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(54) ADJUSTABLE SPINNER FOR A PARTICULATE MATERIAL SPREADER

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Publication Classification

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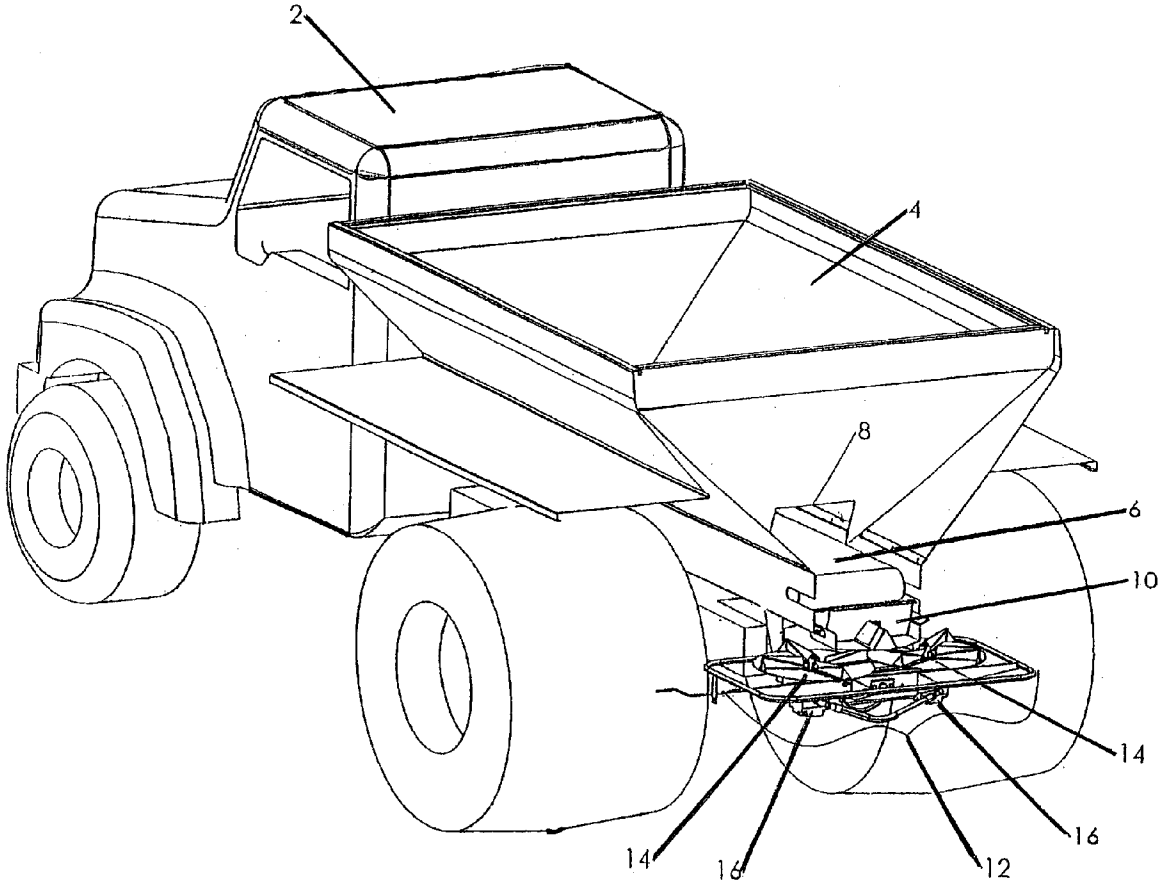
(52) **U.S. Cl.** **239/667**

(57) **ABSTRACT**

An improved particulate material spreader includes an adjustable spinner apparatus which is incrementally adjustable forwardly and rearwardly to a plurality of operating positions relative to the discharge end of the material conveyor. The adjustment may be manual or automatic to adjust the drop point of the material onto the spinners, thereby accommodating varying application rates of the particulate material on a field, lawn, road, or other area. The spreader may be operatively connected to a microprocessor to receive data input and sensor feedback for variable rate technology.



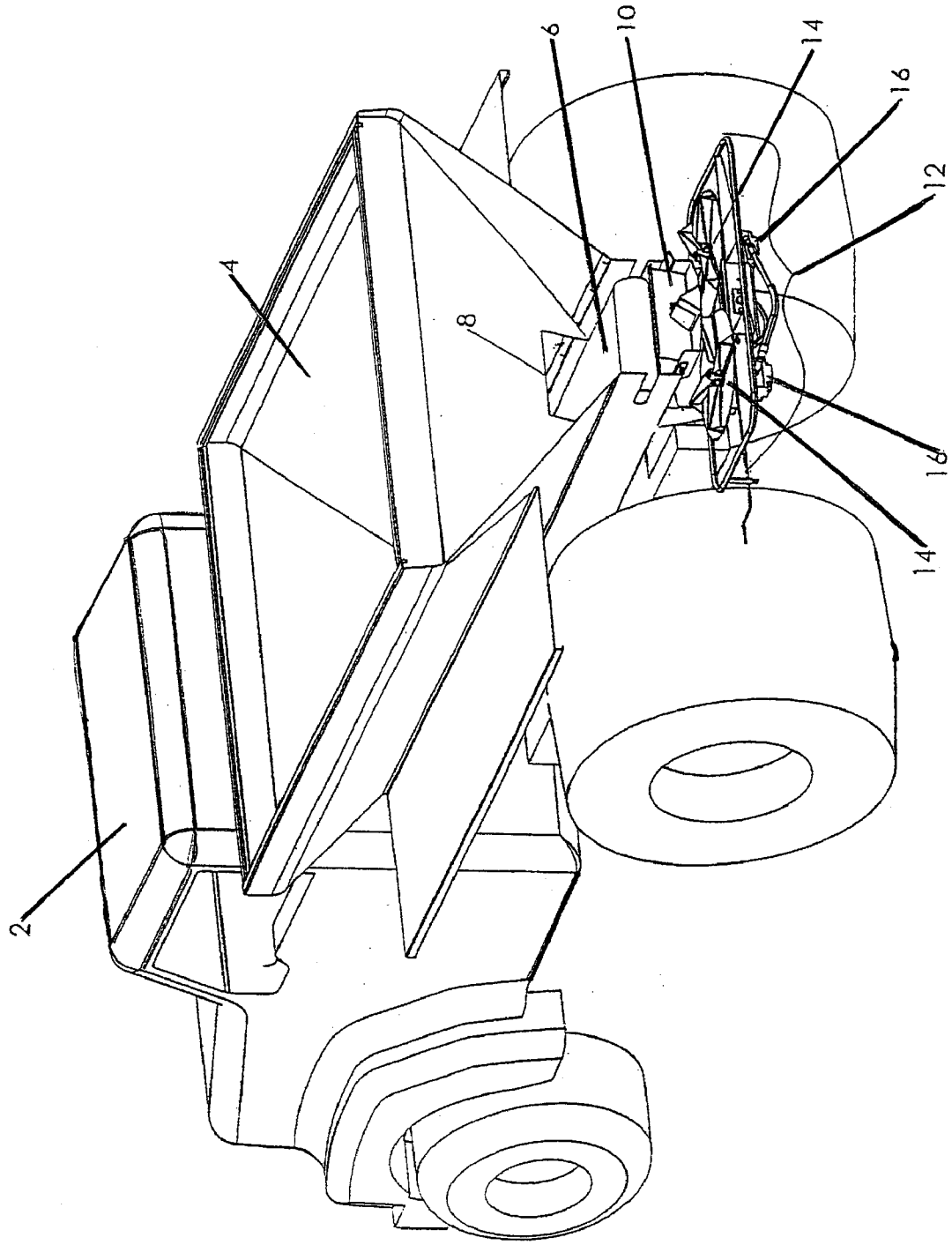


FIGURE 1

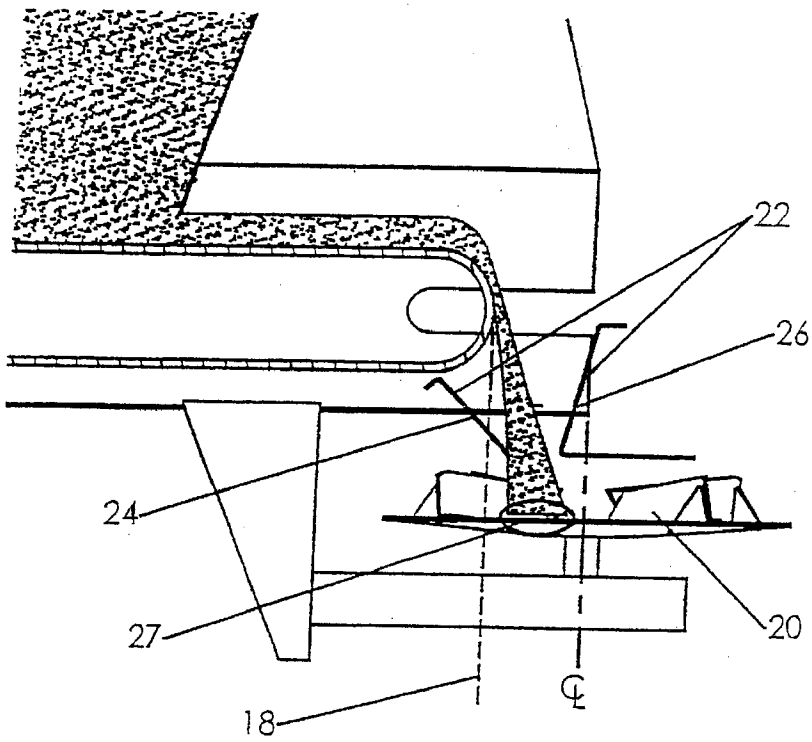


FIGURE 2A
PRIOR ART

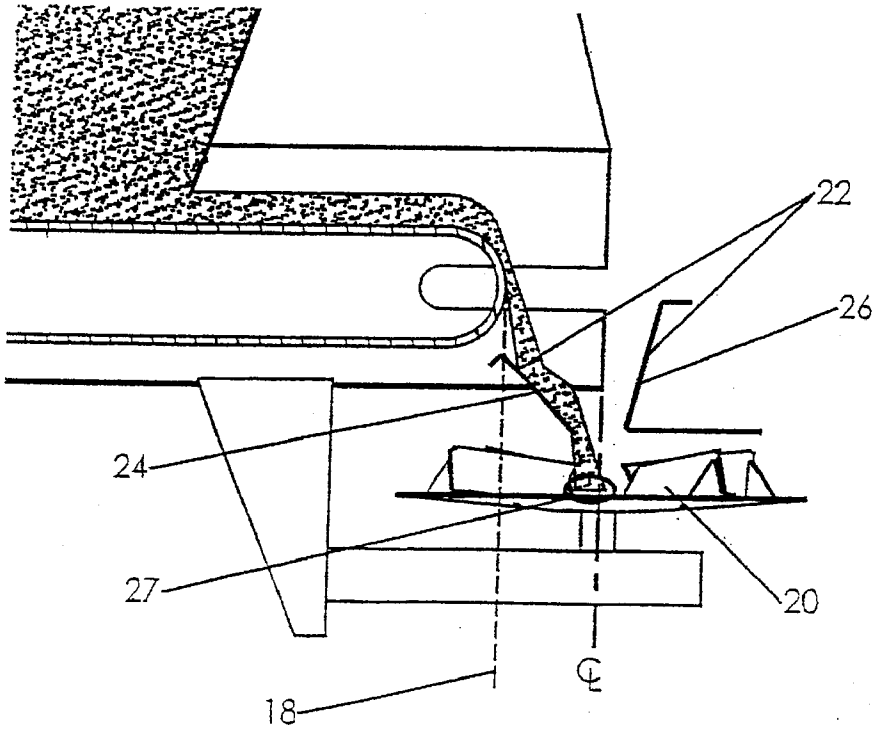


FIGURE 2B
PRIOR ART

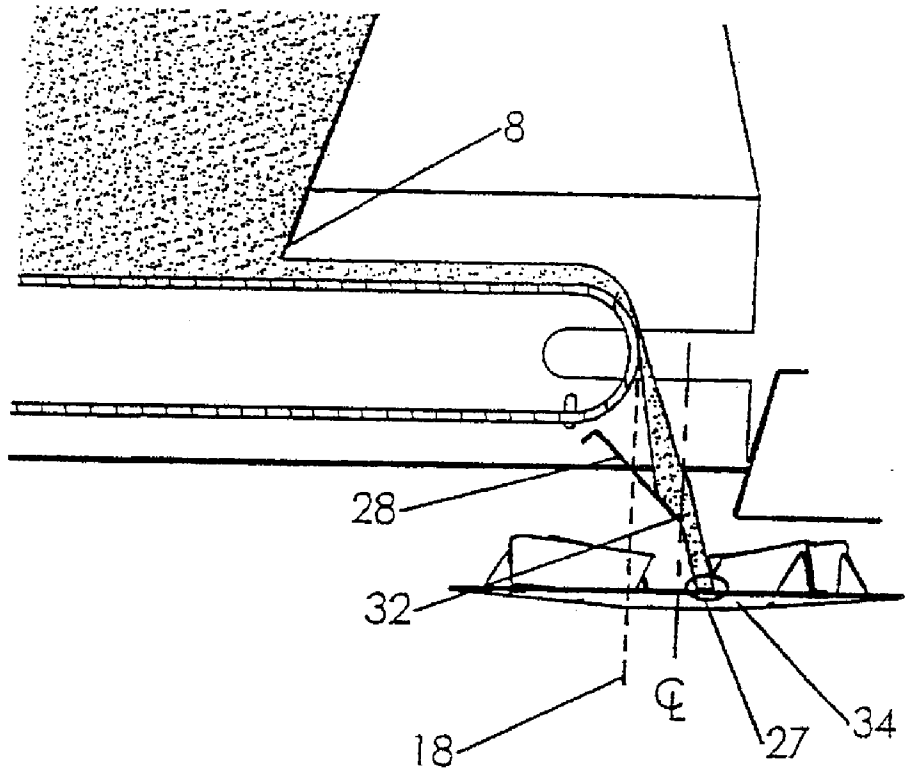


FIGURE 3A

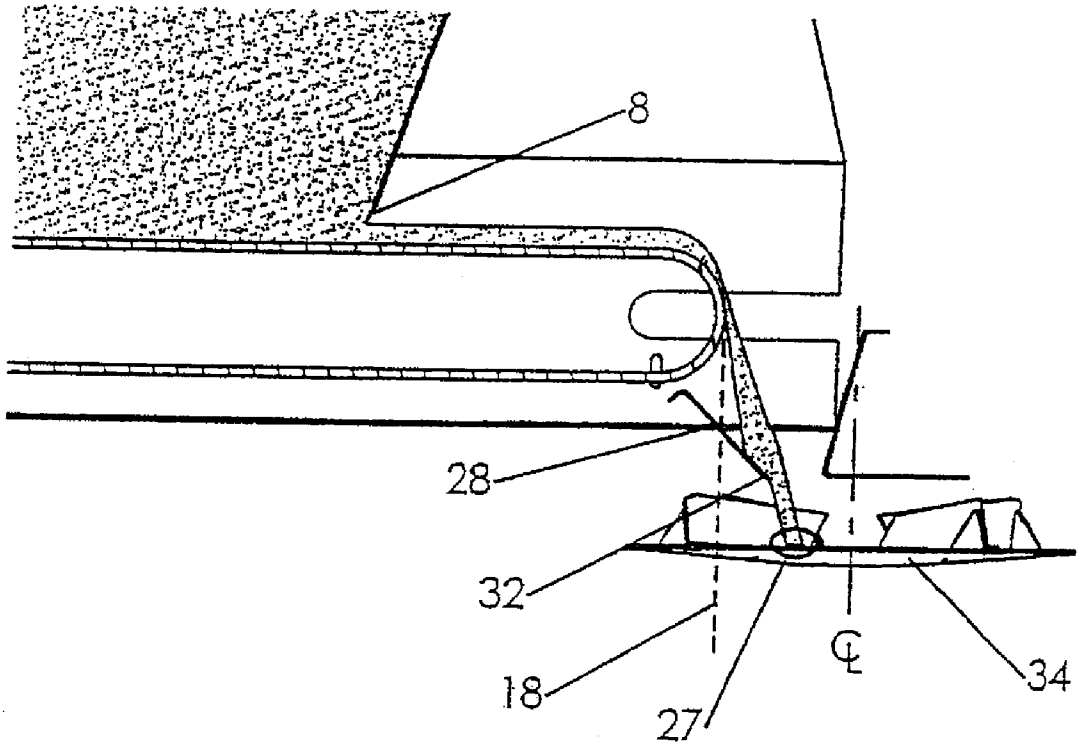


FIGURE 3B

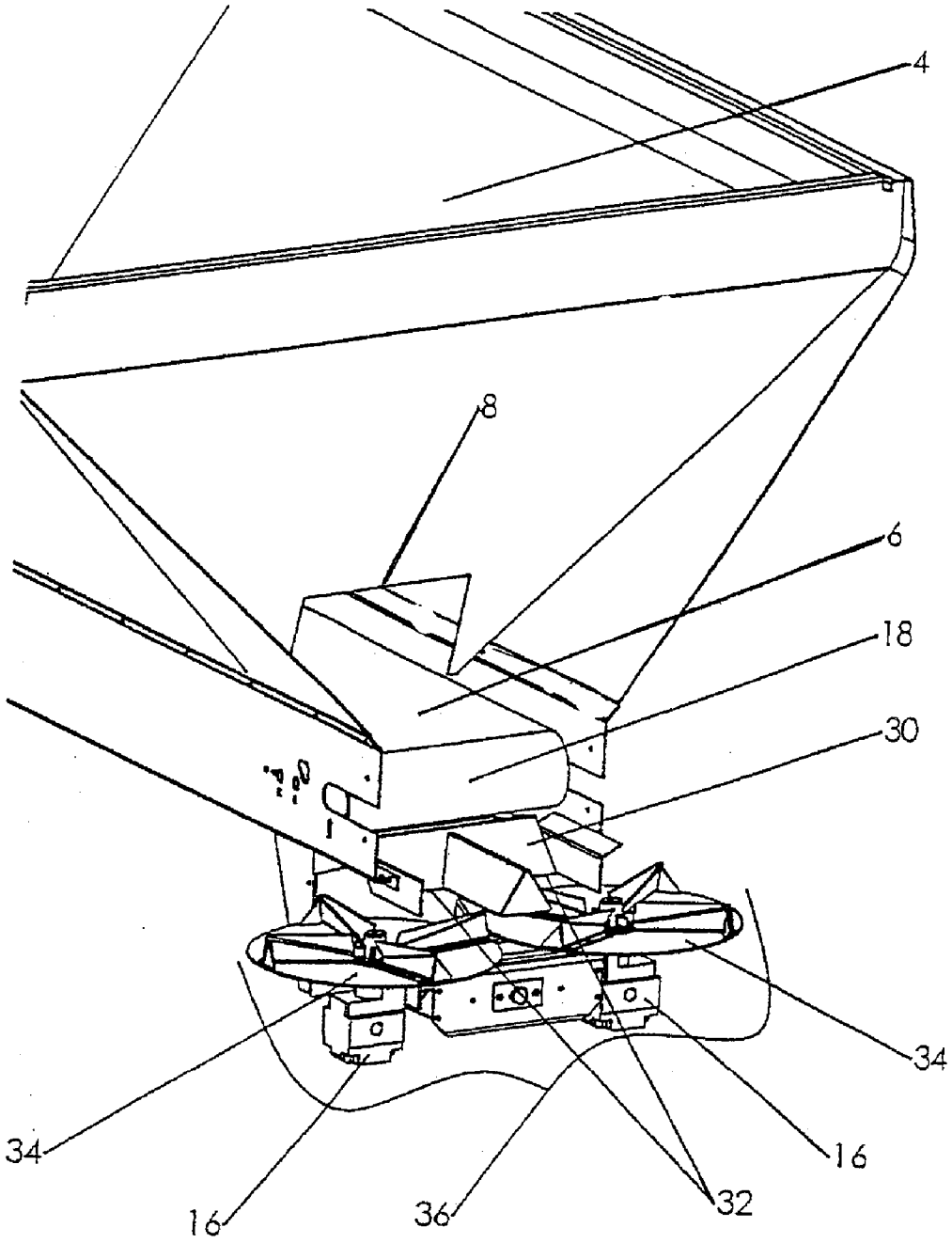


FIGURE 4

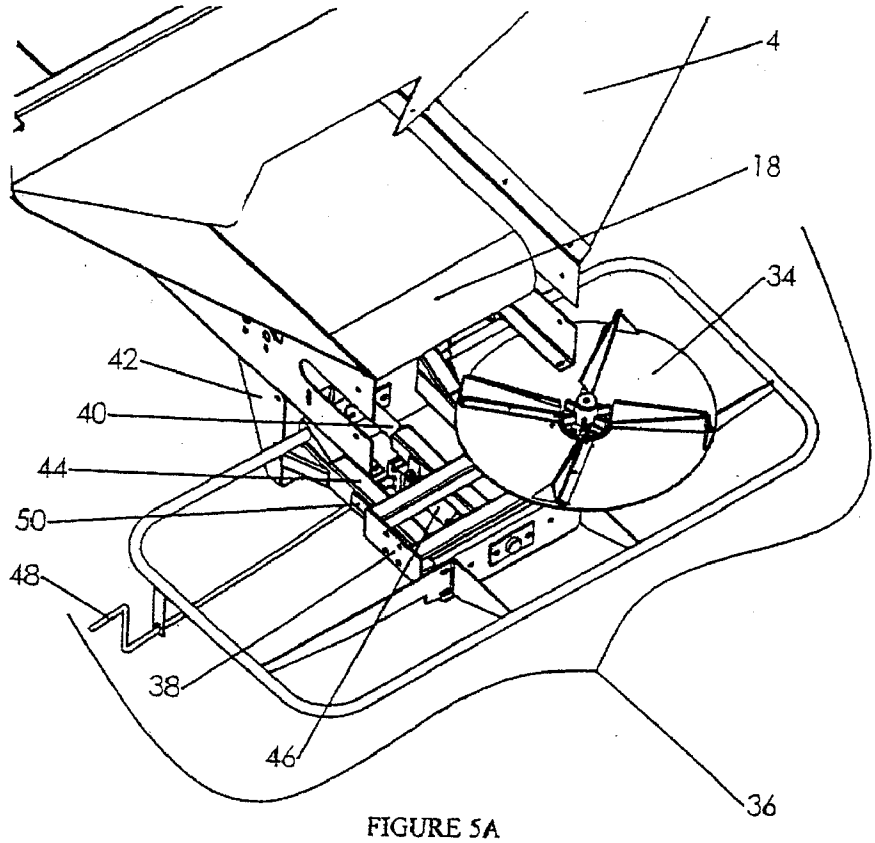


FIGURE 5A

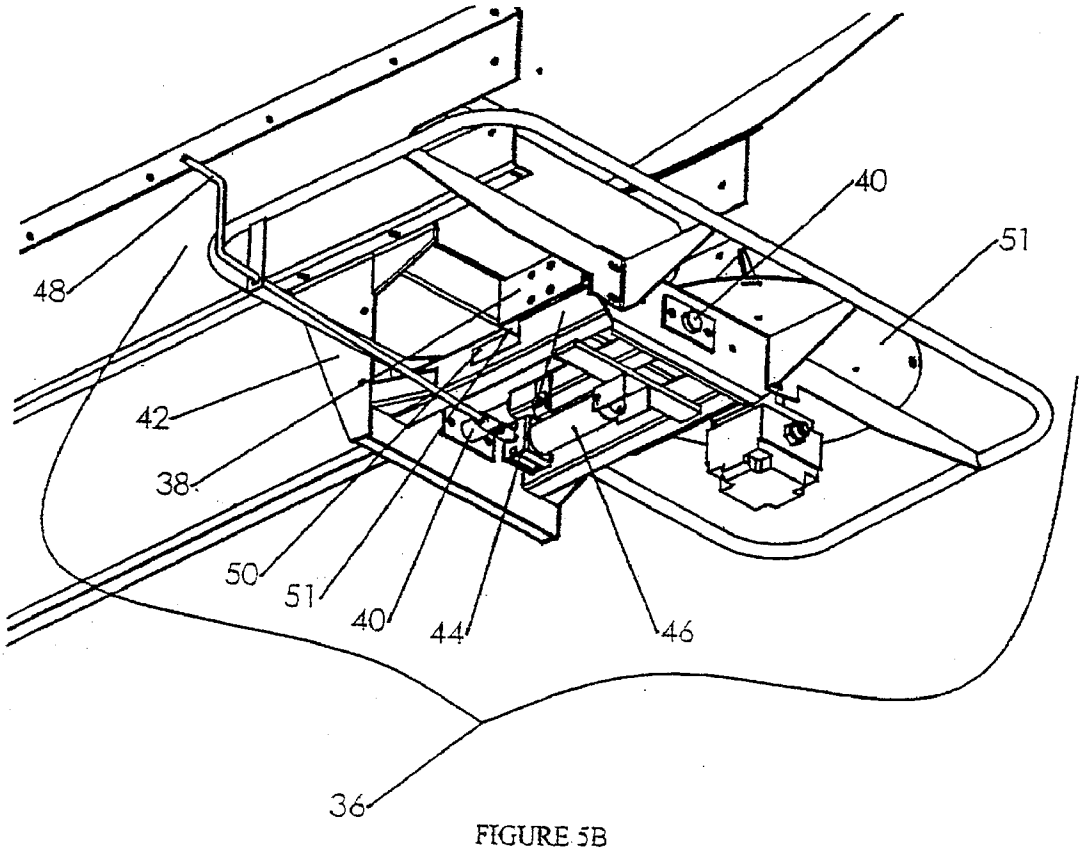


FIGURE 5B

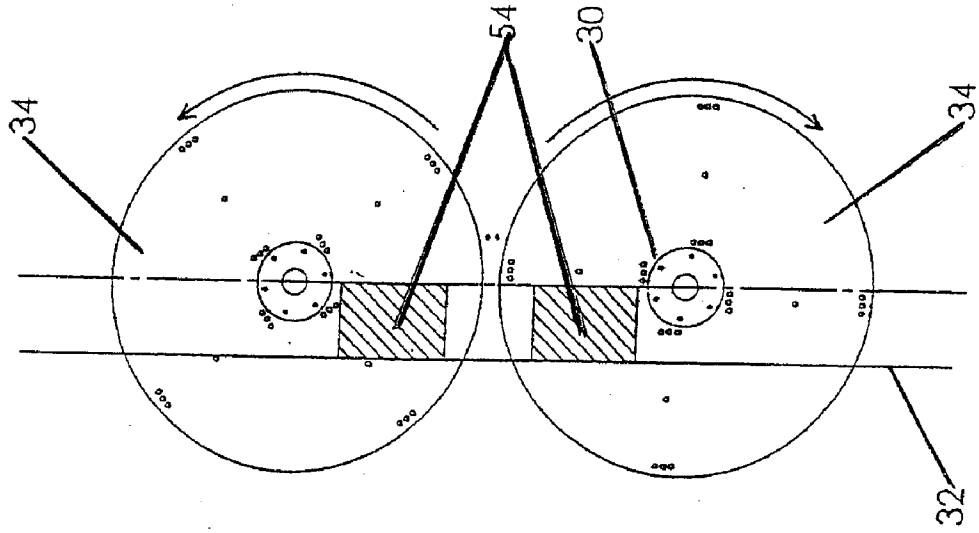


FIGURE 6B

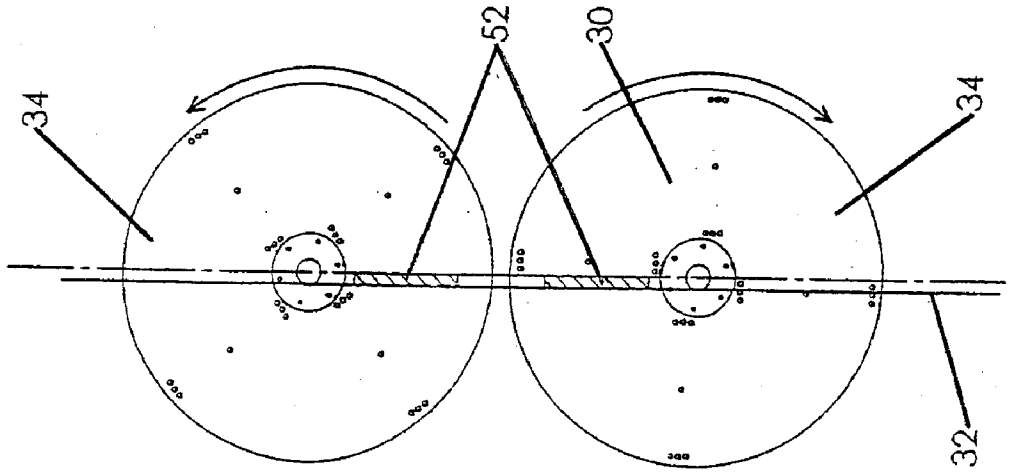


FIGURE 6A

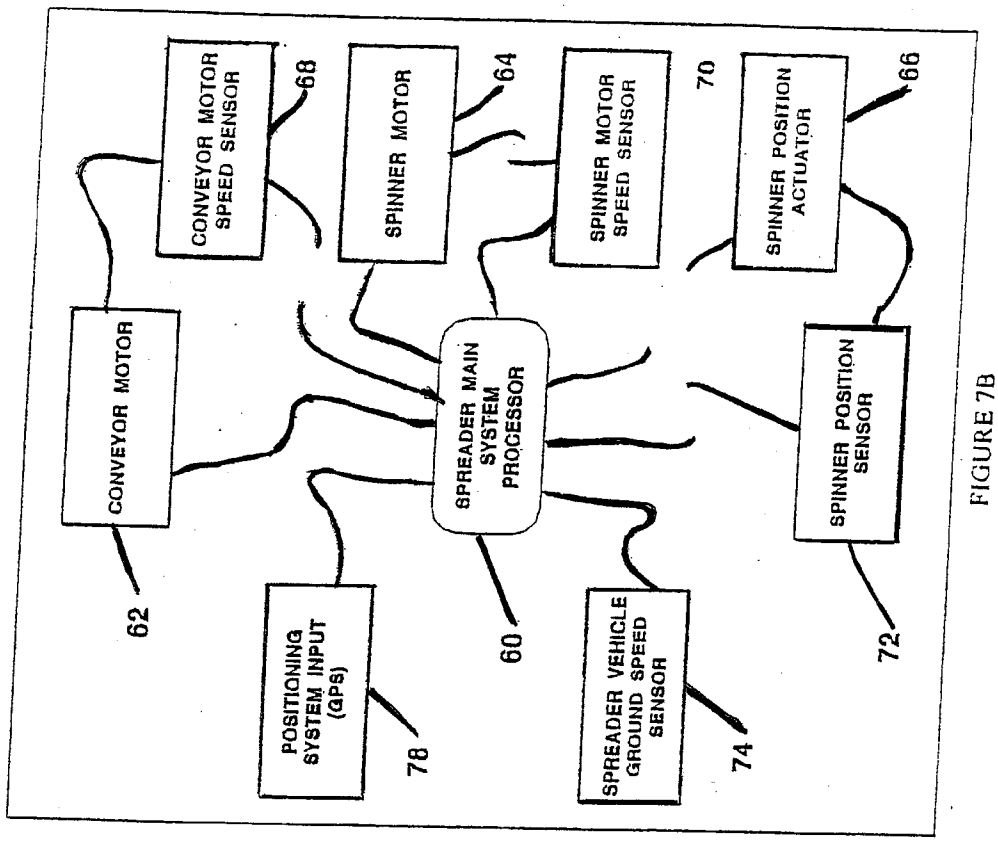


FIGURE 7B

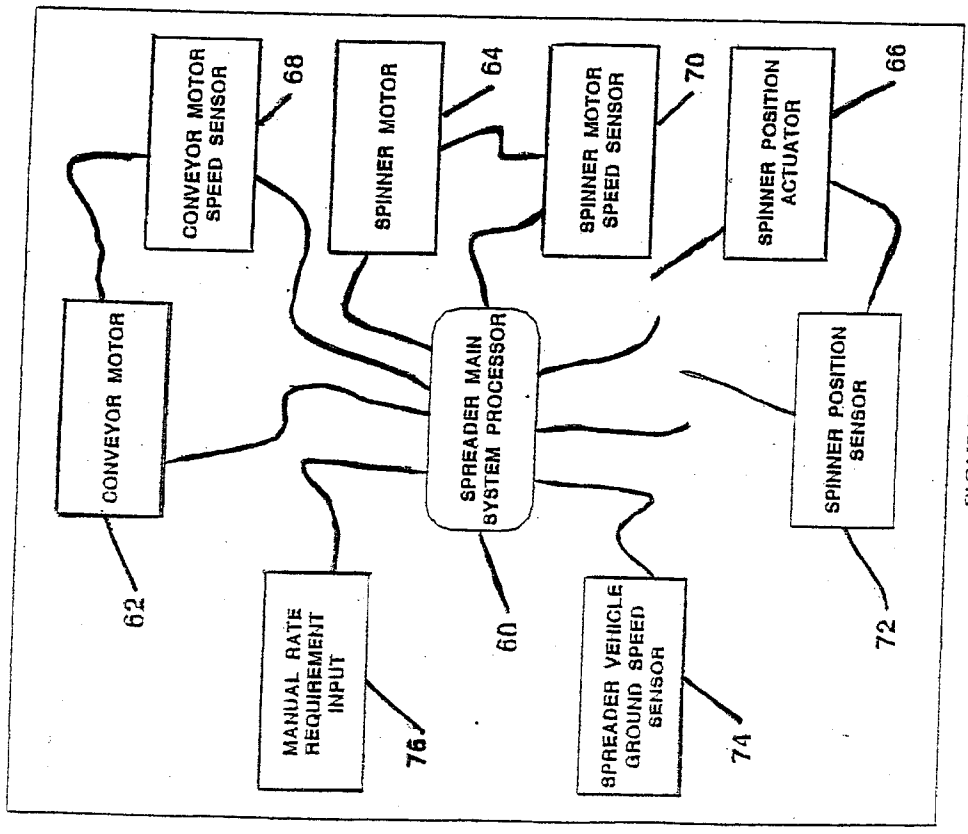


FIGURE 7A

ADJUSTABLE SPINNER FOR A PARTICULATE MATERIAL SPREADER

Detailed Description of the Invention

Cross Reference to Related Applications

[0001] This is a continuation application of an application entitled Adjustable Spinner For A Particulate Material Spreader, having application serial number 09/574,600, filed on May 19, 2000, and now issued as U.S. Patent No. 6,517,281 B1, on February 11, 2003, by Matthew W. Rissi, which application is incorporated herein in its entirety by this reference.

Background of Invention

[0002] Spinner spreaders for particulate material are well known in the art, both for agricultural application, lawn care, and road maintenance application. Typically, such spreaders are mounted onto a truck body, truck chassis, trailer, or slid into a truck's dump body. The spreader includes a material storage bin(s), a conveyor system(s) and rotating spinner(s). The conveyor transfers material from the storage bin(s) to the spinner(s). The spinner(s) broadcast the material across the field, lawn, or road. Usually a single spinner or a pair of laterally spaced spinners are provided, with a material divider plate positioned above the spinner(s) to direct the material from the discharge end of the conveyor(s) onto the spinner(s). A wide range of spinner diameters are in use with a general understanding that the amount of material to be spread and the size of the broadcast area are proportional to the diameter of the spinners.

[0003] Recently, a new technology has emerged known as variable rate technology. Unlike the past when it was desirable to apply a constant rate of material per acre or lane mile, variable rate technology advances the benefits of varying rates while moving across the field, lawn, or roadway. As it relates to agriculture, it is now desirable to apply different rate of a material in different grids of the same field in order to obtain optimum pH and/or fertility values over the entire field. As for roadways, it is now common practice, for example, to apply a varying rate of de-icing materials during the winter depending on the grade of the road; increasing rates on steep roads or at intersections while decreasing rates on less traveled or level roads. This new variable rate technology has challenged makers of broadcast spreaders to provide a spreader that can achieve optimum spread patterns while applying varying low and high rates of materials while the spreader is traveling at variable ground speeds (MPH) over the field, lawn or road. Variable ground speeds combined with variable application rates result in a variable amount of material (cubic feet per minute) passing across the spinner(s). As the rate of material changes, it is necessary to change the drop point onto the spinner(s) to achieve optimal spread patterns.

[0004] Furthermore, it is common to spread different density materials with the same spreader, which makes it necessary to change the drop point onto the spinner(s) to achieve optimal spread patterns when switching from high to low density material applications.

[0005] In conventional prior art spreaders, the drop area of the material from the conveyor(s) is fixed in relationship to the spinner(s). Minor adjustability of the drop area has been accommodated by adjusting the position of a material divider(s) such that the material is deflected by the divider(s) onto a different drop area on the spinner(s). However, such movement of the divider(s) relative to the spinner(s) does not provide uniform material flow through the divider(s) creating difficulty in achieving uniform spread patterns. Furthermore, the aperture of the divider(s) must be large enough to accommodate the highest rate of application lest it would hinder material flow onto the spinner(s). The divider aperture therefore creates a null zone where the divider setting or the divider movement has no consistent affect on the drop area of the material during a change from high to low rate applications. Also, the movement of the divider(s) is substantially limited due to the structure of the divider and/or conveyor and does not allow for the proper material placement on the spinner for achieving optimum spread patterns of both low and high rates of material. Therefore, the limitations of a conventional prior art spreader does not allow achieving optimal spread patterns when applying variable volume rates of material or different densities of material.

[0006] Accordingly, a primary objective of the present invention is the provision of an improved particulate material spreader that achieves proper placement of both low and high volumetric and density based rates of material.

[0007] Another objective of the present invention is the provision of a particulate material spreader having spinner(s) which are incrementally adjustable, fore and aft, relative to the conveyor(s) discharge end and material divider(s).

[0008] A further objective of the present invention is the provision of an improved spreader for agricultural, lawn care, and road maintenance use with uniform material flow from the conveyor(s) discharge end through the material divider(s) and onto the adjustable spinner(s) of the spreader.

[0009] Another objective of the present invention is the provision of an improved particulate material spreader wherein the position of the spinner(s) is quickly and easily adjustable.

[0010] A further objective of the present invention is the provision of spinner(s) for particulate material spreader which can be manually adjusted to accommodate varying low and high application rates of material onto an area, such as a field, lawn or road.

[0011] Another objective of the present invention is the provision of an improved particulate material spreader to automatically adjust the spinner(s) position, fore and aft in relationship to the conveyor discharge end and material divider, based on the rate being applied while the spreader is moving over the field, lawn, or road at either fixed or variable ground speeds (MPH).

[0012] These and other objectives will become apparent from the following description of the invention.

Summary of Invention

[0013] The adjustable spinner of the present invention is adapted for use with a spreader for broadcasting particulate material onto a field, lawn, road, or other area. The spinner includes a frame which is adapted to be adjustably mounted to the spreader beneath a conveyor discharge end and a

material divider. Spinner disc(s) and blades are rotatably mounted on the spinner frame and adapted to receive material from the conveyor through the material divider and broadcast the material as the truck or trailer moves through the field, lawn, or along a road. The position of the spinner(s) relative to the conveyor discharge end and material divider is adjustable, either manually or automatically, with or without automatic position feedback, by any number of means such as mechanical, electrical, pneumatic, or hydraulic, so as to adjust the drop point of the material onto the spinner(s), and thereby accommodate varying application rates of the particulate material.

Brief Description of Drawings

[0014] **Figure 1** overview of truck mounted material storage box, divider, and spinner spreader.

[0015] **Figure 2A** prior art cross section view of the discharge area, divider, and spinner with divider in a forward position.

[0016] **Figure 2B** prior art cross section view of the discharge area, divider, and spinner with divider in a rearward position.

[0017] **Figure 3A** present invention cross section view of the discharge area, fixed position divider, and adjustable spinner(s) in a forward position.

[0018] **Figure 3B** present invention cross section view of the discharge area, fixed position divider, and adjustable spinner(s) in a rearward position.

[0019] **Figure 4** perspective view of present invention in dual spinner configuration.

[0020] Figures 5A & 5B perspective views of present invention in dual spinner configuration with one spinner, spinner motor, and divider removed.

[0021] **Figure 6A** top view of spinners of present invention with spinner in rearward position.

[0022] **Figure 6B** top view of spinners of present invention with spinners in forward position.

[0023] **Figure 7A** Logic schematic of automatic control for variable ground speed.

[0024] **Figure 7B** Logic schematic of automatic control for variable rate applications driven by a positioning system such as GPS.

Detailed Description

[0025] **Figure 1** is a somewhat diagrammatic perspective view of a truck for spreading particulate material generally designated 2. The truck 2 includes a material storage bin 4 with sloping side walls and a belt conveyor 6 for transporting material to the discharge opening 8. Mounted at the rear of the material storage bin 4 at the discharge end of the conveyor is a material divider 10. Mounted below the material divider 10 is the spinner spreader apparatus generally designated 12.

[0026] The spinner spreader 12 of **Figure 1** consists of spinners 14 mounted to motors 16 positioned to accept materials falling from the conveyor end 18 and through material divider 10.

[0027] The above described structure is conventional and does not constitute a part of the present invention.

[0028] **Figure 2A** is a somewhat diagrammatic longitudinal section view of conventional prior art showing a spinner 20 fixed in relative position to the conveyor end 18 and a moveable material divider 22 in a full forward position with a quantity of material falling through the divider aperture without influence from the divider front surface 24 or rear surface 26. It is obvious that the divider would need to move significantly rearward before affecting where this quantity of material is dropped onto the fixed position spinner 20. At the same time, a larger quantity of material flowing from conveyor end 18 may strike the rear surface 26 of the divider. There is no consistent relationship between the drop area 27 on the spinner, the material flow and divider setting.

[0029] **Figure 2B** is a somewhat diagrammatic longitudinal section view of conventional prior art similar to **Figure 2A**, but showing a moveable material divider 22 in a rearward position with material falling through the divider aperture with influence from the divider front surface 24. It is obvious that the divider front surface 24 would affect the shape of the column of material as the divider 22 is moved fore and aft. The drop area 27 on the fixed spinner 20 changes accordingly with the shape of the material column.

[0030] **Figure 3A** is a somewhat diagrammatic longitudinal section view of the present invention showing material falling from the conveyor end 18 onto the front surface 28 of a fixed divider 30, off a fixed drop edge 32, through the front part of the divider aperture, and at a drop point 27 on a moveable spinner 34 shown in a forward position. Divider 30 is not required for the present invention to operate as intended. With divider 30 removed, the conveyor end 18 will serve the same function as the fixed drop edge of a divider.

[0031] **Figure 3B** is a somewhat diagrammatic longitudinal section view of the present invention showing material falling from the conveyor end 18 onto the front surface 28 of a fixed divider 30, off a fixed drop edge 32, through the front part of the divided aperture, and at a drop point 27 on a moveable spinner 34 shown in a rearward position. It is obvious that the material is falling in the same column shape as shown in **Figure 3A** but landing at a drop point 27 further forward on the spinner. Because the material strikes the divider 30 consistently, the material arrives at the moveable spinner 34 consistently and will thus have a spread pattern consistent and repeatable with the location of moveable spinner 34 in relation to divider surface 28 and the fixed drop edge 32.

[0032] The present invention of the improved spreader generally designated 36 is shown in the perspective view of **Figure 4** in a dual spinner configuration. Material from storage bin 4 is conveyed through discharge opening 8 by conveyor 6 until the material falls from conveyor end 18 onto the front surface of fixed divider 30. The fixed divider 30 is mounted to the storage box 4 in a position fixed relative to the end of conveyor 18. The material further falls through the divider aperture along the same front edge, or drop edge 32, of divider 30 and onto the moveable spinners 34. It is the fixed drop edge 32 of the divider 30 that results in a consistent drop point 27 of material onto the moveable spinners 34. The spinners are rotated by motors 16 from below. The spinners rotate in opposite directions. The spinners and motors are moveable fore and aft relative to the fixed divider 30.

[0033] Figures 5A and 5B are upper and lower perspective views of the present invention in a dual spinner configuration spreader generally designated 36 with one spinner 34, spinner motor 16, and the fixed divider 30 of **Figure 4** removed. The spinners and motors are mounted to a subframe 38. In this configuration, the subframe 38 with mounted motors and spinners, is moveable fore and aft along longitudinal shaft 40 secured to main supporting frame 42. Further, the subframe 38 rests on longitudinal members 44 of the main supporting frame 42. The main supporting frame 42 is mounted to the storage bin 4 and is fixed in position relative to the conveyor end 18 and divider drop edge. In this configuration, fore and aft movement of the subframe 38 and the associated motors and spinners is accomplished through means of a screw jack 46 placed between the main supporting frame 42 and subframe 38. In manually operated form, the operator of the spreader can adjust the position of the spinners relative to the conveyor end and divider drop edge by extending or collapsing the screw jack 46 by means of a rotatable handle 48. Location of the spinners relative to the drop edge is indicated by scale 50 and pointer 51.

[0034] When using laterally spaced spinners having opposite rotation, the operator can adjust for higher or lower application rates by moving the spinners 34 forward or rearward with respect to the fixed drop edge 32 of the fixed divider 30.

[0035] **Figure 6A** is a top view of the spinners of the present invention depicting a low application rate with a small column of material, represented by hatched sections 52, which has passed over the front surface of the divider, off the drop edge 32 and onto the spinners 34. The spinners 34 are retracted forwardly such that the small column of material 54 has a drop point near the spinners centerline. Furthermore, as the rate of material is reduced, the material would be introduced later in respect to the spinner's rotation. For any spinner rotation, as the rate of material is reduced, the column of material 52 and the associated drop point, would move in the same direction as the spinner rotation.

[0036] **Figure 6B** is a top view of the present invention showing a higher application rate, which has a larger column of material, represented by hatched sections 54. The spinners 34 are moved rearwardly such that the added volume of material is introduced earlier in respect to the spinner's rotation. The center of the drop point moves in a direction opposite the spinner rotation. For any spinner rotation, as the rate of material is increased, the column of material 54 and the associated drop point, would move in the direction opposite the spinner rotation.

[0037] The spinners 34 can be adjusted to any position between full extension and full retracted positions to accommodate various application rates of materials. Spinner location is also adjustable to accommodate varying material densities. The accurate adjustability of the spinners allow for a more accurate deposit of material onto the spinners, and thus more accurate application of the material onto the field, lawn, or road.

[0038] In an automatically adjustable form, the screw jack 46 of Figures 5A and 5B is replaced with any number of actuating means, such as mechanical electrical actuators, pneumatic cylinders, or hydraulic cylinders, with a positive feed back to control spinner location from the operator's driving position or other remote location. The operator can immediately adjust the spinner position for accurate broadcast of material based on an application rate.

[0039] **Figure 7A** is a logic flow chart of a general type of control for the remote adjustment just described. Spreader main system processor 60 controls conveyor motor 62, spinner motor 64, and spinner position actuator 66 by constantly monitoring conveyor speed sensor 68, spinner rotation speed sensor 70, spinner position actuator sensor 72 and vehicle ground speed sensor 74 to meet the rate requirements 76 manually input by the operator to meet predetermined material application rates. When a new rate requirement 76 is input, the main system processor 60 adjusts one or more of the conveyor motor speed 62, spinner speed 64, and spinner position actuator 66 until feedback from conveyor speed sensor 68, spinner speed sensor 70, and spinner position actuator sensor 66 meet programmed requirements for the new rate for any given vehicle speed from sensor 74. Specifically, it is the ability to change the drop point onto the spinners that allow for optimum spread patterns.

[0040] In a further automatically adjustable form, the screw jack 46 is replaced with any number of actuating means, such as mechanical electrical actuators, pneumatic cylinders, or hydraulic cylinders, with a positive feed back to control spinner location and thereby adjusting automatically for variable rate technology application of the particulate material. In this case, the spinner location is changed as the spreader is moving about the field, lawn or along the roadway for accurate broadcast of material based on predetermined application rates and position knowledge gained from a location positioning system such as a common Global Positioning System (GPS).

[0041] **Figure 7B** is a logic flow chart of a general type of control for variable rate technology. With variable rate technology, the spreader main system processor 60 controls conveyor motor 62, spinner motor 64, and spinner position actuator 66 by constantly monitoring conveyor speed sensor 68, spinner rotation speed sensor 70, spinner position actuator sensor 72 and vehicle ground speed sensor 74, and a positioning system such as a common Global Positioning System 78. The addition of the positioning system and a set of predetermined variable application rate needs for a field grid or roadway gives the spreader the information necessary to apply different rates of material at variable ground speeds. However, it is the ability to consistently change the effective material drop point on the spinners that allows a spreader to achieve the optimal spread patterns needed for the variable ground speeds and high to low application rates. Therefore, as the spreader is moving about the field, lawn or along the roadway, the main system processor 60 constantly monitors and adjusts the spinner position for best results with regard to application rates based on the positioning system's location information and vehicle ground speed.

What is Claimed is:

1.(Previously amended)A vehicle for spreading matter over an area, the vehicle comprising: a chassis; a material storage box, coupled to said chassis for holding matter; an outlet from said material storage box, permitting said matter to exit said material storage box; a spinning spreader adjustably coupled to said chassis, said spinning spreader for broadcasting said matter over an area; said spinning spreader adjustably positioned to a plurality of spinner positions with respect to a fixed location on said chassis, such that said

spinning spreader lies in a constant spinning spreader plane, irrespective of being positioned in a plurality of spinner positions; and wherein said spinning spreader is supported by and translates on a longitudinal member which is coupled to said chassis at a point lower than said spinning spreader plane.

2.(Previously amended)A vehicle of claim 1 wherein said longitudinal member does not move forward and backward with respect to the chassis when said spinning spreader translates.

3.(Previously amended)A vehicle for spreading matter over an area, the vehicle comprising: a chassis; a material storage box, coupled to said chassis for holding matter; an outlet from said material storage box, permitting said matter to exit said material storage box; a spinning spreader adjustably coupled to said chassis, said spinning spreader for broadcasting said matter over an area; a path of matter between said outlet and said spinning spreader with a fixed diverter disposed therein; said spinning spreader adjustably positioned to a plurality of spinner positions with respect to a fixed location on said chassis; said path being free from obstruction by an adjustable diverter; and a motor coupled to said spinning spreader and wherein said spinning spreader translates in a plane above a longitudinal member supporting said spinning spreader and said motor.

4.(Previously amended)A vehicle of claim 3 wherein said longitudinal member is stationary with respect to said chassis when said spinning spreader is positioned in a plurality of spinner positions.

5.(Previously amended)A vehicle for spreading matter over an area, the vehicle comprising: a chassis; a material storage box, coupled to said chassis for holding matter; an outlet from said material storage box, permitting said matter to exit said material storage box; a spinning spreader adjustably coupled to said chassis through an adjustable coupling, said spinning spreader for broadcasting said matter over an area; said spinning spreader adjustably positioned to a plurality of spinner positions with respect to a fixed location on said chassis; said adjustable coupling being a non-pivotable coupling; and wherein said non-pivotable coupling is a translational coupling which translates below said spinning spreader.

6.(Previously amended)A vehicle of claim 5 wherein said translational coupling is coupled to said chassis by a rigid stationary vertical member extending from a fixed point on said chassis to a point below said spinning spreader.

7.(Original)A vehicle of claim 6 further comprising a path of matter between said outlet and said spinning spreader with a fixed diverter disposed therein; and, said path being free from obstruction by an adjustable diverter.

8.(Original)A vehicle of claim 7 further comprising: an actuator, coupled to said spinning spreader, said actuator for adjustably positioning said spinning spreader between said plurality of spinner positions; said actuator being responsive to input electronic signals; a global positioning system receiver, disposed on said vehicle, said global positioning system receiver for providing position signals representative of a location characteristic of said vehicle; and, an electronic system processor, disposed on said vehicle, said electronic system processor for providing said input electronic signals in response to position signals from said global positioning system receiver.

9.(Original)A vehicle for spreading matter over an area, the vehicle comprising: a chassis: a material storage box, coupled to said chassis for holding matter; an outlet from said material storage box, permitting said matter to exit said material storage box; a spinning spreader adjustably coupled to said chassis, said spinning spreader for broadcasting said matter of an area; said spinning spreader adjustably positioned to a plurality of spinner positions with respect to a fixed location on said chassis; an actuator, coupled to said spinning spreader, said actuator for adjustably positioning said spinning spreader between said plurality of spinner positions; said actuator being responsive to input electronic signals; a global positioning system receiver, disposed on said vehicle, said global positioning system receiver for providing position signals representative of a location characteristic of said vehicle; and, an electronic system processor, disposed on said vehicle, said electronic system processor for providing said input electronic signals in response to position signals from said global positioning system receiver.

10.(Original)A vehicle of claim 9 further comprising a spinner position sensor which provides spinner position signals to said electronic system processor.

11.(Previously amended)A vehicle of claim 10 further comprising a conveyor disposed in said material storage box and a rigid stationary substantially vertical member disposed at a fixed point on said chassis; a substantially horizontal rigid stationary member fixed to said rigid stationary substantially vertical member, such that said spinning spreader translates along said substantially horizontal rigid stationary member, as said spinning spreader is moved between said plurality of spinner positions.

12.(Original)A vehicle for spreading matter comprising: means for storing matter; means for creating a stream of matter; means for spreading said matter; means for translating, with respect to a fixed reference on said vehicle and among a plurality of coplanar positions, a location of said means for spreading; and said means for translating disposed below said means for spreading.

13.(Previously amended)A method of spreading matter comprising the steps of: providing a stream of matter; maintaining a path for said stream in a manner such that said stream is not affected by an adjustable material diverter disposed in said path; and, broadcasting said matter from a spinner adjustably disposed on a vehicle in a plurality of spinner positions with respect to a fixed location on said vehicle, where said fixed location is above said spinner and said fixed location is a location of a stationary vertical support which is coupled to a stationary horizontal support, upon which said spinner translates.

14.(Previously amended)A method of spreading matter comprising the steps of: providing a store of matter on a vehicle; providing a stream of matter; broadcasting said matter from a first spinner adjustably disposed on a vehicle in a plurality of first spinner positions; wherein a projection angle of said matter from each of said plurality of first spinner positions is at a single angle with respect to a reference plane which is horizontal with respect to said vehicle; and wherein said first spinner translates on a fixed member disposed below a chassis connecting portion of a second member which rigidly couples said first member to a chassis of said vehicle.

15.(Original)A method of claim 14 wherein said stream of matter is a stream of de-icing agent and said plurality of

spinner positions result from a translation between support members where said translation occurs below said first spinner.

16.(Original)A method of claim 15 wherein a signal from a GPS receiver is used to control positioning of said first spinner.

17.(Original)A method of claim 16 where an electronically controlled hydraulic cylinder is used to actuate said first spinner.

18.(Original)A method of claim 17 comprising broadcasting matter from a second spinner wherein said first spinner and said second spinner are counter-rotating.

19.(Original)A method of claim 18 wherein said first spinner and said second spinner each has an inner plurality of holes therein and an outer plurality of holes therein.

20.(New)A vehicle for spreading a particulate material over an area, the vehicle comprising: a chassis, having a support member oriented in a first direction; a material container disposed on and supported by said chassis; a spinner, disposed below said material container, said spinner configured to disperse particulate matter leaving said material container; a spinner adjustment mechanism configured to move said spinner fore and aft with respect to first direction; and, said spinner adjustment mechanism comprising a first meshing member and a second meshing member; wherein elevated portions of said first meshing member mate with recessed portions of said second meshing member, such that when said first meshing member is rotated, said second meshing member is forced into relative linear motion with respect to said first meshing member.

21.(New)A vehicle of claim 20 wherein said spinner adjustment mechanism is a screw jack.

22.(New)A vehicle of claim 21 wherein said first meshing member is a helical gear.

23.(New)A vehicle of claim 20 wherein said second meshing member translates with said spinner.

24.(New)A method of adjusting a spinner on a vehicle comprising the steps of: providing a material spreading spinner which is configured to be free to translate fore and aft; rotating a first toothed member in a meshed configuration with a second toothed member so as to result in a linear movement of said second toothed member; and causing said spinner to translate with said second toothed member, whereby, an adjustment of a position of said material spreading spinner can be accomplished by rotating said first toothed member.

25.(New)A method of claim 24 wherein said first toothed member is a helical gear.

26.(New)A method of claim 25 wherein said first toothed member and said second toothed member are components of a screw jack.

27.(New)A method of claim 24 wherein said step of rotating said first toothed member comprises rotating a crank.

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