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(54) Title: ADJUSTABLE GATE FOR FLUTED METERING WHEEL SYSTEMS

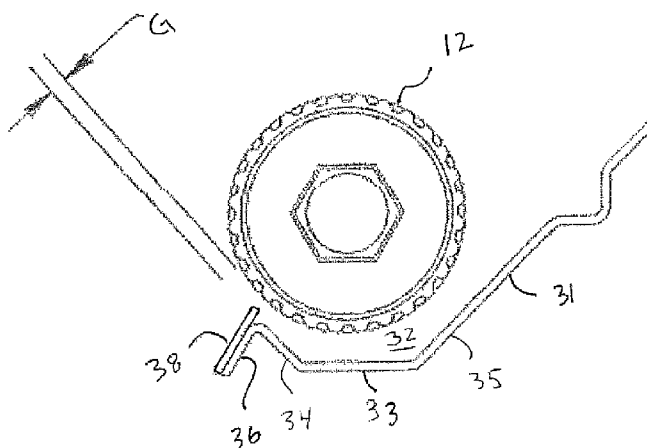


FIG. 3

(57) Abstract: A hopper assembly (10) for an agricultural fertilizer spreader includes a hopper (14, 16) for holding an agricultural product to be dispersed onto a field. The hopper assembly has a metering wheel (12) with a plurality of fluted cylinder sections (22) alternatingly interspaced with a plurality of blank cylinder sections (24) configured to receive agricultural product from the hopper. The hopper assembly has a metering housing (31) in which the metering wheel rotates, the metering housing forming a reservoir (32) under the metering wheel, wherein the metering housing has an angled flange (36) along one transverse edge. The hopper assembly has a metering gate (38) fastened on the angled flange and a gate retaining mechanism (40) configured to fasten the metering gate to the angled flange, wherein the metering gate can be adjusted to vary the width of a gap (G) between a proximal edge of the metering gate and the metering wheel.



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ADJUSTABLE GATE FOR FLUTED METERING WHEEL SYSTEMS

BACKGROUND OF THE INVENTION

Field of Invention

[0001] This invention relates to a metering system for an agricultural vehicle, and in particular to an apparatus for “low rate” metering of seed or other particles from a hopper of the metering system.

Description of Related Art

[0002] An air spreader is commonly used in automated planting operations. The air spreader carries fertilizer and possibly other chemicals in one or more reservoirs in communication with a pneumatic conveyance system. The pneumatic conveyance system uses air flow at such a velocity that the fertilizer is entrained into the air stream and is thereby conveyed through a fertilizer tube. Metering mechanisms control the flow of fertilizer to the pneumatic conveyance system to control the rate of application of fertilizer to the ground.

[0003] Fertilizer spreaders equipped with a micro-nutrient bin and metering system can spread both fertilizer and micro-nutrients (such as zinc, boron, iron, manganese, etc.). These micro-nutrients are typically applied at very low rates (such as between 2 and 200 lb/ac) and so are metered using different mechanisms than typical fertilizers like Nitrogen, Phosphorus or Potassium which require higher applied rates. For example, a typical fertilizer metering system may be a conveyor or an auger and apply at rates between 30 and 1200 lb/ac.

[0004] In a standard metering system, a fluted cylinder is provided, having valleys between raised ridges. Particles to be metered out from a reservoir are carried in the valleys as the cylinder rotates about a horizontal axis. The dimensions of the valleys are generally much larger than the size of the granules to be metered in order to ensure smooth operation. The valleys are generally spaced uniformly around the cylinder and along a length of the cylinder to distribute granules evenly from the granular distribution system (e.g., hopper). The metering cylinder can be a single unit or can be made of a horizontal stack of cylindrical elements. The number and size of valleys on a given metering cylinder determines the volume of granules metered per revolution of the cylinder. Where a low metering rate is desired, it is conventional to use a metering cylinder having smaller valleys to reduce the volume metered per revolution.

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[0005] A typical micro-nutrient metering system might use fluted wheels or small augers to meter rates between 2 and 200 lbs/ac. In addition to a wide variety of potential application rates there is significant diversity in the physical properties of the micro-nutrients. For example density, particle size, hardness and shape can vary widely from one micro-nutrient product to another. These differences in particle sizes can impact the metering rate (on a per revolution basis) of fluted wheel systems.

[0006] One of the solutions commonly used in the past to apply a wide variety of rates is the use of multiple metering wheel sizes. Multiple metering wheels provide flexibility to the operator to optimize the metering system for the rates that they will be applying at. This is important because the driving motor has a limited speed range which provides optimal performance. The high speed is defined by the motor manufacturer for maximum motor life or can also be dictated by the design of the metering wheel, and the minimum speed is dictated by the minimum speed which the motor can turn without cogging or pulsing. For each metering wheel there is an optimal gap between the housing and the fins of the wheel. This gap is adjusted to optimize the force required to turn (larger gap = less force to turn), and the flow rate uniformity between Products (smaller gap results in more uniform rates between different products).

[0007] Accordingly, the present disclosure describes embodiments of an apparatus and method for metering seed or other particles from a hopper.

SUMMARY

[0008] In one aspect, the invention is directed to a hopper assembly for an agricultural fertilizer spreader. The hopper assembly includes a hopper for holding an agricultural product to be dispersed onto a field. The hopper assembly has a metering wheel with a plurality of fluted cylinder sections alternately interspaced with a plurality of blank cylinder sections configured to receive agricultural product from the hopper. The hopper assembly has a metering housing in which the metering wheel rotates, the metering housing forming a reservoir under the metering wheel, wherein the metering housing has an angled flange along one transvers edge. A metering gate is adjustably fastened on the angled flange with a gate retaining mechanism configured to adjustably fasten the metering gate to the angled flange. The gate retaining mechanism is

configured to position the metering gate so as to selectably set a width of a gap between a proximal edge of the metering gate and the metering wheel.

[0009] This summary is provided to introduce concepts in simplified form that are further described below in the Detailed Description. This summary is not intended to identify key features or essential features of the disclosed or claimed subject matter and is not intended to describe each disclosed embodiment or every implementation of the disclosed or claimed subject matter. Specifically, features disclosed herein with respect to one embodiment may be equally applicable to another. Further, this summary is not intended to be used as an aid in determining the scope of the claimed subject matter. Many other novel advantages, features, and relationships will become apparent as this description proceeds. The figures and the description that follow more particularly exemplify illustrative embodiments.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] The disclosed subject matter will be further explained with reference to the attached figures, wherein like structure or system elements are referred to by like reference numerals throughout the several views;

[0011] FIG. 1 is a partial perspective front and top view of a hopper assembly incorporating an exemplary embodiment of a fluted metering wheel of the present disclosure.

[0012] FIG. 2 is a perspective view of the fluted metering wheel, removed from the assembly of FIG. 1;

[0013] FIG. 3 a side view of a the metering wheel; and

[0014] FIG. 4 is an enlarged perspective view of a portion of an adjustable gate for the metering wheel of FIG. 2.

[0015] While the above-identified figures set forth one or more embodiments of the disclosed subject matter, other embodiments are also contemplated, as noted in the disclosure. In all cases, this disclosure presents the disclosed subject matter by way of representation and not limitation. It should be understood that numerous other modifications and embodiments can be devised by those skilled in the art which fall within the scope and spirit of the principles of this disclosure.

[0016] The figures may not be drawn to scale. In particular, some features may be enlarged relative to other features for clarity. Moreover, where terms such as above, below, over, under,

top, bottom, side, right, left, etc., are used, it is to be understood that they are used only for ease of understanding the description. It is contemplated that structures may be oriented otherwise.

DETAILED DESCRIPTION

[0017] FIG. 1 is a partial perspective front and top view of a hopper assembly 10 used for distributing an agricultural product such as fertilizer granules and incorporates an exemplary embodiment of a metering cylinder or metering wheel 12 of the present disclosure. While no particulate fertilizer product is illustrated, it is to be understood that such product in use would be contained in the hopper assembly 30 and flow downward therefrom. The product would flow onto the disclosed metering wheel 12 as the wheel rotates. The wheel 12 hereby controls the flow rate of the agricultural product from the hopper assembly 10. In an exemplary embodiment, the metering wheel 12 also distributes the product along a length of the metering wheel and divides the product flow into separate product flow streams.

[0018] In an exemplary embodiment, hopper assembly 10 includes a first hopper 14 and a second hopper 16, each with its own metering wheel 12. Desirably, the metering wheels 12 are substantially similar so only one of the metering wheels 12 will be discussed herein in detail. In a typical method of use, the metering wheel 12 rotates in direction 18, as shown in FIG. 1. In an exemplary embodiment, the metering wheel 12 includes a plurality of fluted cylinder sections 22 alternatingly interspaced with a plurality of blank cylinder sections 24.

[0019] As shown in FIG. 2, each of the fluted cylinder sections 22 has a fluted exterior surface including raised protrusions 26 extending radially outward, defining valleys 28 between adjacent protrusions 26. Each of the valleys 28 is sized to accommodate granules, thereby preventing binding of the metering assembly if the granule contacts an edge 20 or other components of hopper assembly 10. Each of the blank cylinder sections 24 has a cylindrical exterior surface. The blank cylinder sections 24 block off corresponding areas of metering wheel 12 from accepting particles, thereby reducing the volume of particles metered with each revolution of the metering wheel 12. Each of the fluted cylinder sections 22 and the blank cylinder sections 24 is alternately positioned on shaft (not shown) so they are rotatably coupled to rotate therewith as the shaft turns with gear 30. While a metering wheel 12 including an assembly of a plurality of alternating fluted cylinder sections 22 and blank cylinder sections 24 is shown, it is contemplated that a metering wheel having similar exterior features can be formed as

a unitary, one-piece cylinder. To reduce the volume of metered granules compared to a standard metering cylinder, a plurality of fluted cylinder sections are positioned among a plurality of blank cylinder sections in an alternating arrangement. In an exemplary embodiment, the fluted cylinder sections are mated to a metering shaft so that they rotate directly with the shaft. In one embodiment, the blank cylinder sections are mated in a similar fashion on the metering shaft for rotation directly with the shaft and the fluted cylinder sections. In another embodiment, the blank cylinder sections are assembled onto the shaft so that they may rotate freely, rather than fixedly with the shaft. The ability to rotate freely may further reduce the probability that parts of the assembly bind when the metering cylinder rotates relative to other components of the metering mechanism.

[0020] Turning also now to FIG. 3, the metering wheel 12 sits in a metering housing 31. In one embodiment, the metering housing 31 comprises of a sheet of material bent to form a reservoir 32 under the metering wheel 12. The reservoir 32 has a floor section 33 and first and second upwardly-extending walls 34, 35. Along one transvers edge of the upwardly-extending wall 34, the metering housing 31 has an angled flange 36. Desirably, the angled flange is formed with a bend in the sheet material used to form the housing 31. Desirably, the upwardly-extending wall and the angled flange form an angle of greater than 180 degrees, and desirably at least 270 degrees, over which the agricultural product flows. Additionally, the angled flange 36 desirably increases the rigidity of the metering housing 31 thereby reducing warping and flex that results in inconsistent gap measurements between the metering housing 31 and the metering wheel 12. Desirably, an operator can change the metering rate of the hopper assembly 10 by such as by changing out the metering wheels 12 with another metering wheel 12 having larger fluted cylinder sections 22 or smaller blank cylinder sections 24, or by moving an axis about which the metering wheel 12 rotates.

[0021] According to the invention, a small adjustable metering gate 38 is bolted or otherwise adjustably affixed on the angled flange 36. The metering gate 38 can be adjusted to vary the width of a gap G between a proximal edge of the metering gate 38 and the metering wheel 12. The gap G is desirably adjustable independent of the axis of the metering wheel 12. In one embodiment, the metering gate 38 is a metallic strip. Alternately, the metering gate 38 may include a brush material or be formed from rubber or other softer material that would inherently deform under force from the micro-nutrients. The metering gate 38 is retained by a gate

retaining mechanism 40. In the illustrated embodiment, the gate retaining mechanism is a plurality of carriage bolts 42 positioned in slots 44 in the metering gate 38. By moving the metering gate 38 up and down in these slots 44, the position of the gate 38 and thereby the relative position of the gate 38 with respect to the metering wheel 12 can be changed. The axis can be set to the proper position for optimal spur gear 30 center to center distance. The metering gate 38 can then be set to optimize the gap G for a given product. Desirably, the metering gate 38 is set by default so that the flow is slightly restricted compared to distance between the metering housing 31 and the metering wheel 12. This allows the operator to open the gap G for larger products or close the gap down for smaller products. This also allows convenient change of the gap when changing metering wheels. Also, the metering gate 38 can be adjusted to keep an even gap along the row of metering wheels 12 even if the metering housing 31 and the metering wheels 12 are not parallel or there is deformation in the metering housing 31. This ensures that the gap G between each metering wheel 12 and the metering housing 31 is the desired distance, which in turn results in more accurate metering across the metering housing 31 to each part of the fertilizer spreader boom.

[0022] As would be understood by one skilled in the art, the metering gate 38 retaining mechanism could also be a knob, a rack and pinion, or pin and linkage for easier adjustment without departing from the scope of the invention. Additionally, control of the gate retaining mechanism can be automated based on particle size or based on reducing the force to turn the wheels by controlling the gate position with a linear actuator (either electric or hydraulic).

[0023] Although the subject of this disclosure has been described with reference to several embodiments, workers skilled in the art will recognize that changes may be made in form and detail without departing from the spirit and scope of the disclosure. In addition, any feature disclosed with respect to one embodiment may be incorporated in another embodiment, and vice-versa.

WHAT IS CLAIMED IS:

1. A hopper assembly for an agricultural fertilizer spreader, the hopper assembly comprising:

a hopper for holding an agricultural product to be dispersed onto a field;

a metering wheel having a plurality of fluted cylinder sections alternatingly interspaced with a plurality of blank cylinder sections

a metering housing in which the metering wheel rotates, the metering housing forming a reservoir under the metering wheel configured to receive agricultural product from the hopper, wherein the metering housing comprises an angled flange along one transvers edge thereof;

a metering gate adjustably fastened on the angled flange; and

a gate retaining mechanism configured to adjustably fasten the metering gate to the angled flange, wherein the gate retaining mechanism is configured to position the metering gate so as to selectably set a width of a gap between a proximal edge of the metering gate and the metering wheel

2. The hopper assembly of Claim 1 wherein each of the plurality of fluted cylinder sections has a fluted exterior surface including raised protrusions extending radially outward defining valleys between adjacent protrusions with each of the valleys configured to accommodate agricultural product and the blank cylinder sections block off corresponding areas of metering wheel from accepting agricultural product, thereby reducing the volume of particles metered with each revolution of the metering wheel.

3. The hopper assembly of Claim 1 wherein the housing forms the reservoir with a floor section and first and second upwardly-extending walls, wherein the angled flange is formed with a bend in sheet material used to form the housing.

4. The hopper assembly of Claim 1 wherein the first upwardly-extending wall and the angled flange form an angle of greater than 180 degrees.

5. The hopper assembly of Claim 1 wherein the first upwardly-extending wall and the angled flange form an angle of greater than 270 degrees over which the agricultural product flows.

6. The hopper assembly of Claim 1 wherein the metering gate is a metallic strip.

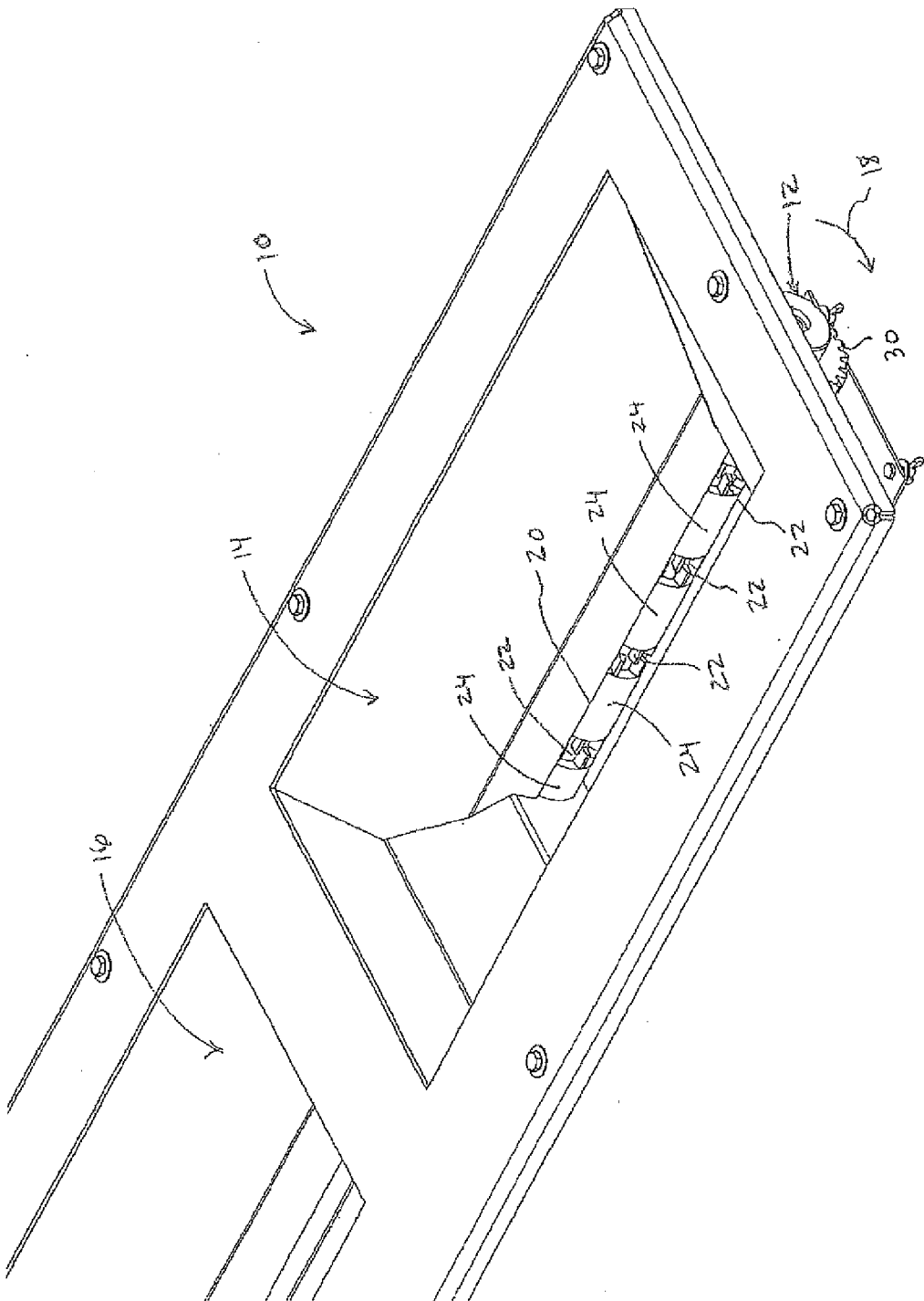


FIG. 1

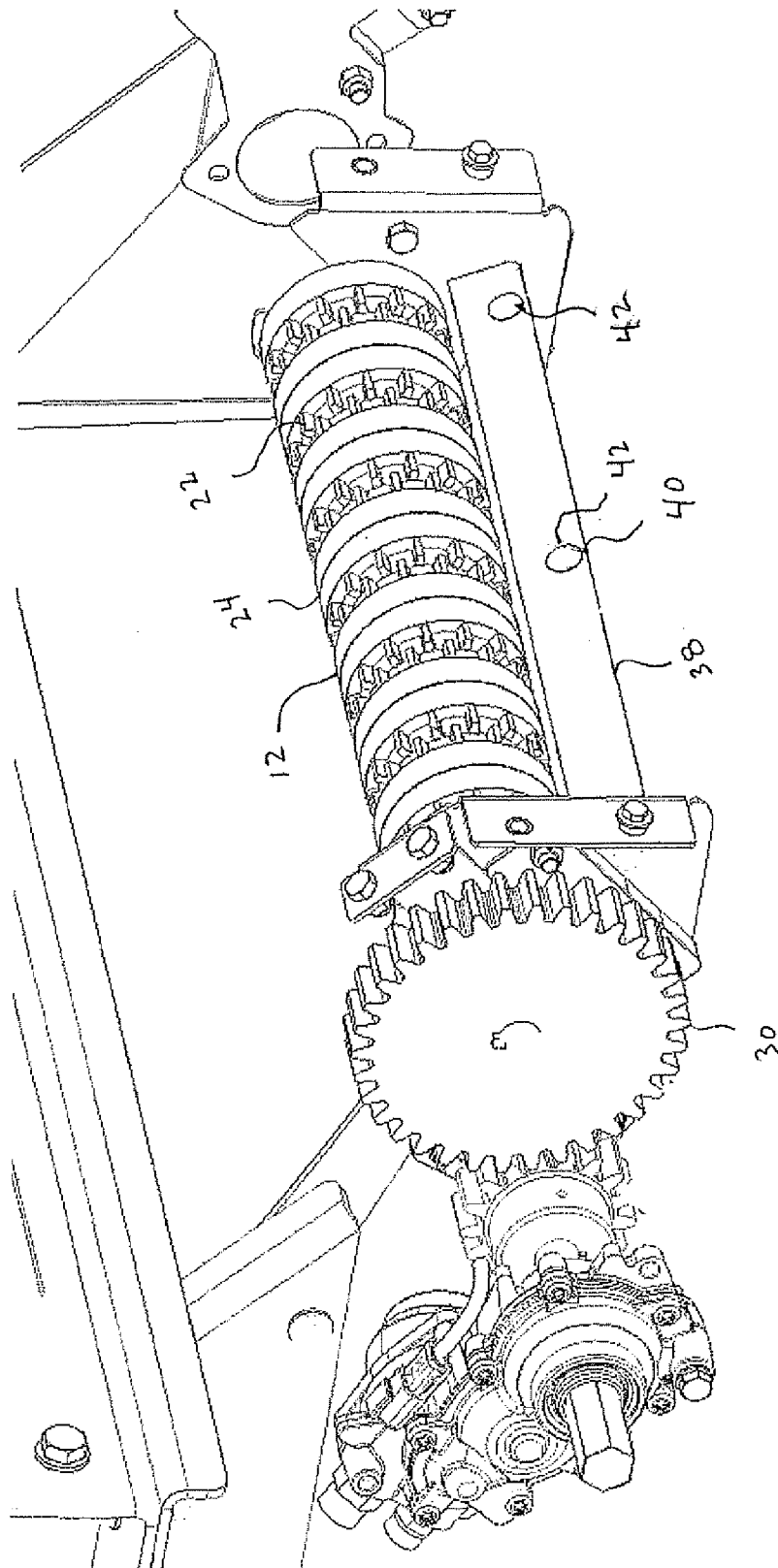


FIG. 2

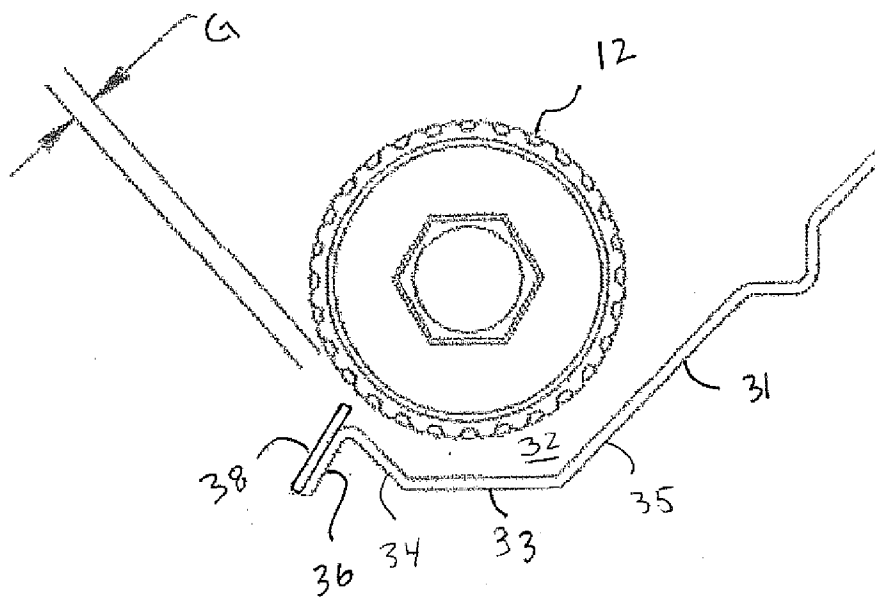


FIG. 3

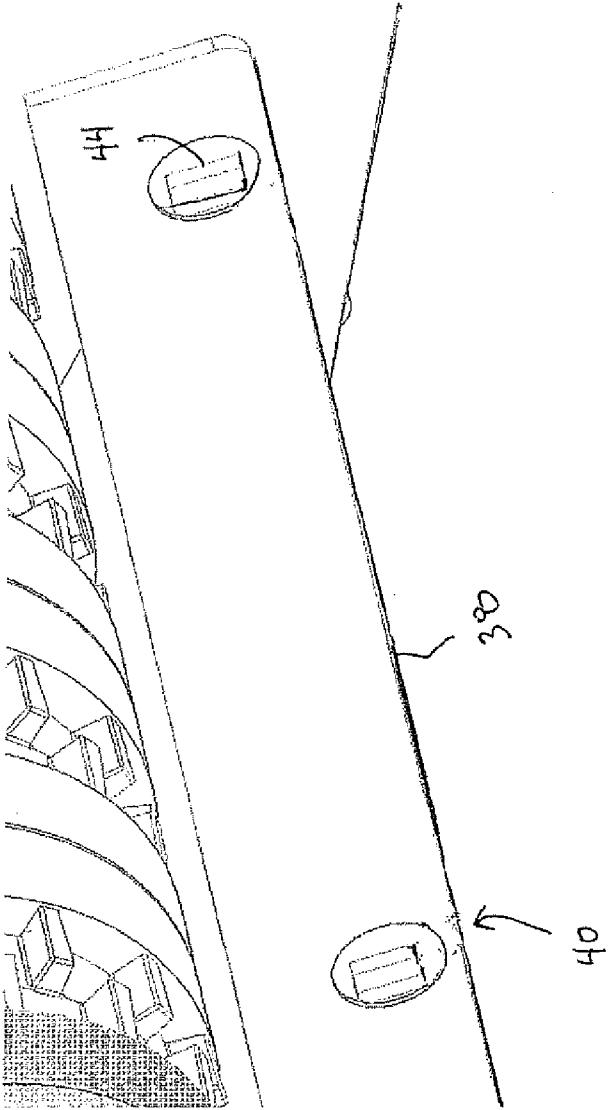


FIG. 4

INTERNATIONAL SEARCH REPORT

International application No

PCT/IB2018/060579

A. CLASSIFICATION OF SUBJECT MATTER

INV. A01C7/12

ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

A01C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	EP 2 786 649 A2 (RAUCH LANDMASCHFAB GMBH [DE]) 8 October 2014 (2014-10-08) figures 1,2,10,11,15b paragraphs [0030], [0032], [0043], [0044] -----	1-6
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Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

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"&" document member of the same patent family

Date of the actual completion of the international search

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INTERNATIONAL SEARCH REPORT

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INTERNATIONAL SEARCH REPORT

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