodiment of a seed disc.

DESCRIPTION

[0038] Referring now to the drawings, wherein like reference numerals designate identical or corresponding parts throughout the several views, FIG. 1 illustrates a single row unit 10 of a conventional row crop planter. As is well known in the art, the row units 10 are mounted in spaced relation along the length of a transverse toolbar 12 by a parallel linkage 14 which permits each row unit 10 to move vertically independently of the toolbar and the other spaced row units in order to accommodate changes in terrain or upon the row unit encountering a rock or other obstruction as the planter is drawn through the field. Each row unit 10 includes a frame 16 which operably supports a seed hopper 18, a furrow opening assembly 20, a seed meter 100, a seed tube 46 and a furrow closing assembly 50.

[0039] The furrow opening assembly 20 comprises a pair of furrow opening discs 22 which are rotatably mounted on shafts 26 secured to a shank 30 comprising a part of the row unit frame 16. The furrow opening assembly 20 further comprises a pair of gauge wheels 32 rotatably supported by gauge wheel arms 35 also secured to the frame 16. As the planter is drawn through the field, the rotating furrow opening discs 22 cut a V-shaped furrow 40 through the soil surface 36. The egress end of the seed tube 46 is disposed between the rearwardly diverging furrow opening discs 22.

[0040] In operation, as the planter is drawn through the field along the direction of travel as indicated by the arrow 38, the seed hopper 18 communicates a constant supply of seeds 42 to the seed meter 100. The seed meter 100 meters or dispenses individual or “singulated” seeds 42 at regularly spaced intervals into the seed tube 46. The seed tube 46 directs the seeds downwardly and rearwardly between the diverging furrow opening discs 22 before depositing the seeds into the V-shaped furrow 40. The seeds are then covered with soil by the furrow closing assembly 50. A seed sensor 60 detects the passage of seeds through the seed tube 46 as is known in the art.

Novel Seed Meter Embodiments

[0041] Embodiments of a novel seed meter 100 are illustrated in FIGS. 2-20. Referring to FIGS. 2 and 3, the seed meter 100 includes a housing comprised of a vacuum cover 110 and a seed housing 105. As described further herein, the seed meter 100 functions by selecting one seed at a time from seeds communicated into the seed housing 105 and dispensing each seed through the seed exit 180. A vacuum inlet 115 is coupled to the vacuum cover 110. Vacuum hoses or tubes (not shown) connect the vacuum inlet 115 to a vacuum source (not shown) such as a vacuum impeller.

[0042] The seed housing 105 includes pivots 113 (FIG. 3) and tabs 103 (FIG. 2). When assembled, the tabs 103 extend through holes in the vacuum cover 110 such that retaining springs 108 may be biased against pivots 113 and tabs 103 to retain the seed housing 105 in position against the vacuum cover 110.

[0043] Referring to FIG. 3, the seed meter 100 is shown with the vacuum cover 110 and other components removed for clarity. A shaft 183 is rotatably coupled to bearings 184. Bearings 184 are held in place by the vacuum cover 110. A drive plate 186 is coupled to and rotates with the shaft 183. Drive plate 186 is releasably coupled to a seed disc 120. Seed disc 120 includes apertures 122 and preferably includes drive teeth 121. In operation, the seed disc 120 may be rotated by a driven gear (not shown) coupled to drive teeth 121 (as described further herein) or by a driven shaft (not shown) coupled to an adapter 185 (FIG. 2) mounted to the shaft 183.

[0044] Turning to FIG. 4, the interior of the seed housing 105 is shown with the seed disc 120, drive shaft 183 and drive plate 186 removed. A brush 112 is mounted to seed housing 105 such that its bristles contact the seed-side surface of the seed disc 120. A singulator 130 is mounted to the seed housing 105 (as described further herein) which cooperates with the seed disc 120 to singulate the seeds before they are dispensed through the seed exit 180. The singulator preferably includes multiple singulator surfaces in contact with a seed side surface 140 of the seed disc 120.

[0045] Referring to FIGS. 5, 6, and 13A-C, seeds are communicated into the seed meter 100 beneath a baffle 160

mounted to the seed housing 105. A seed pool area 150 (FIG. 5) is disposed horizontally adjacent to the seed disc 120 near a bottom end of the seed housing 105 for collection of seeds communicated into the seed meter.

[0046] The height of baffle 160 may be adjusted along guides 164 and 166. The baffle 160 is mounted to the seed housing 105 by rivet 162, which extends outside the seed housing 105 (as best seen in FIGS. 9 and 13C) and may be moved vertically by the operator along a notched slot 117 without disassembling the housing. Each notch in slot 117 is sized to hold the rivet 162 in place such that the operator can select the height of baffle 160 by pushing the rivet up and down. As illustrated, visual indicators (e.g., numbers 1 through 4) are preferably located adjacent to the notches for positioning the rivet 162 at corresponding heights of the baffle 160 for ease of reference.

Removable Floating Singulator Embodiments

[0047] Referring to FIGS. 6-8, the singulator 130 is releasably mounted to the seed housing 105 so as to bias the singulator against the seed disc 120 while allowing the singulator to “float” both axially and longitudinally with respect to the axis of rotation of the seed disc. The singulator is releasably coupled to an axial spring 137 by attachment ears 139. The axial spring 137 is preferably made of a material (e.g., spring steel) which is elastically deformable. The axial spring 137 is mounted to bosses 142. The bosses 142 are sized such that the singulator 130 is biased against the face of the seed disc 120 when the seed disc is in its normal position. Thus, when the seed disc 120 is deflected axially away from the vacuum cover 110, the tension in axial spring 137 increases, allowing the singulator to remain in contact with the seed disc without interfering with the rotation of the seed disc. Likewise, when the seed disc is deflected axially toward the vacuum cover 110, the tension in axial spring 137 decreases such that the singulator remains in contact with the seed disc.

[0048] Radial spring 111 is mounted to the seed housing 105 such that in operation, the radial spring biases the singulator radially against the seed disc 120 when the seed disc is in its normal position.

[0049] Referring to FIGS. 12A-D, the singulator 130 is illustrated in detail attached to the axial spring 137. The singulator 130 includes base 133, arms 136, upper lobe plate 134 and lower lobe plate 132. The upper lobe plate 134 includes three singulation lobes, while the lower lobe plate 132 includes two singulation lobes. In operation, attachment ears 139 grasp the base 133. When the axial spring 137 is attached to the singulator 130, the attachment ears 139 extend past and away from the base 133 and are easily manipulated and deflected. It should be appreciated that other configurations of the singulator 130 could be used to achieve the objectives described herein.

[0050] It should be appreciated that the singulator 130 is easily replaceable with another singulator with a different lobe configuration for different seeds or if it is necessary to replace the singular due to wear on the singulator lobes. The singulator 130 is removable by pulling it away from the axial spring 137 with sufficient force that the attachment ears 139 deflect away from each other sufficiently to release the base 133. The attachment ears 139 may also be deflected away from each other with one hand while pulling the singulator 130 away from the axial spring 137 with the other. Likewise, the singulator 130 may be replaced by pressing the base 133

of the singulator between the attachment ears 139 with sufficient force to cause the attachment ears to deflect away from each other to allow the base of the singulator to pass between them. To replace the singulator, the base 133 may be pushed between the ears causing them to deflect away from one another before returning to the normal position in which the base of the singulator is again secured between the ears. In this way the singulator 130 may be easily removed and replaced by hand without the use of tools and without removing or changing the location of axial spring 137, which remains in the correct location to bias the singulator 130 against the seed disc 120 while allowing the singulator 130 to “float” with deflections or deformations of the seed disc.

[0051] Referring to FIGS. 10 and 11, the seed meter 100 is illustrated with the seed housing 105 and other components removed so that the singulator 130 may be seen in its preferred location biased against the seed-side surface 140 of the seed disc 120. The seed-side surface 140 is preferably normal to the axis of rotation of the seed disc 120. The seed-side surface 140 is also preferably substantially flat with the exception of cavities 128, described in more detail later. For clarity, only the upper and lower lobe plates 132 and 134 are shown in FIG. 11. In operation, the seed disc 120 rotates in the direction indicated by arrow 129 such that the seed apertures 122 travel along a seed aperture path. A portion of the seed aperture path is adjacent to the seed pool area 150. As the seed apertures 122 turn past the seed pool area 150 at the bottom of the seed housing 105, a vacuum side of each seed aperture is placed in fluid communication with the vacuum source such that one or more seeds 42 become entrained over apertures 122. As the seed-bearing apertures rotate between the upper and lower lobe plates 132, 134, the lobes of the lobe plates bump, rotate and position the seeds so that only one seed is firmly entrained over the aperture while the other seeds drop back into the seed pool 150, thereby leaving one seed per aperture. After the apertures 122 rotate past the 3 o’clock position as viewed in FIG. 11, the apertures 122 are no longer in communication with the vacuum source resulting in the seeds being released from the apertures and falling into the seed exit 180.

[0052] Referring to FIGS. 14-16, the vacuum cover 110 includes a continuous mounting groove into which a vacuum seal 190 is press fit. In operation, the vacuum seal 190 is pressed against the vacuum-side of the seed disc 120 and the interior of the vacuum seal is in communication with the vacuum inlet 115 (FIG. 1) such that as the apertures 122 rotate past the perimeter of the vacuum seal 190 toward its interior they are placed in fluid communication with the vacuum source.

Removable Seed Ejector Assemblies

[0053] It has been found that seeds or partial seeds may become lodged in the seed apertures 122 and remain there even after the apertures 122 pass outside of the vacuum seal 190 where no vacuum is imposed. This is undesirable because when the apertures re-enter the seed reservoir an additional seed may not be entrained in an aperture holding a seed or partial seed. Thus, referring again to FIGS. 14-16, a seed ejector assembly 170 is preferably mounted to the vacuum cover 110. The seed ejector assembly 170 includes a shaft 174, a mounting clip 172, a lever arm 175 and an ejector wheel 176 having plungers 177. The ejector wheel 176 is rotatably coupled to the lever arm 175. The lever arm

is rotatably coupled to the shaft 174. The shaft is rotatably received within the mounting clip 172. As best seen in FIG. 15, the mounting clip 172 is attached to a mounting port 179, which is preferably formed integrally with the vacuum cover 110. As best seen in FIG. 14, as the seed disc 120 rotates, the ejector wheel 176 rotates and the plungers 177 enter each seed aperture 122, knocking out any seeds, partial seeds or debris in the seed apertures from the back side or vacuum-side of the seed disc 120.

[0054] As best illustrated in FIGS. 14 and 15, a spring 171 is preferably disposed between the lever arm 175 and the vacuum cover 110. The spring 171 has a first end held in place at a first end by a knob 173 on the lever arm 175 and has a second end held in place by cavity 192 in the vacuum cover 110. It should be appreciated that the spring 171 biases the ejector wheel 176 against the disc and allows the seed ejector assembly 170 to “float” with deflections or deformations of the seed disc 120.

[0055] It should be appreciated that the user may wish to remove the seed ejector assembly 170 or replace it due to wear on the ejector wheel 176, to install a differently configured seed ejector assembly, or for other reasons. As illustrated in FIGS. 16, 17A and 17B, the mounting clip 172 may be easily removed from and reattached to the mounting port 179 without the use of tools. The mounting port 179 includes apertures 196 and a tab 195. Mounting clip 172 includes rigid hooks 197 and resilient hook 198. During installation, the user first inserts rigid hooks 197 into apertures 196, then preferably presses mounting clip 172 against vacuum cover 110 such that resilient hook 198 deflects around tab 195 and returns to a relaxed state secured around tab 195. It should be appreciated that in addition to deflection of resilient hook 198 with respect to mounting clip 172, the mounting clip 172 also preferably deflects to allow resilient hook 198 to deflect around the tab 195. After attachment, the mounting clip 172 is secured against mounting port 179 until the user removes the mounting clip by bending the mounting clip to release the resilient hook 198 from tab 195 and then moving the rigid hooks 197 free of the apertures 196.

Alternative Ejector Wheel and Disc Embodiments

[0056] Turning to FIGS. 18A-18D, a modified seed ejector assembly 270 is illustrated in cooperation with a modified seed disc 220. The seed disc 220 includes an array 224 of apertures 222. The seed disc 220 further includes an array 234 of guide cavities 232. The guide cavity array 234 is preferably substantially concentric with the seed aperture array 224.

[0057] The seed ejector assembly 270 includes a lever arm 275. The lever arm 275 is preferably pivotally biased toward the seed disc 220 as described herein with respect to the lever arm 175. As best illustrated in FIG. 18B, the seed ejector assembly 270 also includes an ejector wheel 276 pivotally mounted to the lever arm 275 and a guide wheel 286 pivotally mounted to the lever arm 275. Continuing to refer to FIG. 18B, the ejector wheel 276 and the guide wheel 286 are preferably pivotally mounted to the lever arm by a retaining pin 272 extending through central apertures in the ejector wheel and guide wheel. The retaining pin 272 preferably allows the ejector wheel 276 and the guide wheel to translate slightly toward and away from the lever arm 275 such that the ejector wheel and guide wheel are allowed to translate radially toward and away from the center of the

seed disc 220. As best illustrated in FIGS. 18C and 18D, the ejector wheel 276 includes radially arranged plungers 278 and the guide wheel 286 includes radially arranged guide teeth 288. The seed ejector assembly preferably includes more guide teeth 288 than plungers 278, and preferably includes three guide teeth per plunger. The ejector wheel 276 is preferably fixed to the guide wheel 286 such that the ejector wheel is constrained to rotate synchronously with the guide wheel. Each plunger 278 is preferably aligned with one of the guide teeth 288. For example, as shown in FIG. 18D, the upper and lower plungers 278 are aligned with upper and lower guide teeth along a plane A1 and the left and right plungers 278 are aligned with left and right guide teeth along a plane A2.

[0058] In some embodiments of the ejector wheel 276, the plungers 278 include tips 277. In some embodiments of the seed disc 220, the apertures 222 are tapered to small openings 223 (FIG. 18A). The tips 277 are preferably sized to fit within the small openings 223. It should be appreciated that in such embodiments, more precise alignment of the ejector wheel 276 with respect to the seed disc 220 is necessary in order to knock seeds or debris from the small openings 223 without interference between the ejector wheel and seed disc.

[0059] In operation, as the disc rotates, the guide teeth 288 sequentially engage the guide cavities 232. The plungers 278 sequentially engage the seed apertures 222. Referring to FIG. 18A, the guide cavity array 234 is aligned with the seed aperture array 224 such that each seed aperture 222 is aligned with a guide cavity 232 along a plane (e.g., plane A3) intersecting the center of the seed disc 220. It should be appreciated that guide teeth 288 engage guide cavities 232 when the plungers 278 are not engaging the seed apertures 222, thus moving the ejector wheel 286 to the proper angular position to successfully engage each seed aperture. Additionally, it should be appreciated that as the ejector wheel translates with respect to the retaining pin 272, the guide teeth 232 likewise retain the ejector wheel 286 at the proper radial distance from the center of the seed disc 220 such that the ejector wheel can successfully engage each seed aperture 222.

Seed Disc Cavities

[0060] Referring to FIGS. 19A-19C, the seed disc 120 preferably includes seed disc cavities 128 disposed near the radial edge of the seed disc. The cavities 128 are preferably disposed to pass adjacent to the seed pool area 150. Each cavity 128 is preferably disposed forward of an adjacent seed aperture 122 along the direction of travel of the seed aperture path. The cavities 128 are preferably disposed between each pair of seed apertures 122. Seed apertures 122 are preferably substantially normal to the surface 140 of the seed disc 120; i.e., a central axis of each seed aperture 122 is preferably substantially normal to the surface 140 of the seed disc 120. Raised surfaces 123 with respect to the bottom of the associated cavity 128 are preferably disposed between each aperture 122 and the adjacent cavity 128. The upper surface of the raised surfaces 123 are preferably co-planar with the surface 140 of the seed disc 120.

[0061] Each cavity 128 preferably comprises an agitation cavity sized to agitate the seeds in the seed pool area 150. Thus the cavities 128 are preferably sized to allow significant movement of seeds 42 into and out of the cavities as each cavity moves adjacent to the seed pool 150. The outer

perimeter of the cavity 128 is preferably larger than the outer perimeter of the adjacent seed aperture 122. The area of an intersection between the surface 140 of the seed disc 120 and each cavity 128 is preferably greater than the area of an intersection between the surface 140 and each seed aperture 122. It should be appreciated that each seed aperture is sized to allow limited movement of seeds 42 into the seed aperture. Moreover, the cavities 128 are preferably wider than the average size of seeds 42 to be planted using the seed disc 120. Moreover, the depth D (FIG. 19B) of the cavities 128 is preferably greater than 0.05 inches.

[0062] Referring to FIG. 10 in combination with FIG. 19, each cavity 128 preferably has an inner sidewall 242 and an outer sidewall 240 located at distances Ri, Ro respectively from the center C (i.e., the central or rotational axis) of the disc. The difference between the radii Ro and Ri is preferably greater than the diameter of the seed apertures 122. The radius Ro is preferably larger than the distance between the seed aperture and the center of the seed disc 120. The radius Ri is preferably larger than the radius Ra between a distal end of said seed aperture 122 and the center of the disc 120.

[0063] In operation, as the seed disc 120 rotates through the seed pool area 150 located to the side of the seed disc (as best illustrated in FIG. 11), seeds move in and out of the cavities 128 such that the seed pool is stirred or agitated. This agitation improves the successful loading of seeds on the seed apertures 122, particularly at relatively high planting speeds which correspond to faster seed disc rotation speeds.

[0064] Each cavity 128 preferably includes a sidewall 124 oriented to face the seed pool area 150 as the cavity rotates into the seed pool area. The sidewall 124 is preferably substantially vertical (FIG. 19B), i.e., substantially normal to the surface 140 of the seed disc 120. As viewed along the rotational axis of the seed disc (FIG. 19A), the sidewall 124 is preferably curved, and preferably is semicircular. In operation, the sidewalls 124 sequentially enter the seed pool area 150 and push the seeds such that the seed pool is stirred and agitated.

[0065] The cavities 128 preferably include a bevel 126 oriented to face away from the seed pool as the disc 120 rotates into the seed pool area 150. An angle A (FIG. 19B) between bevel 126 and the surface 140 of the seed disc 120 is preferably between 15 and 35 degrees with respect to the surface of the disc. In operation, when seeds are released from the disc (at approximately the 3 o'clock position on the view of FIG. 11), seeds occasionally fall toward the disc and into the cavity 128 located below the seed aperture 122. In such instances, the seed bounces or slides against the bevel 126, smoothly transitioning the seed back out of the cavity 128 and increasing consistency between seed fall times.

[0066] Although a seed disc 120 is disclosed herein including series of seed apertures 122 and cavities 128 having the same radial distance from the center of the seed disc, other embodiments include rows of seed cavities

[0067] Referring to FIGS. 20A-20D, an alternative seed disc 320 is illustrated having cavities 328 disposed between seed apertures 322. Each cavity 328 preferably includes vertical sidewalls 324 and bevels 326. Each cavity 328 preferably includes a beveled inner sidewall 342 and a beveled outer sidewall 340. The beveled sidewalls 342, 340 reduce the interior volume of the cavity 328 and allow seeds to smoothly transition out of the cavity 328 while the seeds are being agitated in the seed pool area 150. Thus each

beveled sidewall 342, 340 discourages entrapment of seeds in the cavities 328, particularly smaller seed varieties.

[0068] Although the various improvements described herein are illustrated with respect to a vacuum-type seed meter, they would be equally applicable to other seed singulating meters, including positive-air meters such as that disclosed in U.S. Pat. No. 4,450,979 to Deckler, incorporated herein in its entirety by reference.

[0069] The foregoing description is presented to enable one of ordinary skill in the art to make and use the invention and is provided in the context of a patent application and its requirements. Various modifications to the preferred embodiment of the apparatus, and the general principles and features of the system and methods described herein will be readily apparent to those of skill in the art. Thus, the present invention is not to be limited to the embodiments of the apparatus, system and methods described above and illustrated in the drawing figures, but is to be accorded the widest scope consistent with the spirit and scope of the appended claims.

1. A seed distribution element for precision pneumatic seed drills, comprising:

- a sowing disc which is rotated by a motor-driven transmission drive shaft at controlled speed;
- a housing with a fixed portion and a portion which is movable relative to the fixed portion and can be closed against the fixed portion;
- a seed collection chamber being defined in the fixed portion;
- a pneumatic suction chamber being defined in the movable portion;
- the sowing disc being interposed between the fixed and movable portions and having opposed surfaces delimiting the chambers;
- the sowing disc having at least one ring of selector holes extending between the opposed surfaces; and
- a seal which is arranged on the movable portion and is capable of sliding contact with the facing surface of the disc when the fixed and movable portions are closed against one another;
- wherein a pressure differential is provided between the opposed surfaces in the region of a circumferential segment of the ring of holes;
- wherein the seed distribution element further comprises a thrust-bearing element of the sowing disc, which thrust-bearing element is supported rotatably in the movable portion in order to withstand at least some of the axial load produced by the disc on the seal.

2. The seed distribution element according to claim 1, wherein the thrust-bearing element is rotated with the disc when the fixed and movable portions are closed against one another.

3. The seed distribution element according to claim 1, wherein the thrust-bearing element comprises a thrust-bearing plate which can bear on that surface of the sowing disc which faces the seal, in a zone radially inside of the ring of holes.

4. The seed distribution element according to claim 3, wherein the thrust-bearing element comprises a drive element which is fixed for rotation with the plate and can be coupled with the drive shaft of the disc when the fixed and movable portions are closed against one another.

5. The seed distribution element according to claim 4, wherein the drive element is self-centring relative to the drive shaft.

6. The seed distribution element according to claim 4, wherein the drive element comprises a coupling member which rotates jointly with the thrust-bearing plate but has radial and/or circumferential clearance so as to be self-centred during rotational coupling with the drive shaft of the disc.

7. The seed distribution element according to claim 1, wherein the movable portion is hinged to the fixed portion.

8. A sowing element for precision seed drills comprising a frame on which a seed distribution element according to claim 1 is mounted.

9. A seed drill comprising a supporting structure on which a plurality of sowing elements according to claim 8 are mounted.

10. A kit for the retrofitting of seed distribution elements of precision pneumatic seed drills wherein the distribution elements are of the type including:

- a sowing disc which is rotated by a motor-driven transmission drive shaft at controlled speed;
- a housing with a fixed portion and a portion which is movable relative to the fixed portion and can be closed against the fixed portion;
- a seed collection chamber being defined in the fixed portion;
- a pneumatic suction chamber being defined in the movable portion;
- the sowing disc being interposed between the fixed and movable portions and having opposed surfaces delimiting the chambers;
- the sowing disc having at least one ring of selector holes extending between the opposed surfaces; and
- a seal which is arranged on the movable portion and is capable of sliding contact with the facing surface of the disc when the portions are closed against one another;
- wherein a pressure differential is provided between the opposed surfaces in the region of a circumferential segment of the ring of holes;
- wherein the kit comprises the movable portion pre-assembled with a thrust-bearing element of the sowing disc, which thrust-bearing element is supported rotatably in the movable portion in order to withstand at least some of the axial load produced by the disc on the seal.

11. The kit according to claim 10 wherein the movable portion and the thrust-bearing element comprise at least one feature according to claim 2.

12. The kit according to claim 10 wherein the movable portion and the thrust-bearing element comprise at least one feature according to claim 3.

13. The kit according to claim 10 wherein the movable portion and the thrust-bearing element comprise at least one feature according to claim 4.

14. The kit according to claim 10 wherein the movable portion and the thrust-bearing element comprise at least one feature according to claim 5.

15. The kit according to claim 10 wherein the movable portion and the thrust-bearing element comprise at least one feature according to claim 6.

16. The kit according to claim 10 wherein the movable portion and the thrust-bearing element comprise at least one feature according to claim 7.

17. A seed meter for an agricultural planter, said seed meter comprising:

- a seed disc which is rotated by a motor-driven shaft at controlled speed;
- a meter housing with a fixed portion and a portion which is movable relative to the fixed portion and can be closed against the fixed portion;
- a seed pool area being defined in the fixed portion;
- a vacuum area defined in the movable portion;
- the seed disc being interposed between the fixed and movable portions and having opposed surfaces delimiting the seed pool area from the vacuum area;
- the seed disc having at least one ring of seed apertures extending between the opposed surfaces; and
- a seal which is arranged on the movable portion and is capable of sliding contact with the facing surface of the disc when the fixed and movable portions are closed against one another

wherein a pressure differential is provided between the opposed surfaces in the region of a circumferential segment of the ring of seed apertures;

wherein the seed meter further comprises a thrust-bearing element of the seed disc, which thrust-bearing element is supported rotatably in the movable portion in order to withstand at least some of the axial load produced by the disc on the seal.

18. The seed meter according to claim 17, wherein the thrust-bearing element is rotated with the disc when the fixed and movable portions are closed against one another.

19. The seed meter according to claim 17, wherein the thrust-bearing element comprises a thrust-bearing plate which can bear on that surface of the seed disc which faces the seal, in a zone radially inside of the ring of seed apertures.

20. The seed meter according to claim 19, wherein the thrust-bearing element comprises a drive element which is fixed for rotation with the plate and can be coupled with the shaft of the disc when the fixed and movable portions are closed against one another.

21. The seed meter according to claim 20, wherein the drive element is centered relative to the shaft.

22. The seed meter according to claim 20, wherein the drive element comprises a coupling member which rotates jointly with the thrust-bearing plate.

23. The seed meter according to claim 17, wherein the movable portion is mechanically coupled to the fixed portion.

24. An agricultural planter comprising a frame on which a seed meter according to claim 17 is mounted.

25. An agricultural planter including a supporting structure on which a plurality of seed meters according to claim 24 are mounted.

26. An assembly for a seed meter of an agricultural planter wherein the seed meter is of the type including:

- a seed disc which is rotated by a motor-driven shaft at controlled speed;
- a meter housing with a fixed portion and a portion which is movable relative to the fixed portion and can be closed against the fixed portion;
- a seed pool area being defined in the fixed portion;
- a vacuum area defined in the movable portion;
- the seed disc being interposed between the fixed and movable portions and having opposed surfaces delimiting the seed pool area from the vacuum area;
- the seed disc having at least one ring of seed apertures extending between the opposed surfaces; and
- a seal which is arranged on the movable portion and is capable of sliding contact with the facing surface of the disc when the fixed and movable portions are closed against one another;

wherein a pressure differential is provided between the opposed surfaces in the region of a circumferential segment of the ring of seed apertures;

wherein the assembly comprises, in said movable portion, a thrust-bearing element of the seed disc, which thrust-bearing element is supported rotatably in the movable portion in order to withstand at least some of the axial load produced by the disc on the seal.

27. The assembly according to claim 26 wherein the thrust-bearing element is rotated with the disc when the fixed and movable portions are closed against one another.

28. The assembly according to claim 26 wherein the thrust-bearing element comprises a thrust-bearing plate which can bear on that surface of the seed disc which faces the seal, in a zone radially inside of the ring of seed apertures.

29. The assembly according to claim 26 wherein the thrust-bearing element comprises a drive element which is fixed for rotation with the plate and can be coupled with the shaft of the disc when the fixed and movable portions are closed against one another.

30. The assembly according to claim 29 wherein the drive element is centered relative to the shaft.

31. The assembly according to claim 29 wherein the drive element comprises a coupling member which rotates jointly with the thrust-bearing plate.

32. The assembly according to claim 26 wherein the movable portion is mechanically coupled to the fixed portion.

* * * * *

Appendix B4

Doc code: IDS

Doc description: Information Disclosure Statement (IDS) Filed

PTO/SB/08a (03-15)

Approved for use through 07/31/2016. OMB 0651-0031

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number		
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	First Named Inventor	Derek Sauder	
	Art Unit		
	Examiner Name		
	Attorney Docket Number	27151.10027US04	

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Examiner Initial*	Cite No	Patent Number	Kind Code ¹	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number			
	Filing Date			
	First Named Inventor	Derek Sauder		
	Art Unit			
	Examiner Name			
	Attorney Docket Number	27151.10027US04		

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	Attorney Docket Number	27151.10027US04	

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	1	Amazone ED 302 Manual, appears to be dated October 2005; https://app.box.com/s/m3wrkxxc1d9vv1dkzd5oxu9u39c794x	☐
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	Art Unit		
	Examiner Name		
	Attorney Docket Number	27151.10027US04	

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Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

☐ That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

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☐ See attached certification statement.

☐ The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

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A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Thomas J. Oppold/	Date (YYYY-MM-DD)	2015-07-10
Name/Print	Thomas Oppold	Registration Number	42054

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Appendix B5

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Doc description: Information Disclosure Statement (IDS) Filed

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	Filing Date	2019-11-25
	First Named Inventor	Derek Sauder
	Art Unit	3619
	Examiner Name	
	Attorney Docket Number	27151.10027US09

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number		16694471
	Filing Date		2019-11-25
	First Named Inventor	Derek Sauder	
	Art Unit	3619	
	Examiner Name		
	Attorney Docket Number	27151.10027US09	

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number		16694471
	Filing Date		2019-11-25
	First Named Inventor	Derek Sauder	
	Art Unit	3619	
	Examiner Name		
	Attorney Docket Number	27151.10027US09	

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number		16694471
	Filing Date		2019-11-25
	First Named Inventor	Derek Sauder	
	Art Unit	3619	
	Examiner Name		
	Attorney Docket Number	27151.10027US09	

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	Filing Date		2019-11-25	
	First Named Inventor	Derek Sauder		
	Art Unit	3619		
	Examiner Name			
	Attorney Docket Number	27151.10027US09		

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6	68916976	DE	D1	1994-08-25	ATELIERS RIBOULEAU, LARGEASSE, FR	☒
7	9602123	WO	A1	1996-02-01	STANHAY WEBB LIMITED	☐
8	102006002766	DE	A1	2007-07-26	AMAZONEN-WERKE H. DREYER GMBH & CO. KG	☒
9	201097488	CN	Y	2008-08-13	CHEN HENG	☒
10	2009003257	WO	A1	2009-01-08	ROSSATO ROBERTO OTAVIANO	☐
11	2010002754	WO	A1	2010-01-07	MONSANTO TECHNOLOGY LLC	☐

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number		16694471	
	Filing Date		2019-11-25	
	First Named Inventor	Derek Sauder		
	Art Unit	3619		
	Examiner Name			
	Attorney Docket Number	27151.10027US09		

	12	2225928	EP	A2	2010-09-08	DEERE & COMPANY	☐
	13	201718187	CN	U	2011-01-26	CHEN HENG	☒
	14	102009043881	DE	A1	2011-03-03	BRÜGGEMANN KLAUS	☒
	15	2012062786	WO	A1	2012-05-18	SANDVIK INTELLECTUAL PROPERTY AB	☐
	16	2341765	EP	B1	2013-08-28	KVERNELAND AS	☒
	17	2991132	FR	A1	2013-12-06	KUHN S.A.	☒
	18	102013100113	DE	A1	2014-07-10	KVERNELAND AS	☒
	19	2637492	EP	B1	2014-12-03	MASCHIO GASPARD S.P.A.	☐
	20	2848109	EP	A1	2015-03-18	MASCHIO GASPARD S.P.A.	☐
	21	2688385	EP	B1	2016-07-20	DEERE & COMPANY	☐
	22	2688386	EP	B1	2016-11-02	DEERE & COMPANY	☐

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number		16694471
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	Examiner Name		
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	1	"Amazone ED 302 Manual", website - https://appl.box.com/s/m3wrkxxc1d9vv1dkzd5oxu9u39c794x , 10/2005, 172 pages		
	2	"John Deere Manual Excerpt I - Vacuum Meter Inspection and Service", website - http://manuals.deere.com/omview/OMA88840_19/OUO6074_00008DD_19_26MAY09_1.htm , 05/2009, 3 pages		
	3	"John Deere Manual Excerpt II - Cleanout and Inspection of Seed Hoppers and Meter Units", website - http://manuals.deere.com/omview/OMA88840_19/AG_OUO6074_1210_19_22MAY09_1.htm , 05/2009, 4 pages		
	4	"Kinze Manufacturing, Edge Vac Operator & Parts Manual", Williamsburg Iowa, 03/2007, 196 pages		
	5	"Monosem NG+ Manual", website - http://www.monosem-inc.com/pdfs/manuals/ng+3/6.rowunit.single.pdf , 04/2005, 19 pages		
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¹ See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. ² Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). ³ For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. ⁴ Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. ⁵ Applicant is to place a check mark here if English language translation is attached.				

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CERTIFICATION STATEMENT			
Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):			
That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).			
OR			
That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).			
See attached certification statement.			
The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.			
☒ A certification statement is not submitted herewith.			
SIGNATURE			
A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.			
Signature	/Thomas J. Oppold/	Date (YYYY-MM-DD)	2020-06-19
Name/Print	Thomas J. Oppold	Registration Number	42054
This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.			

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The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these records.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
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5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Appendix B6



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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/694,471	11/25/2019	Derek Sauder (deceased)	US11/105/WO/US-9	5564
88988	7590	10/05/2021		
AGCO Corporation, IP Legal Jeff Ellsworth 420 W. Lincoln Blvd. Hesston, KS 67062			EXAMINER TORRES, ALICIA M	
			ART UNIT 3671	PAPER NUMBER
			NOTIFICATION DATE 10/05/2021	DELIVERY MODE ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

patents@agcocorp.com

Office Action Summary	Application No. 16/694,471	Applicant(s) Sauder (deceased), Derek	
	Examiner ALICIA M TORRES	Art Unit 3671	AIA (FITF) Status No

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTHS FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).

Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1) ☒ Responsive to communication(s) filed on 11/25/2019.
 ☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on ____.

2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.

3) ☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on ____; the restriction requirement and election have been incorporated into this action.

4) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims*

5) ☒ Claim(s) 1-32 is/are pending in the application.
 5a) Of the above claim(s) ____ is/are withdrawn from consideration.

6) ☐ Claim(s) ____ is/are allowed.

7) ☒ Claim(s) 1-32 is/are rejected.

8) ☐ Claim(s) ____ is/are objected to.

9) ☐ Claim(s) ____ are subject to restriction and/or election requirement

* If any claims have been determined allowable, you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to PPHfeedback@uspto.gov.

Application Papers

10) ☐ The specification is objected to by the Examiner.

11) ☒ The drawing(s) filed on 11/25/2019 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
 Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
 Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

Priority under 35 U.S.C. § 119

12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
Certified copies:
 a) ☐ All b) ☐ Some** c) ☐ None of the:
 1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. ____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

** See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)

2) ☒ Information Disclosure Statement(s) (PTO/SB/08a and/or PTO/SB/08b)
 Paper No(s)/Mail Date ____.

3) ☐ Interview Summary (PTO-413)
 Paper No(s)/Mail Date ____.

4) ☐ Other: ____.

DETAILED ACTION

Notice of Pre-AIA or AIA Status

1. The present application is being examined under the pre-AIA first to invent provisions.

Claim Objections

2. Claim 5 is objected to because of the following informalities: line 2, “self-centring” should be changed to –self-centering—. Appropriate correction is required.

Claim 6 is objected to because of the following informalities: line 3, “self-centred” should be changed to –self-centered—. Appropriate correction is required.

Claim 17 is objected to because of the following informalities: line 12, “another” should be changed to –another;—. Appropriate correction is required.

Claim Rejections - 35 USC § 112

3. The following is a quotation of the first paragraph of 35 U.S.C. 112(a):

(a) IN GENERAL.—The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same, and shall set forth the best mode contemplated by the inventor or joint inventor of carrying out the invention.

The following is a quotation of the first paragraph of pre-AIA 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same, and shall set forth the best mode contemplated by the inventor of carrying out his invention.

4. Claims 1-32 are rejected under 35 U.S.C. 112(a) or 35 U.S.C. 112 (pre-AIA), first paragraph, as failing to comply with the written description requirement. The claim(s) contains

subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor or a joint inventor, or for applications subject to pre-AIA 35 U.S.C. 112, the inventor(s), at the time the application was filed, had possession of the claimed invention:

5. The claims recite “a thrust-bearing element”. However, this specific type of bearing has not been disclosed throughout the continuation (CON) chain of applications. The limitations requiring a thrust-bearing element therefore comprise new subject matter.

6. The following is a quotation of 35 U.S.C. 112(b):
(b) CONCLUSION.—The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the inventor or a joint inventor regards as the invention.

The following is a quotation of 35 U.S.C. 112 (pre-AIA), second paragraph:
The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

7. Claims 11-16 are rejected under 35 U.S.C. 112(b) or 35 U.S.C. 112 (pre-AIA), second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which the inventor or a joint inventor (or for applications subject to pre-AIA 35 U.S.C. 112, the applicant), regards as the invention:

8. The phrase “at least one feature according to claim X”, used in claims 11-16, renders the claims the indefinite as it is unclear which “feature” of the claims the phrase is referring to.

9. Claims 26-32 are rejected under 35 U.S.C. 112(b) or 35 U.S.C. 112 (pre-AIA), second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which the inventor or a joint inventor (or for applications subject to pre-AIA 35 U.S.C. 112, the applicant), regards as the invention:

10. Regarding claim 26, the phrase "of the type" renders the claim(s) indefinite because the claim(s) include(s) elements not actually disclosed (those encompassed by "of the type"), thereby rendering the scope of the claim(s) unascertainable.

Claim Rejections - 35 USC § 102

11. The following is a quotation of the appropriate paragraphs of pre-AIA 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(a) the invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for a patent.

12. Claim(s) 1-32 is/are rejected under pre-AIA 35 U.S.C. 102(a) as being anticipated by Bragatto WO 2012/062876 A1.

13. **Independent Claim 1:** Bragatto discloses a seed distribution element for precision pneumatic seed drills, comprising:

a sowing disc (16) which is rotated by a motor-driven transmission drive shaft (20) at controlled speed (page 4, line 24-page 5, line 1);

a housing (10) with a fixed portion (11) and a portion (12) which is movable relative to the fixed portion and can be closed against the fixed portion;

a seed collection chamber (15) being defined in the fixed portion;

a pneumatic suction chamber (17) being defined in the movable portion;

the sowing disc being interposed between the fixed and movable portions and having opposed surfaces (16a, 16b) delimiting the chambers (as seen in Fig. 1);

the sowing disc having at least one ring of selector holes (23) extending between the opposed surfaces; and

a seal (24) which is arranged on the movable portion and is capable of sliding contact with the facing surface of the disc when the fixed and movable portions are closed against one another (page 5, lines 9-11);

wherein a pressure differential is provided between the opposed surfaces in the region of a circumferential segment of the ring of holes (page 4, lines 19-23);

wherein the seed distribution element further comprises a thrust-bearing element (26) of the sowing disc, which thrust-bearing element is supported rotatably in the movable portion in order to withstand at least some of the axial load produced by the disc on the seal (see Fig. 1, page 5; lines 21-23; page 6, lines 8-13), as per claim 1.

14. **Dependent Claims 2-7:** Bragatto discloses wherein the thrust-bearing element (26) is rotated with the disc (page 6, lines 8-13) when the fixed (11) and movable (12) portions are closed against one another, as per claim 2;

wherein the thrust-bearing element (26) comprises a thrust-bearing plate (31) which can bear on that surface (16a) of the sowing disc (16) which faces the seal (24), in a zone radially inside of the ring of holes (23, see Fig. 1), as per claim 3;

wherein the thrust-bearing element (26) comprises a drive element (32) which is fixed for rotation with the plate (31) and can be coupled with the drive shaft (20) of the disc (16) when the fixed (11) and movable (12) portions are closed against one another (page 6, lines 8-13), as per claim 4;

wherein the drive element (32) is self-centring relative to the drive shaft (20, page 6, lines 10-13), as per claim 5;

wherein the drive element (32) comprises a coupling member ("coupling device" not shown, see page 6, lines 10-11) which rotates jointly with the thrust-bearing plate (31) but has radial and/or circumferential clearance so as to be self-centred during rotational coupling with the drive shaft (20) of the disc (16, page 6, lines 8-13), as per claim 6;

wherein the movable portion (12) is hinged (12a, 13) to the fixed portion (11), as per claim 7.

15. **Independent Claim 8:** Bragatto discloses a sowing element (2) for precision seed drills (3) comprising a frame (6) on which a seed distribution element according to claim 1 (as rejected by Bragatto above) is mounted, as per claim 8.

16. **Independent Claim 9:** Bragatto discloses a seed drill (3) comprising a supporting structure (8) on which a plurality of sowing elements (2) according to claim 8 (as rejected by Bragatto above) are mounted, as per claim 9.

17. **Independent Claim 10:** Bragatto discloses a kit for the retrofitting of seed distribution elements of precision pneumatic seed drills wherein the distribution elements are of the type including:

a sowing disc (16) which is rotated by a motor-driven transmission drive shaft (20) at controlled speed (page 4, line 24-page 5, line 1);

a housing (10) with a fixed portion (11) and a portion (12) which is movable relative to the fixed portion and can be closed against the fixed portion;

a seed collection chamber (15) being defined in the fixed portion;

a pneumatic suction chamber (17) being defined in the movable portion;

the sowing disc being interposed between the fixed and movable portions and having opposed surfaces (16a, 16b) delimiting the chambers (as seen in Fig. 1);

the sowing disc having at least one ring of selector holes (23) extending between the opposed surfaces; and

a seal (24) which is arranged on the movable portion and is capable of sliding contact with the facing surface of the disc when the portions are closed against one another (page 5, lines 9-11);

wherein a pressure differential is provided between the opposed surfaces in the region of a circumferential segment of the ring of holes (page 4, lines 19-23);

wherein the kit comprises the movable portion pre-assembled with a thrust-bearing element (26) of the sowing disc, which thrust-bearing element is supported rotatably in the movable portion in order to withstand at least some of the axial load produced by the disc on the seal (see Fig. 1; page 5, lines 21-23; page 6, lines 8-13), as per claim 10.

18. **Dependent Claims 11-16:** Bragatto further discloses wherein the movable portion (12) and the thrust-bearing element (26) comprise at least one feature according to claim 2 (as rejected by Bragatto above), as per claim 11;

wherein the movable portion (12) and the thrust-bearing element (26) comprise at least one feature according to claim 3 (as rejected by Bragatto above), as per claim 12;

wherein the movable portion (12) and the thrust-bearing element (26) comprise at least one feature according to claim 4 (as rejected by Bragatto above), as per claim 13;

wherein the movable portion (12) and the thrust-bearing element (26) comprise at least one feature according to claim 5 (as rejected by Bragatto above), as per claim 14;

wherein the movable portion (12) and the thrust-bearing element (26) comprise at least one feature according to claim 6 (as rejected by Bragatto above), as per claim 15;

wherein the movable portion (12) and the thrust-bearing element (26) comprise at least one feature according to claim 7 (as rejected by Bragatto above), as per claim 16.

19. **Independent Claim 17:** Bragatto discloses a seed meter for an agricultural planter, said seed meter comprising:

a seed disc (16) which is rotated by a motor-driven shaft (20) at controlled speed (page 4, line 24-page 5, line 1);

a meter housing (10) with a fixed portion (11) and a portion (12) which is movable relative to the fixed portion and can be closed against the fixed portion;

a seed pool area (15) being defined in the fixed portion;

a vacuum area (17) defined in the movable portion;

the seed disc being interposed between the fixed and movable portions and having opposed surfaces (16a, 16b) delimiting the seed pool area from the vacuum area (seen in Fig. 1);

the seed disc having at least one ring of seed apertures (23) extending between the opposed surfaces; and

a seal (24) which is arranged on the movable portion and is capable of sliding contact with the facing surface of the disc when the fixed and movable portions are closed against one another (page 5, lines 9-11);

wherein a pressure differential is provided between the opposed surfaces in the region of a circumferential segment of the ring of seed apertures (page 4, lines 19-23);

wherein the seed meter further comprises a thrust-bearing element (26) of the seed disc, which thrust-bearing element is supported rotatably in the movable portion in order to withstand at least some of the axial load produced by the disc on the seal (Fig. 1; page 5, lines 21-23; page 6, lines 8-13), as per claim 17.

20. **Dependent Claims 18-23:** Bragatto further discloses wherein the thrust-bearing element (26) is rotated with the disc (16, page 6, lines 8-13) when the fixed (11) and movable (12) portions are closed against one another, as per claim 18;

wherein the thrust-bearing element (26) comprises a thrust-bearing plate (31) which can bear on that surface (16a) of the seed disc (16) which faces the seal (24), in a zone radially inside of the ring of seed apertures (23, seen in Fig. 1), as per claim 19;

wherein the thrust-bearing element (26) comprises a drive element (32) which is fixed for rotation with the plate (31) and can be coupled with the shaft (20) of the disc (16) when the fixed (11) and movable (12) portions are closed against one another (page 6, lines 8-13), as per claim 20;

wherein the drive element (32) is centered relative to the shaft (20, page 6, lines 10-13), as per claim 21;

wherein the drive element (32) comprises a coupling member ("coupling device" not shown, page 6, lines 10-11) which rotates jointly with the thrust-bearing plate (31), as per claim 22;

wherein the movable portion (12) is mechanically coupled (via 12a, 13) to the fixed portion (11), as per claim 23.

21. **Independent Claim 24:** Bragatto discloses an agricultural planter (3) comprising a frame (6) on which a seed meter (1) according to claim 17 (as rejected by Bragatto above) is mounted, as per claim 24.

22. **Independent Claim 25:** Bragatto discloses an agricultural planter (3) including a supporting structure (8) on which a plurality of seed meters (1) according to claim 24 (as rejected by Bragatto above) are mounted, as per claim 25.

23. **Independent Claim 26:** Bragatto discloses an assembly for a seed meter of an agricultural planter wherein the seed meter is of the type including:

- a seed disc (16) which is rotated by a motor-driven shaft (20) at controlled speed (page 4, line 24-page 5, line 1);

- a meter housing (10) with a fixed portion (11) and a portion (12) which is movable relative to the fixed portion and can be closed against the fixed portion;

- a seed pool area (15) being defined in the fixed portion;

- a vacuum area (17) defined in the movable portion;

the seed disc being interposed between the fixed and movable portions and having opposed surfaces (16a, 16b) delimiting the seed pool area from the vacuum area (as seen in Fig. 1);

the seed disc having at least one ring of seed apertures (23) extending between the opposed surfaces; and

a seal (24) which is arranged on the movable portion and is capable of sliding contact with the facing surface of the disc when the fixed and movable portions are closed against one another (page 5, lines 9-11);

wherein a pressure differential is provided between the opposed surfaces in the region of a circumferential segment of the ring of seed apertures (page 4, lines 19-23);

wherein the assembly comprises, in said movable portion, a thrust-bearing element (26) of the seed disc, which thrust-bearing element is supported rotatably in the movable portion in order to withstand at least some of the axial load produced by the disc on the seal (Fig. 1; page 5, lines 21-23; page 6, lines 8-13), as per claim 26.

24. **Dependent Claims 27-32:** Bragatto further discloses wherein the thrust-bearing element (26) is rotated with the disc (16, page 6, lines 8-13) when the fixed (11) and movable (12) portions are closed against one another, as per claim 27;

wherein the thrust-bearing element (26) comprises a thrust-bearing plate (31) which can bear on that surface (16a) of the seed disc (16) which faces the seal (24), in a zone radially inside of the ring of seed apertures (23, see Fig. 1), as per claim 28;

wherein the thrust-bearing element (26) comprises a drive element (32) which is fixed for rotation with the plate (31) and can be coupled with the shaft (20) of the disc (16) when the fixed

(11) and movable (12) portions are closed against one another (page 6, lines 8-13), as per claim 29;

wherein the drive element (32) is centered relative to the shaft (20, page 6, lines 10-13), as per claim 30;

wherein the drive element (32) comprises a coupling member ("coupling device" not shown, see page 6, lines 10-11) which rotates jointly with the thrust-bearing plate (31), as per claim 31;

wherein the movable portion (12) is mechanically coupled (via 12a, 13) to the fixed portion (11), as per claim 32.

Conclusion

25. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Please see the attached PTO-892.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Alicia M. Torres whose telephone number is 571-272-6997. The examiner's fax number is 571-273-6997. The examiner can normally be reached Monday through Friday from 9:00 a.m. – 5:30 p.m EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Thomas B. Will, can be reached at (571) 272-6998.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the group receptionist whose telephone number is 571-272-3600. The fax number for this Group is 571-273-8300.

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Art Unit: 3671

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/Alicia Torres/
Primary Examiner, Art Unit 3671
September 29, 2021

Appendix B7



UNITED STATES PATENT AND TRADEMARK OFFICE

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/694,471	11/25/2019	Derek Sauder (deceased)	US11/105/WO/US-9	5564
88988	7590	10/05/2021		
AGCO Corporation, IP Legal Jeff Ellsworth 420 W. Lincoln Blvd. Hesston, KS 67062			EXAMINER TORRES, ALICIA M	
			ART UNIT 3671	PAPER NUMBER
			NOTIFICATION DATE 10/05/2021	DELIVERY MODE ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

patents@agcocorp.com

DETAILED ACTION

Notice of Pre-AIA or AIA Status

1. The present application is being examined under the pre-AIA first to invent provisions.

Claim Objections

2. Claim 5 is objected to because of the following informalities: line 2, “self-centring” should be changed to –self-centering—. Appropriate correction is required.

Claim 6 is objected to because of the following informalities: line 3, “self-centred” should be changed to –self-centered—. Appropriate correction is required.

Claim 17 is objected to because of the following informalities: line 12, “another” should be changed to –another;—. Appropriate correction is required.

Claim Rejections - 35 USC § 112

3. The following is a quotation of the first paragraph of 35 U.S.C. 112(a):

(a) IN GENERAL.—The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same, and shall set forth the best mode contemplated by the inventor or joint inventor of carrying out the invention.

The following is a quotation of the first paragraph of pre-AIA 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same, and shall set forth the best mode contemplated by the inventor of carrying out his invention.

4. Claims 1-32 are rejected under 35 U.S.C. 112(a) or 35 U.S.C. 112 (pre-AIA), first paragraph, as failing to comply with the written description requirement. The claim(s) contains

subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor or a joint inventor, or for applications subject to pre-AIA 35 U.S.C. 112, the inventor(s), at the time the application was filed, had possession of the claimed invention:

5. The claims recite “a thrust-bearing element”. However, this specific type of bearing has not been disclosed throughout the continuation (CON) chain of applications. The limitations requiring a thrust-bearing element therefore comprise new subject matter.

6. The following is a quotation of 35 U.S.C. 112(b):
(b) CONCLUSION.—The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the inventor or a joint inventor regards as the invention.

The following is a quotation of 35 U.S.C. 112 (pre-AIA), second paragraph:
The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

7. Claims 11-16 are rejected under 35 U.S.C. 112(b) or 35 U.S.C. 112 (pre-AIA), second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which the inventor or a joint inventor (or for applications subject to pre-AIA 35 U.S.C. 112, the applicant), regards as the invention:

8. The phrase “at least one feature according to claim X”, used in claims 11-16, renders the claims the indefinite as it is unclear which “feature” of the claims the phrase is referring to.

9. Claims 26-32 are rejected under 35 U.S.C. 112(b) or 35 U.S.C. 112 (pre-AIA), second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which the inventor or a joint inventor (or for applications subject to pre-AIA 35 U.S.C. 112, the applicant), regards as the invention:

10. Regarding claim 26, the phrase "of the type" renders the claim(s) indefinite because the claim(s) include(s) elements not actually disclosed (those encompassed by "of the type"), thereby rendering the scope of the claim(s) unascertainable.

Claim Rejections - 35 USC § 102

11. The following is a quotation of the appropriate paragraphs of pre-AIA 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(a) the invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for a patent.

12. Claim(s) 1-32 is/are rejected under pre-AIA 35 U.S.C. 102(a) as being anticipated by Bragatto WO 2012/062876 A1.

13. **Independent Claim 1:** Bragatto discloses a seed distribution element for precision pneumatic seed drills, comprising:

a sowing disc (16) which is rotated by a motor-driven transmission drive shaft (20) at controlled speed (page 4, line 24-page 5, line 1);

a housing (10) with a fixed portion (11) and a portion (12) which is movable relative to the fixed portion and can be closed against the fixed portion;

a seed collection chamber (15) being defined in the fixed portion;

a pneumatic suction chamber (17) being defined in the movable portion;

the sowing disc being interposed between the fixed and movable portions and having opposed surfaces (16a, 16b) delimiting the chambers (as seen in Fig. 1);

the sowing disc having at least one ring of selector holes (23) extending between the opposed surfaces; and

a seal (24) which is arranged on the movable portion and is capable of sliding contact with the facing surface of the disc when the fixed and movable portions are closed against one another (page 5, lines 9-11);

wherein a pressure differential is provided between the opposed surfaces in the region of a circumferential segment of the ring of holes (page 4, lines 19-23);

wherein the seed distribution element further comprises a thrust-bearing element (26) of the sowing disc, which thrust-bearing element is supported rotatably in the movable portion in order to withstand at least some of the axial load produced by the disc on the seal (see Fig. 1, page 5; lines 21-23; page 6, lines 8-13), as per claim 1.

14. **Dependent Claims 2-7:** Bragatto discloses wherein the thrust-bearing element (26) is rotated with the disc (page 6, lines 8-13) when the fixed (11) and movable (12) portions are closed against one another, as per claim 2;

wherein the thrust-bearing element (26) comprises a thrust-bearing plate (31) which can bear on that surface (16a) of the sowing disc (16) which faces the seal (24), in a zone radially inside of the ring of holes (23, see Fig. 1), as per claim 3;

wherein the thrust-bearing element (26) comprises a drive element (32) which is fixed for rotation with the plate (31) and can be coupled with the drive shaft (20) of the disc (16) when the fixed (11) and movable (12) portions are closed against one another (page 6, lines 8-13), as per claim 4;

wherein the drive element (32) is self-centring relative to the drive shaft (20, page 6, lines 10-13), as per claim 5;

wherein the drive element (32) comprises a coupling member ("coupling device" not shown, see page 6, lines 10-11) which rotates jointly with the thrust-bearing plate (31) but has radial and/or circumferential clearance so as to be self-centred during rotational coupling with the drive shaft (20) of the disc (16, page 6, lines 8-13), as per claim 6;

wherein the movable portion (12) is hinged (12a, 13) to the fixed portion (11), as per claim 7.

15. **Independent Claim 8:** Bragatto discloses a sowing element (2) for precision seed drills (3) comprising a frame (6) on which a seed distribution element according to claim 1 (as rejected by Bragatto above) is mounted, as per claim 8.

16. **Independent Claim 9:** Bragatto discloses a seed drill (3) comprising a supporting structure (8) on which a plurality of sowing elements (2) according to claim 8 (as rejected by Bragatto above) are mounted, as per claim 9.

17. **Independent Claim 10:** Bragatto discloses a kit for the retrofitting of seed distribution elements of precision pneumatic seed drills wherein the distribution elements are of the type including:

a sowing disc (16) which is rotated by a motor-driven transmission drive shaft (20) at controlled speed (page 4, line 24-page 5, line 1);

a housing (10) with a fixed portion (11) and a portion (12) which is movable relative to the fixed portion and can be closed against the fixed portion;

a seed collection chamber (15) being defined in the fixed portion;

a pneumatic suction chamber (17) being defined in the movable portion;

the sowing disc being interposed between the fixed and movable portions and having opposed surfaces (16a, 16b) delimiting the chambers (as seen in Fig. 1);

the sowing disc having at least one ring of selector holes (23) extending between the opposed surfaces; and

a seal (24) which is arranged on the movable portion and is capable of sliding contact with the facing surface of the disc when the portions are closed against one another (page 5, lines 9-11);

wherein a pressure differential is provided between the opposed surfaces in the region of a circumferential segment of the ring of holes (page 4, lines 19-23);

wherein the kit comprises the movable portion pre-assembled with a thrust-bearing element (26) of the sowing disc, which thrust-bearing element is supported rotatably in the movable portion in order to withstand at least some of the axial load produced by the disc on the seal (see Fig. 1; page 5, lines 21-23; page 6, lines 8-13), as per claim 10.

18. **Dependent Claims 11-16:** Bragatto further discloses wherein the movable portion (12) and the thrust-bearing element (26) comprise at least one feature according to claim 2 (as rejected by Bragatto above), as per claim 11;

wherein the movable portion (12) and the thrust-bearing element (26) comprise at least one feature according to claim 3 (as rejected by Bragatto above), as per claim 12;

wherein the movable portion (12) and the thrust-bearing element (26) comprise at least one feature according to claim 4 (as rejected by Bragatto above), as per claim 13;

wherein the movable portion (12) and the thrust-bearing element (26) comprise at least one feature according to claim 5 (as rejected by Bragatto above), as per claim 14;

wherein the movable portion (12) and the thrust-bearing element (26) comprise at least one feature according to claim 6 (as rejected by Bragatto above), as per claim 15;

wherein the movable portion (12) and the thrust-bearing element (26) comprise at least one feature according to claim 7 (as rejected by Bragatto above), as per claim 16.

19. **Independent Claim 17:** Bragatto discloses a seed meter for an agricultural planter, said seed meter comprising:

a seed disc (16) which is rotated by a motor-driven shaft (20) at controlled speed (page 4, line 24-page 5, line 1);

a meter housing (10) with a fixed portion (11) and a portion (12) which is movable relative to the fixed portion and can be closed against the fixed portion;

a seed pool area (15) being defined in the fixed portion;

a vacuum area (17) defined in the movable portion;

the seed disc being interposed between the fixed and movable portions and having opposed surfaces (16a, 16b) delimiting the seed pool area from the vacuum area (seen in Fig. 1);

the seed disc having at least one ring of seed apertures (23) extending between the opposed surfaces; and

a seal (24) which is arranged on the movable portion and is capable of sliding contact with the facing surface of the disc when the fixed and movable portions are closed against one another (page 5, lines 9-11);

wherein a pressure differential is provided between the opposed surfaces in the region of a circumferential segment of the ring of seed apertures (page 4, lines 19-23);

wherein the seed meter further comprises a thrust-bearing element (26) of the seed disc, which thrust-bearing element is supported rotatably in the movable portion in order to withstand at least some of the axial load produced by the disc on the seal (Fig. 1; page 5, lines 21-23; page 6, lines 8-13), as per claim 17.

20. **Dependent Claims 18-23:** Bragatto further discloses wherein the thrust-bearing element (26) is rotated with the disc (16, page 6, lines 8-13) when the fixed (11) and movable (12) portions are closed against one another, as per claim 18;

wherein the thrust-bearing element (26) comprises a thrust-bearing plate (31) which can bear on that surface (16a) of the seed disc (16) which faces the seal (24), in a zone radially inside of the ring of seed apertures (23, seen in Fig. 1), as per claim 19;

wherein the thrust-bearing element (26) comprises a drive element (32) which is fixed for rotation with the plate (31) and can be coupled with the shaft (20) of the disc (16) when the fixed (11) and movable (12) portions are closed against one another (page 6, lines 8-13), as per claim 20;

wherein the drive element (32) is centered relative to the shaft (20, page 6, lines 10-13), as per claim 21;

wherein the drive element (32) comprises a coupling member ("coupling device" not shown, page 6, lines 10-11) which rotates jointly with the thrust-bearing plate (31), as per claim 22;

wherein the movable portion (12) is mechanically coupled (via 12a, 13) to the fixed portion (11), as per claim 23.

21. **Independent Claim 24:** Bragatto discloses an agricultural planter (3) comprising a frame (6) on which a seed meter (1) according to claim 17 (as rejected by Bragatto above) is mounted, as per claim 24.

22. **Independent Claim 25:** Bragatto discloses an agricultural planter (3) including a supporting structure (8) on which a plurality of seed meters (1) according to claim 24 (as rejected by Bragatto above) are mounted, as per claim 25.

23. **Independent Claim 26:** Bragatto discloses an assembly for a seed meter of an agricultural planter wherein the seed meter is of the type including:

a seed disc (16) which is rotated by a motor-driven shaft (20) at controlled speed (page 4, line 24-page 5, line 1);

a meter housing (10) with a fixed portion (11) and a portion (12) which is movable relative to the fixed portion and can be closed against the fixed portion;

a seed pool area (15) being defined in the fixed portion;

a vacuum area (17) defined in the movable portion;

the seed disc being interposed between the fixed and movable portions and having opposed surfaces (16a, 16b) delimiting the seed pool area from the vacuum area (as seen in Fig. 1);

the seed disc having at least one ring of seed apertures (23) extending between the opposed surfaces; and

a seal (24) which is arranged on the movable portion and is capable of sliding contact with the facing surface of the disc when the fixed and movable portions are closed against one another (page 5, lines 9-11);

wherein a pressure differential is provided between the opposed surfaces in the region of a circumferential segment of the ring of seed apertures (page 4, lines 19-23);

wherein the assembly comprises, in said movable portion, a thrust-bearing element (26) of the seed disc, which thrust-bearing element is supported rotatably in the movable portion in order to withstand at least some of the axial load produced by the disc on the seal (Fig. 1; page 5, lines 21-23; page 6, lines 8-13), as per claim 26.

24. **Dependent Claims 27-32:** Bragatto further discloses wherein the thrust-bearing element (26) is rotated with the disc (16, page 6, lines 8-13) when the fixed (11) and movable (12) portions are closed against one another, as per claim 27;

wherein the thrust-bearing element (26) comprises a thrust-bearing plate (31) which can bear on that surface (16a) of the seed disc (16) which faces the seal (24), in a zone radially inside of the ring of seed apertures (23, see Fig. 1), as per claim 28;

wherein the thrust-bearing element (26) comprises a drive element (32) which is fixed for rotation with the plate (31) and can be coupled with the shaft (20) of the disc (16) when the fixed

(11) and movable (12) portions are closed against one another (page 6, lines 8-13), as per claim 29;

wherein the drive element (32) is centered relative to the shaft (20, page 6, lines 10-13), as per claim 30;

wherein the drive element (32) comprises a coupling member ("coupling device" not shown, see page 6, lines 10-11) which rotates jointly with the thrust-bearing plate (31), as per claim 31;

wherein the movable portion (12) is mechanically coupled (via 12a, 13) to the fixed portion (11), as per claim 32.

Conclusion

25. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Please see the attached PTO-892.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Alicia M. Torres whose telephone number is 571-272-6997. The examiner's fax number is 571-273-6997. The examiner can normally be reached Monday through Friday from 9:00 a.m. – 5:30 p.m EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Thomas B. Will, can be reached at (571) 272-6998.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the group receptionist whose telephone number is 571-272-3600. The fax number for this Group is 571-273-8300.

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/Alicia Torres/
Primary Examiner, Art Unit 3671
September 29, 2021

AMENDMENTS TO THE CLAIMS

Claims 1-16 (Canceled)

17. (Currently Amended) A seed meter for an agricultural planter, said seed meter comprising:

- a seed disc which is ~~rotated by a motor driven shaft~~ rotatable at controlled speed;
- a meter housing with a fixed portion and a portion which is movable relative to the fixed portion and can be closed against the fixed portion;
- a seed pool area being defined in the fixed portion;
- a vacuum area defined in the movable portion;
- the seed disc being interposed between the fixed and movable portions and having opposed surfaces delimiting the seed pool area from the vacuum area;
- the seed disc having at least one ring of seed apertures extending between the opposed surfaces; and

- a seal which is arranged on the movable portion and is capable of sliding contact with the ~~fac~~ing surface of the seed disc facing the seal when the fixed and movable portions of the housing are closed against one another;

- wherein a pressure differential is provided between the opposed surfaces in the region of a circumferential segment of the ring of seed apertures;

- wherein the ~~seed meter further comprises a thrust bearing element of the seed disc, which thrust bearing element~~ seed disc is supported rotatably in the movable portion of the housing by a shaft coupled to bearings held in place by the movable portion of the housing in order to withstand at least some of the axial load produced by the disc on the seal.

18. (Currently Amended) The seed meter according to claim 17, wherein the ~~thrust bearing element is rotated~~ shaft rotates with the seed disc when the fixed and movable portions of the housing are closed against one another.

19. (Currently Amended) The seed meter according to claim 17, ~~wherein the thrust bearing element comprises a thrust bearing plate which can bear on that surface of the seed disc which faces~~ further including a drive plate coupled to and rotatable with the shaft, the

drive plate releasably coupled to the seed disc on the surface facing the seal, in a zone radially inside of the ring of seed apertures.

20. (Currently Amended) The seed meter according to claim 19, wherein the ~~thrust bearing element comprises a drive element which is fixed for rotation with the plate and can be coupled with seed disc is rotated by a driven shaft operably coupled to the shaft of the disc when the fixed and movable portions are closed against one another.~~

21. (Currently Amended) The seed meter according to claim ~~20~~ 19, wherein the ~~drive element is centered relative to the shaft~~ seed disc is rotated by a driven gear engaging with drive teeth on the seed disc when the fixed and movable portions are closed against one another.

22. (Canceled)

23. (Currently Amended) The seed meter according to claim 17, wherein the movable portion of the housing is mechanically coupled to the fixed portion of the housing.

24. (Original) An agricultural planter comprising a frame on which a seed meter according to claim 17 is mounted.

25. (Currently Amended) An agricultural planter including a supporting structure on which a plurality of seed meters according to claim ~~24~~ 17 are mounted.

26. (Currently Amended) An assembly for a seed meter of an agricultural planter wherein the seed meter ~~is of the type including~~ comprises:

- a seed disc ~~which is rotated by a motor driven shaft~~ rotatable at controlled speed;
- a meter housing with a fixed portion and a portion which is movable relative to the fixed portion and can be closed against the fixed portion;
- a seed pool area being defined in the fixed portion;
- a vacuum area defined in the movable portion;
- the seed disc being interposed between the fixed and movable portions and having opposed surfaces delimiting the seed pool area from the vacuum area;
- the seed disc having at least one ring of seed apertures extending between the opposed surfaces; and

a seal which is arranged on the movable portion and is capable of sliding contact with the ~~face~~ surface of the seed disc facing the seal when the fixed and movable portions of the housing are closed against one another;

wherein a pressure differential is provided between the opposed surfaces in the region of a circumferential segment of the ring of seed apertures;

wherein the assembly comprises, in said movable portion of the housing, ~~a thrust-bearing element of the seed disc, which thrust-bearing element is supported rotatably in the movable portion of the housing by a shaft coupled to bearings held in place by the movable portion of the housing in order to withstand at least some of the axial load produced by the disc on the seal.~~

27. (Currently Amended) The seed meter assembly according to of claim 26 wherein the ~~thrust-bearing element is rotated~~ shaft rotates with the seed disc when the fixed and movable portions of the housing are closed against one another.

28. (Currently Amended) The seed meter assembly according to of claim 26, wherein the ~~thrust-bearing element comprises a thrust-bearing plate which can bear on that surface of the seed disc which faces~~ further including a drive plate coupled to and rotatable with the shaft, the drive plate releasably coupled to the seed disc on the surface facing the seal, in a zone radially inside of the ring of seed apertures.

29. (Currently Amended) The seed meter assembly according to of claim 26, wherein the ~~thrust-bearing element comprises a drive element which is fixed for rotation with the plate and can be coupled with~~ seed disc is rotated by a driven shaft operably coupled to the shaft of the disc when the fixed and movable portions are closed against one another.

30. (Currently Amended) The seed meter assembly according to claim 29 ~~26~~, wherein the ~~drive element is centered relative to the shaft~~ seed disc is rotated by a driven gear engaging with drive teeth on the seed disc when the fixed and movable portions are closed against one another.

31. (Currently Amended) The seed meter assembly according to of claim 29 wherein the ~~drive element comprises a coupling member which rotates jointly with the thrust-bearing plate~~ driven shaft is coupled to an adapter mounted to the shaft.

32. (Currently Amended) The seed meter assembly ~~according to~~ of claim 26 wherein the movable portion of the housing is mechanically coupled to the fixed portion of the housing.

Appendix C

Curriculum Vitae

DAVIDE LOCAS

Nationality: Italian

Address: Via Miraglia 29 - 30173 - Venice, Mestre, Italy

Date and place of birth: Venice, Italy, 28/08/1976

Contacts: telephone: +39 3471301652 (mobile)
e-mail: d.locas@cantaluppi.com

PROFILE

Almost 20 years experienced in intellectual property, with a full vision of all different areas. Member of the management team for more than 9 years and directly involved in everyday managing as well as in key decisions.

WORK EXPERIENCE

June 2010 - Cantaluppi & Partners S.r.l.

Today

During my years in Cantaluppi & Partners I had the occasion to advise clients in all aspects of Intellectual Property: prior art searches, opinions, freedom to operate analysis, patent drafting, patent prosecution in Italy, Europe and in foreign countries together with our local associates. I also deal with post grant procedure, in particular EPO oppositions and court litigation.

My clients range from single inventors to small and medium enterprises, from local companies to international clients.

Member of the board of administrators since 2015, I manage the firm in all different aspect, in particular human resources, business organization, organization of each office departments (patent, trademark, accounting, IT), relationship

with clients and with foreign associates. As INTA member I attend the INTA annual meeting every year.

More in general I am involved in all decision of the board, including key decisions, such as new acquisitions or admission of new partners.

Since 2017 I am also board member of the firm Ing. Dallaglio S.r.l., which has been acquired by Cantaluppi & Partners S.r.l. in the same year. I was entrusted with the reorganization of the firm after the main partner retired. My tasks included strengthening the relation with the existing clients, finding new clients and in general improving the reputation of the firm. In five years, turnover of the firm has almost doubled.

Feb. 2007 -

Studio Associato Leone & Spadaro

Jun. 2010

During this work experience I started the office in Padova of the firm Leone & Spadaro, which is now merged with Cantaluppi & Partners. The firm was originally based in Rome, and I was asked to start a new office in North Italy. My task was to find new clients and new business opportunity in addition to dealing with the patent and trademark portfolio of our existing clients.

Jan. 2004 -

Società Italiana Brevetti S.p.A.

2007

My experience and education in Intellectual property started in the Rome office of Società Italiana Brevetti. After a first internship period, I move to the Verona Office of the firm where I was the only patent attorney and I had full responsibility of the local clients.

Mar. 2003 - University of Padua - Department of Mechanical Engineering
Dec.2003

Research fellow for the Machine Design Research Group

PROFESSIONAL QUALIFICATIONS

European Patent and Trademark Attorney

European Patent Litigator

Court Expert for the Court of Venice and for the Court of Trieste

University of Padua: MSc degree in Mechanical Engineering (2003)

PERSONAL SKILLS

Languages

Fluent in English

Italian (mother tongue)

Appendix D

Claim Comparison for 3 patents granted to Precision both in the U.S. and Europe

EP3376845	US10743458
1. A closing wheel assembly (320), comprising: a subframe (350); a pair of closing wheels (322) with one closing wheel disposed on each side of said subframe (350) and disposed to close a planting trench (38); and a soil-loosening assembly (310) disposed on said subframe (350) ahead of said closing wheels (322) in a direction of travel of said closing wheel assembly (320) and disposed to loosen soil (40) adjacent to said planting trench (38), characterised in that each closing wheel (322) is mounted to a rearward end of a pivot arm (324), and each pivot arm is mounted to said subframe (350) at a forward end of each pivot arm (324), and in that the soil-loosening assembly (310) includes a pair of support arms (314) rigidly mounted to opposing sides of the subframe (350), and a pair of soil-loosening devices (312) each mounted to a lower end of the support arms (314).	1. A closing wheel assembly, comprising: a subframe; a first pivot arm and a second pivot arm, each mounted to the subframe at forward ends of the pivot arms, wherein each pivot arm comprises a prong rigidly mounted thereto; a first closing wheel disposed on a first side of the subframe and mounted on a rearward end of the first pivot arm; a second closing wheel disposed on a second side of the subframe and mounted on a rearward end of the second pivot arm, wherein the first and second closing wheels are disposed to close a planting trench; a biasing assembly configured to bias the first and second closing wheels to soil, wherein the biasing assembly comprises: a pivoting adjustment bar oriented transverse to a direction of travel of the closing wheel assembly; a first spring attached to the prong of the first pivot arm and to a first lateral end of the pivoting adjustment bar; and a second spring attached to the prong of the second pivot arm and to a second lateral end of the pivoting adjustment bar; wherein the adjustment bar pivots about a central portion thereof such that the lateral ends are enabled to pivot about the central portion, such that the first and second closing wheels are enabled to pivot independently and vertically displace relative to one another; and a soil-loosening assembly mounted to the subframe ahead of the closing wheels in a direction of travel of the closing wheel assembly and disposed to loosen soil adjacent to the planting trench.

EP2911494	US11140810
1. A seed firmer (100) adapted to be mounted to an agricultural row unit (10), said seed firmer comprising: a resilient body (102), having an upper portion (110), a central portion (120) and a lower portion (130), wherein said central portion of said resilient body is configured to bend resiliently about a horizontal axis to permit deflection of said lower portion relative to said upper portion of said resilient body; said seed firmer being characterized by a resilient insert (150), having a housed portion housed inside of said resilient body, said housed portion extending through said central portion of said resilient body, wherein said resilient insert has a greater effective stiffness than said central portion of said resilient body.	1. A seed firmer and bracket combination for a planter row unit, the planter row unit having a frame member disposed forward of seeds being deposited into a seed trench formed in a soil surface by the row unit as the row unit advances in a forward direction of travel, the combination comprising: a bracket comprising a forward end and a rearward end, said forward end configured to mount to the frame member of the planter row unit, said rearward end extending rearward from the forward end, said rearward end having a forward surface and a back surface; a seed firmer comprising a body having an upper portion, a lower portion, and a resiliently flexible central portion between said upper portion and said lower portion, said upper portion releasably received between said forward surface and said back surface of said rearward end of said bracket such that said central portion and said lower portion extend downwardly and rearwardly from said bracket, said upper portion including a resiliently flexible rearwardly extending upper arm and a rigid rearwardly extending lower arm, said upper arm including a downwardly projecting lip, said lower arm including an upward facing seat, wherein a top edge of said back surface of said bracket engages with said lip and a bottom edge of said back surface engages with said seat, whereby said upper portion of said firmer is restrained from moving vertically and horizontally relative to said bracket, until said resiliently flexible upper arm is pushed upwardly disengaging said lip from said top edge of said back surface.

EP3742882	US11903378
1. A fluid system for applying fluid to an agricultural field comprising: a pump (1256) for pumping fluid from a storage tank (1290) of an agricultural implement (1240) through at least one fluid line (715, 716); and a pressure measurement module (1000, 700) in fluid communication with the pump (1256) for measuring inlet and outlet pressure, the pressure measurement module comprising: an inlet pressure port (1010, 710) having a connection (1040-1) for fluid communication to a fluid line (715) before a filter (750) and the inlet pressure port (1010, 710) comprising a first pressure sensor (1050-1, 711); an outlet pressure port (1020, 720) having a connection (1040-2) for fluid communication to a fluid line (716) after the filter (750) and the outlet pressure port (1020, 720) comprising a second pressure sensor (1050-2, 721); and at least one signal port (1110, 1120) disposed in the module (1000, 700), wherein the first pressure sensor (1050-1, 711) and the second pressure sensor (1050-2, 721) during operation are in signal communication with the at least one signal port (1110, 1120), characterized in that the fluid system is configured to calibrate the pressure measurement module (1000, 700) when the pump (1256) is not operating to generate pressure in the fluid system.	1. A pressure measurement module for measuring inlet and outlet pressure comprising: a body of the pressure measurement module; an inlet pressure port disposed in the body for fluid communication to a fluid line before a filter and the inlet pressure port comprising a first pressure sensor; an outlet pressure port disposed in the body for fluid communication to a fluid line after the filter and the outlet pressure port comprising a second pressure sensor; and at least one signal port disposed in the body of the pressure measurement module and communicatively coupled to a fluid application system, wherein the first pressure sensor and the second pressure sensor during operation are communicatively coupled with the at least one signal port.