METHOD & APPARATUS FOR SPREADING AGGREGATE AND ROAD BUILDING MATERIALS RELATED TO VEHICLE SPEED

A spreader assembly for the controlled delivery to a surface of granular materials such as aggregates from a hopper in communication with a source of the materials external to said assembly; wherein the assembly comprises; an opening to said hopper which receives said materials from said materials source, a discharge opening from the hopper; a gate or gates adjacent said discharge opening; control means for adjusting the rate and or quantity (weight or volume) of said materials delivered from said hopper; wherein the control means includes means to receive at least one input parameter and means to convert said at least one input parameter into an output parameter for performing at least one mechanical activity in the assembly; wherein the rate or quantity at which said material is delivered is dependent upon the at least one input parameter and said mechanical activity.
IMPROVED METHOD AND APPARATUS FOR SPREADING OF AGGREGATE AND ROAD BUILDING MATERIALS

BACKGROUND

The present invention relates to methods and apparatuses for delivery of materials such as but not limited to aggregates and more particularly relates to an improved method for delivery of such aggregates from a spreader assembly and a system for controlling that delivery. The invention further relates to an attachable assembly for fixing to a vehicle having a source of granular material and the like and a control system for controlling the delivery of the material from the assembly.

PRIOR ART

Aggregates are widely used globally in pavement and road construction either for providing a road or pavement base or a durable wear surface which stands up to heavy traffic wear. One method of road construction involves preparing a sub grade surface, coating that sub grade with a layer of bitumen or the like and spreading gravel, metal aggregate road base or the like over the surface of the bitumen. This process is carried out partly by machine and partly by human labour in conjunction with the machine and has been used globally in road pavement constructions for many years. In large scale surfacing operations, machines are used which include a rear hopper from which is discharged the aggregate for the purpose of the surfacing. Due to the high cost of materials it is important to minimise wastage of pavement materials and particularly aggregates to maintain economies. This has proven to be difficult according to the prior art methods, as the use of manual labour in part of the process leads
to inaccuracies in the distribution of the materials. Not only is there a high labour cost component when manual input is employed but also a high wastage component due to human error in material spreading.

In road construction and resurfacing it is highly desirable that the correct design volume of resurfacing aggregate is applied for economic and safety reasons. If too much aggregate is deposited on a surface, apart from the economic waste, there is a safety hazard from gravel mounds which often result from manual spreading. The prior art apparatuses have not, provided an aggregate discharge assembly which can be accurately controlled to deliver an accurate design quantity of material from a hopper and which may be calibrated and adjusted to compensate for assembly and operation parameters which influence discharge rate and quantity.

INVENTION

The present invention provides an improved apparatus and method for the spreading of construction materials such as aggregates in such applications as, but not limited to road pavement construction. More particularly, the invention provides an apparatus and method for the automated and controlled delivery of construction materials particularly in road pavement surfacing. The invention operates to accurately spread granular material such as but not limited to aggregate, according to a predetermined rate on to a surface such as a road pavement or the like. The invention further provides an apparatus which is capable of computer control of both small and large material delivery jobs and which removes the inaccuracies of operation of the known equipment and
provides economies by reduction of human labour and elimination of materials losses caused by oversupply per unit area.

In one broad form the present invention comprises:

5 An apparatus for the controlled delivery of granular materials such as aggregates from a space for receiving and holding said materials to a surface exterior of said apparatus; wherein the apparatus comprises;

control means for adjusting the rate and or quantity of said materials delivered from said apparatus; wherein said control means includes means to receive at least one input parameter and means to convert said at least one input parameter into a mechanical activity performed by said apparatus; wherein said rate or quantity at which said material is delivered is dependent upon said at least one input parameter.

Preferably the control means is a computer.

15 In another broad form the present invention comprises:

an apparatus for the controlled delivery of granular materials such as aggregates from a space for receiving and holding said materials to a surface exterior of said apparatus; wherein the apparatus comprises;

a programmable logic computer for adjusting the rate and or quantity of said materials delivered from said apparatus; wherein said control means includes a computer input having means to receive at least one input parameter and means to convert said at least one input parameter into a mechanical activity performed by said apparatus; wherein said rate or quantity at which said material is delivered is influenced by said at least one input parameter.

20 In another broad form the present invention comprises:


an apparatus for the controlled delivery of granular materials such as aggregates from a hopper for receiving and holding said materials to a surface exterior of said apparatus; wherein the apparatus comprises;

countrol assembly for adjusting the rate and or quantity of said materials delivered from said apparatus; wherein said control assembly includes mechanical rams operably connected to said hopper; control means to receive at least one input parameter and means to convert said at least one input parameter into a mechanical activity performed by said apparatus; wherein said hopper is adjusted by said assembly to control the rate or quantity at which said material is delivered responsive to said at least one input to said control means. Preferably the control means is a computer.

According to a preferred embodiment, the material delivered by said apparatus is road pavement aggregate which is delivered under gravity from said hopper via adjustable gates which may be adjusted to accommodate a design width for a job and weight per unit area. Preferably, said adjustable gate/s controls the size of an opening from which said aggregate is discharged wherein the size of the opening is adjusted in response to predetermined parameters such as apparatus speed over the ground and quantity of aggregate to be delivered in order to maintain a predetermined volume of aggregate per unit area.

In one broad form of the method aspect, the present invention comprises:

a method for controlled delivery of a granular material from a hopper to a surface using an apparatus for the controlled delivery of granular materials such as aggregates from a space for receiving and holding said materials to a surface exterior of said apparatus; wherein the method comprises the steps of;
a) inputting at least one operating parameter into a computer in communication with an aggregate hopper attached to said apparatus;

b) activating control by said computer of said hopper in accordance with at least one said operating parameter;

c) allowing a predetermined amount of material to be discharged from said hopper responsive to said at least one input parameter;

According to a preferred embodiment, the method comprises the further step of converting said input to a mechanical action thereby allowing at least one gate on said hopper to adjust responsive to said at least one input parameter so that said predetermined amount of material is discharged from said apparatus.

According to a preferred embodiment said at least one parameters may include, discharge rate of said material from said hoper in m³/unit area, speed of said apparatus, dimensions of said hopper opening, spread rate in kg/m².

According to one embodiment the spread rate may be adjusted 0.5kg per m² at any time from minimum to maximum settings. Preferably, the apparatus is adapted as an attachment for mounting to the rear of a tipper truck.

In another broad form the present invention comprises:

an attachment apparatus for the controlled delivery of granular materials such as aggregates from a space for receiving and holding said materials to a surface exterior of said apparatus; wherein the apparatus comprises;

control means for adjusting the rate and or quantity of said materials delivered from said apparatus; wherein said control means includes a computer having means to receive at least one input parameter and means to convert said at least one input parameter into a mechanical activity performed by said apparatus;

wherein said rate or quantity at which said material is delivered is dependent upon said at least one input parameter and said mechanical activity.
According to a preferred embodiment, said mechanical activity is the adjustment of one or more gates to adjust an opening in a hopper. Preferably the attachment is adapted to attachment to a vehicle such as a truck.

In its broadest form the present invention comprises:

5 a spreader assembly for the controlled delivery to a surface of granular materials such as aggregates from a hopper in communication with a source of said materials external to said assembly; wherein the assembly comprises;

an opening to said hopper which receives said materials from said materials source,

10 a discharge opening from said hopper;

a gate adjacent said discharge opening;

control means for adjusting the rate and or quantity (weight or volume) of said materials delivered from said hopper; wherein said control means includes a computer having means to receive at least one input parameter and means to

15 convert said at least one input parameter into an output parameter for performing at least one mechanical activity in the assembly; wherein the rate or quantity at which said material is delivered is dependent upon said at least one input parameter and said mechanical activity.

In another broad form the present invention comprises:

20 a vehicle including a spreader assembly for the controlled delivery of granular materials such as aggregates from the vehicle to a hopper in said assembly; wherein the assembly comprises;

an opening to said hopper which receives said materials from said vehicle;

a discharge opening from said hopper;
a gate adjacent said discharge opening capable of regulating the discharge of
the granular material;
control means for adjusting the rate and/or quantity (weight or volume) of
said materials delivered from said hopper; wherein said control means includes
means to receive at least one input parameter and means to convert said at least
one input parameter into an output parameter for performing at least one
mechanical activity in the assembly which controls the delivery rate and/or
quantity of said granular material; wherein the rate or quantity at which said
material is delivered is dependent upon said at least one input parameter.
Preferably the input parameter or parameters are received and processed by a
computer.
In another broad form the present invention comprises;
a control system for use in the controlled delivery of granular materials such as
aggregates from a vehicle mounted spreader assembly including a hopper for
holding and discharging said materials from said hopper; wherein the control
system comprises;
a programmable logic computer (PLC) for adjusting the delivery rate and/or
quantity of said materials delivered from said hopper;
a sensor for detecting the speed of a vehicle to which the assembly is attached;
said control system further comprising a computer input having means to
receive at least one input parameter and means to convert said at least one
input parameter into at least one mechanical activity performed by said
apparatus and which regulates the discharge of said materials delivered from
the vehicle responsive to said input; wherein said rate or quantity at which said
material is delivered is dependent upon said at least one input parameter.
In a further broad form of a method aspect the present invention comprises:

a method for controlled delivery of a granular material from a vehicle mounted spreader assembly to a pavement surface, wherein the assembly comprises

a hopper which receives said materials from said materials source,

a discharge opening from said hopper;

a gate adjacent said discharge opening;

control means for adjusting the rate and or quantity (weight or volume) of said materials delivered from said hopper; wherein said control means includes a computer having means to receive at least one input parameter and means to convert said at least one input parameter into an output parameter for performing at least one mechanical activity in the assembly; wherein the method comprises the steps of;

rate or quantity at which said material is delivered is dependent upon said at least one input parameter and said mechanical activity; wherein the method comprises the steps of;

a) inputting vehicle parameters into said computer;

b) calibrating operation of said spreader assembly;

c) selecting an aggregate size for delivery by said hopper;

d) selecting spread rate weight and allowing conversion to a raw proportional gate position;

e) adjusting values by compensating for tilt and/or road speed;

f) obtaining a repeatable set value for spread rate of aggregate.
DETAILED DESCRIPTION

The present invention will now be described in more detail according to a preferred but non-limiting embodiment and with reference to the accompanying illustrations; wherein,

Figure 1: shows a perspective view of a spreader assembly and control console according to one embodiment of the invention;

Figure 2: shows a side elevation of the spreader assembly and control console of figure 1.

Figure 3: shows a side elevation of the spreader with control console removed and with aggregate delivery gate closed.

Figure 4: shows the spreader of figure 3 with aggregate delivery gate partially open.

Figure 5: shows the spreader of figure 4 with aggregate delivery gate fully open.

Figure 6: shows the spreader of figure 1 with hopper detached from a vehicle.

Figure 7: shows a schematic layout of control system elements according to a preferred embodiment.

Figure 8: shows a flow diagram of a typical operation of the control system of a computerised spreader box.

The invention will now be described in detail according to one embodiment, in its application to controlled spreading of road and pavement surfacing. It will however, be appreciated by persons skilled in the art that the spreader
apparatus, control system and method of operation may be adapted to applications other than road and pavement surfacing.

In a typical road surfacing operation, a spreader, which will normally include a hopper for receiving and holding a road or pavement construction material such as an aggregate, will be preferably detachably attached to the rear of a truck or other source of material supply by means of pin connections, bolts or nuts or alternative form of connection. The truck will be pre loaded with a supply of a flowable material such as but not limited to road base, aggregate (such as used in road surfacing operations) or other paving material. The material will be required to flow upon elevation of a tipper so granular materials are preferred such as aggregates, road bases sands and the like. The material to be spread as road base or on a pavement surface will be typically funnelled from a tipper into the hopper. The hopper receives and retains material delivered from the tipper for discharge via the spreader box.

Referring to figure 1 there is shown a perspective view of a spreader assembly 1 attached to a tip truck 2. Assembly 1 includes a control console 3 and an operator platform 4. Control console 3 comprises a programmable logic computer 5 which is responsive to predetermined operating parameters inserted by the operator to control delivery of aggregate 6 from vehicle 2.

Referring to figure 2 there is shown a side elevation of the spreader assembly 1 of figure 1. Once programmed, assembly 1 operates automatically in response to selected operating parameters which influence the required rate of discharge of aggregate 6 for a predetermined thickness of aggregate layer 7. Assembly 1 is detachably fitted to vehicle 2 by means of bolts or alternative means. Due
to the weight of assembly 1 a fork lift may be required to lift the assembly into position.

An operator will stand on platform 4 (as shown in figure 1) and operate the spreader assembly 1 by inputting operating parameters into a programmable logic computer (PLC) 5 which is located in frame 8. PLC 5 may alternatively be located in and operated from the cabin of vehicle 2 or remote from the spreader assembly thereby allowing remote control of spreading operations.

Assembly 1 further comprises a gate assembly 9 which is preferably air actuated but could be hydraulically operated. Gate assembly 9 may comprises a single gate or an array of separate gates individually operable. As shown in figure 1, assembly 1 may comprise individual gates which are individually and selectively operable by means of pneumatic cylinders 11-19. The number of gates can be adjusted according to design requirements. Thus the assembly can comprise a single gate disposed the full width of the assembly or individual gates which allow an operator to make adjustments according to the width of the required aggregate layer 6. Assembly 1 is attached to tipper 10 via bolts 20 and includes side baffles 21 and 22 to retain aggregate 6 within the assembly envelope. Aggregate 6 gravitates into hopper 23 and is released by gate assembly 24. Assembly 1 further comprises ground engaging telescopic members 25 and 26 which engage a ground surface when the assembly is released from vehicle 2. Screeding assembly 27 is adjustable by operation of cylinder 28 (see figure 2) and allows variation of the thickness of aggregate 6. Cylinder 28 is preferably an air operated actuator or electric actuator. Alternatively the cylinder may be hydraulically operated.
Figure 2 shows a side elevation of the spreader assembly and control console of figure 1 with corresponding numbering.

Referring to figure 3 there is shown an enlarged cross sectional elevation of a spreader assembly 30 according to a preferred embodiment. Spreader 30 comprises a hopper 31 (abbreviated) which receives aggregate 32 from an aggregate supply vehicle (not shown). Hopper 31 communicates with spreader box 33 which temporarily receives and retains until discharge aggregate 32. The volume capacity of hopper 31 can be manufactured to suit job requirements. Spreader box 33 includes a connection assembly 34 which includes bolts 35 and 36 capable of attachment to a tipper 10 of a vehicle (see figure 1). Spreader assembly 30 may be adapted for attachment to a vehicle other than a truck although a tipping truck is a preferred feed source of aggregate/road base or pavement surfacing material for spreader assembly 30. Assembly 30 further comprises a gate 37 which may either span the width of an aggregate discharge chute opening 38 in spreader box 33 or comprise one of a plurality of similar gates which are independently operable responsive to at least one input.

Gate 37 which is pivotally attached at hinge 39. Gate 37 is operably connected to adjustable air actuated cylinder 40 to enable alteration of the size of a discharge opening 38 through which a material such as aggregate 32 fed into hopper 31 thence spreader box 33 will be discharged from assembly 30. Cylinder 28 is preferably an air operated actuator or electric actuator. Alternatively, the cylinder may be hydraulically operated. Gate 37 is actuated by means of pneumatic rams 41 which is responsive to an output from PLC which in turn responds to an input parameter as will be described in more
detail below. Ram 41 is either directly or indirectly linked to gate 37. As shown in figure 3, ram 41 is pivotally connected to arm 42 via pin connection 43. Arm 42 is in turn pivotally connected to hinge 39 by pin 44. Arm 42 is therefore capable of movement relative to pin connections 43 and 44. Ram 41 in operation selectively moves in the direction of arrows 45 and 46. Movement in the direction of arrow 46 will effect closure of gate 37 whereas movement of ram 41 in the direction of arrow 45 will open gate 37. Gate 37 may be segmented and therefore adjusted according to the width of spread required or the discharge rate.

Assembly 30 further comprises a screeding assembly 47 comprising a downwardly depending strut 48 connected at one end to pivoting hinge 49 via pin 50. Arm 51 is also pivotally attached at one end to hinge 49 and at the other end to electrically actuated cylinder 53 via pin connection 52. Electrically actuated cylinder 53 is also linked to the PLC. Cylinder 53 includes ram 55 capable of movement in the direction of arrows 56 and 57. When ram 55 moves in the direction of arrow 56 strut 48 moves about pin 50 causing screeding assembly 47 to move in the general direction of arrow 58. Screeding assembly 47 can therefore move forwards or backwards. This enables the depth of the layer of discharged material to be adjusted.

Figure 4 shows the spreader of figure 3 with aggregate delivery gate 37 partially open. Aggregate 32 is shown discharging from spreader box 33 to pavement surface 59 as the assembly advances in the direction of arrow 60. In the case where bitumen is laid and is covered with gravel/aggregate/road base, to ensure that the vehicle does not travel over the freshly laid bitumen the vehicle may discharge the surfacing gravel/aggregate/road base, as it reverses
in the direction of arrow 60a. This ensures that the vehicle travels only on the
discharged gravel/aggregate/road base, and not on the bitumen.

Screeing assembly 47 trails discharge chute opening 38 and maintains
aggregate 32 at a predetermined thickness. The clearance distance d between
screeing assembly 47 and ground surface 58 will dictate the thickness of the
material 32.

Figure 5 shows the spreader of figure 3 with aggregate delivery gate 37 fully
open and screeing assembly 47 disposed at an angle allowing a greater
aggregate thickness. Screeing assembly 47 may be rotated in the opposite
direction by retraction of ram 55 in the direction of arrow 56. By adjusting air
operated gate 37 and screeing assembly 47 the discharge rate and thickness
can be adjusted during delivery and responsive to one or more
predetermined input parameters, such as vehicle speed or motion.

Figure 6 shows a perspective view of the spreader assembly of figure 1
with corresponding numbering detached from a vehicle.

Figure 7 shows a schematic layout of control system elements according to a
preferred embodiment. Figure 7 is best read in conjunction with figure 8 which
shows a schematic flow diagram of the steps of operation of the spreader
assembly. Figure 7 shows the preferred locations of speed sensor, electronic
transmitters and switches. Vehicle speed sensor 70 is located on or near
chassis 71. Tilt position transmitter 72 is preferably located at the rear of the
vehicle. Likewise the electronics for operation of the gate positions are located
near the gates. Each gate includes a proportional gate position transmitter 73
with proportional gate open limit switch 74 and proportional gate closed limit
75.
Figure 8 shows a flow diagram of the operation of the spreader assembly according to a preferred embodiment. An important objective of the computer controlled spreader assembly is to ensure that the required amount of material is discharged to eliminate wastage by oversupply of material and to ensure consistency of delivery to meet design requirements. Accurate delivery of granular material from a moving hopper charged by a material supply is difficult to achieve as it is dependent upon a number of fixed and variable parameters whose relationship is constantly changing during delivery as some external and unpredictable influences may change delivery rate and conditions for a linear distance. The vehicle which discharges the aggregate material may influence discharge rates due to tyre circumference, differential ratio, road speed translating into pulses /revolution. The truck includes a pick up sensor which senses road speed. It also includes a tilt sensor which detects body tilt angle. The pick up sensor detects road speed pulses per revolution. A signal proportional to body tilt angle is emitted preferably between 4-20 mA. A proportional signal relative to stroke position if proportional gate is emitted between 0-10 vDC. Proportional gate position limit switches set open and closed position limits. The PLC contains four main programs. The first of these is a vehicle safety check program which allows an operator to check to determine if operation is available. Operator console switches and selections are checked to ensure operation is available. If all safeties are clear an indication lamp is set to ON. Alternatively, an error message is displayed and the proportional gate is disabled from operating. The operator may then rectify any problems and re establish available operation.
The second program allows setting of truck parameters. Road speed is the critical parameter which is a function of the product of tyre circumference, differential ratio and road speed pulses/ pulses per revolution. A third program allows for gate calibration which is required daily to establish if the spread rate delivered is commensurate with the spread rate prescribed. This is carried out by performing spread rate and mat tests prior to commencing a job. A fourth program allows loading of truck operation parameters. An aggregate size parameter is loaded by an operator. This parameter will be the starting point for determination of the remaining operating parameters which must accommodate aggregate size. The operation program is loaded with parameters which correspond to aggregate size. The spread rate weight is selected by the operator and converted to a raw proportional gate position. This result is then compensated for by the tilt feedback value. The proportional gate tilt compensated position is then calculated by a ratio of the raw proportional gate position and the truck tilt angle. The road speed compensated value is then calculated by a ratio of the proportional gate tilt compensated position and the calculated road speed. This result provides the operating set value for the proportional gate position. The set value then provides an accurate repeatable spread rate of aggregate on the ground.

The operator console screen displays operating parameters, truck operating status, selected aggregate recipe and weight, recipe details and error or fault messages.

The proportional gate position is controlled by the calculated set value compared to the position feedback signal. The comparison result will activate either an open or close command signal for the gates. Gates 11-19 are each
activated by individual selector open and close switches which actuate solenoids connected to each drive cylinders for each gate. Timed pulse open signal opens solenoid valves for each material gate.

In use, the operator stands on the operator platform and selects the required amount of aggregate. Next, gate assemblies are opened in accordance with a corresponding input parameter or parameters. The operator console is preferably push button digital operation. Once the gate assemblies are set with reference to the kg/m² discharge rate set for a particular job, aggregate is fed into the hopper and eventually onto a road surface. A speed sensor linked to a tail shaft of the vehicle will precipitate a response parameter which may adjust the opening of gate assemblies which in turn adjusts the discharge of aggregate to maintain the design discharge rate for a particular job. The function of sensor is to detect the number of pulses determined by rotation of the tail shaft and relay this information to the PLC for appropriate adjustment of the gate assembly. According to one embodiment the sensor includes a cog on the tail shaft which reads pulses commensurate with the degree of travel of a vehicle wheel. The PLC, knowing the number of pulses can calculate the distance of travel of the wheel or horizontal speed and adjusts the gate assembly to either increase or decrease discharge of the material to be spread according to the design spread rate for a particular job. In an alternative embodiment, the PLC may make the gate assembly adjustments with reference to an alternative parameter such as wheel revolutions. The assembly may further comprise an incline meter to determine the angel of a truck body and
an absolute linear displacement sensor which determines the precise position of the spread rate screeding assembly.

According to one embodiment there are nine individual gate assemblies which are opened and closed by separate individual air actuated pneumatic rams. These may alternatively be hydraulically or electrically actuated. This enables an adjustment of the width of aggregate discharge opening. Gate arms may be forced open by pneumatic air and the aggregate in the hopper. The spread rate screeding rack controls the amount of gravel spread onto the road surface via an electric actuator. The range and degree of movement that the actuator controls forward or reverse movement is predetermined by the PLC. The computer receives it operating data from such parameters as road speed, angle of truck body, and an absolute linear displacement which determines the precise position of the spread rate. The PLC program will calculate from the input parameters the job discharge rate requirements and adjust the gate assembly accordingly, to ensure correct kg/m² discharge or spread rate.

The present invention herein described according to a preferred embodiment has numerous advantages over the prior art. Firstly, the computer control eliminates the human error which prevails in the prior art methods and apparatuses by allowing accurate control of the discharges of material by adjusting in the event of vehicle stoppages or slow down. The computer accurately controls the material spread rate in each and al operations and leaves the operator free to assume a monitoring role which includes watching for obstructions such as power lines. It is a mandatory requirement in road surfacing in which aggregate is spread from a hopper to employ an observer with a 5099 ticket whose mandate is to watch for power lines to ensure no
snagging. This activity requires at least one individual but where a computer controlled assembly is employed in accordance with the invention, the operator of the assembly can also function safely as an observer due to the automation provided by the logic computer. The invention being adaptable as an attachment to a vehicle frees a tipper when not attached to the box spreader to be employed elsewhere. It also enables adaption to relatively small spreading jobs. For example jobs as small as 300mm wide to 900mm wide may be performed. The computer controlled apparatus can be used in spreading up and down hills or around corners and may be transported on public roads day or night. The spreader assembly may be switched from manual to automatic (computer driven) operation or from computer to manual operation.

It will be recognised by persons skilled in the art that numerous variations and modifications may be made to the invention as broadly described herein without departing from the overall spirit and scope of the invention. Examples of such variations include use of a single gate or plurality of gates to close the hopper opening, use of a hydraulic cylinder rather than an air actuated ram.
THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A spreader assembly for the controlled delivery to a surface of granular materials such as aggregates from a hopper in communication with a source of said materials external to said assembly; wherein the assembly comprises:
   an opening to said hopper which receives said materials from said materials source,
   a discharge opening from said hopper;
   a gate adjacent said discharge opening;
   control means for adjusting the rate and or quantity (weight or volume) of said materials delivered from said hopper; wherein said control means includes means to receive at least one input parameter and means to convert said at least one input parameter into an output parameter for performing at least one mechanical activity in the assembly; wherein the rate or quantity at which said material is delivered is dependent upon said at least one input parameter and said mechanical activity.

2. An assembly according to claim 1 wherein the assembly is attached to a vehicle and one said at least one input parameter is vehicle speed.

3. An assembly according to claim 2 wherein said mechanical activity is opening and closing said gate to adjust the rate and/or quantity of discharge said materials.

4. An assembly according to claim 3 wherein the vehicle includes a pick up sensor which senses road speed in pulses per revolution.
An assembly according to claim 4 wherein the vehicle includes a tilt sensor which detects body tilt angle.

An assembly according to claim 5 wherein the control means is a PLC and includes a first program which allows setting of truck parameters.

An assembly according to claim 6 wherein the PLC includes a vehicle safety check program which allows an operator to check to determine if operation is available.

An assembly according to claim 7 wherein the PLC includes a third program which allows for gate calibration to establish if a spread rate of material delivered is commensurate with a prescribed spread rate.

An assembly according to claim 8 wherein the PLC includes a fourth program which allows loading of vehicle operation parameters.

An assembly according to claim 9 wherein material discharge rates are determined with reference to tyre circumference, differential ratio, road speed translating into pulses/revolution.

An assembly according to claim 10 wherein the there are a plurality of separate gates including limit switches which provide open and closed position limits.

An assembly according to claim 11 wherein vehicle operation program is loaded with parameters which correspond to material aggregate size.

An assembly according to claim 12 wherein a spread rate weight is selected and converted to a raw proportional gate position.

An assembly according to claim 13 wherein the raw proportional gate position is compensated for by the tilt feedback value.
15 An assembly according to claim 14 wherein the proportional gate tilt compensated position is a ratio of the raw proportional gate position and the truck tilt angle.

16 An assembly according to claim 15 wherein a road speed compensated value is calculated by a ratio of the proportional gate tilt compensated position and a calculated road speed.

17 An assembly according to claim 16 wherein an operator console screen of the PLC displays operating parameters, vehicle operating status, selected aggregate recipe and weight, recipe details and error or fault messages.

18 An assembly according to claim 17 wherein a timed pulse open signal opens solenoid valves for each material gate.

19 An assembly according to claim 18 wherein said gates are each activated by individual selector open and close switches which actuate solenoids connected to air actuated pneumatic rams for each gate.

20 An assembly according to claim 19 wherein operating parameters of said assembly may include, discharge rate of said material from said hopper in m³/unit area, speed of said apparatus, dimensions of said hopper opening, spread rate in kg/m².

21 An assembly according to claim 20 wherein the spread rate may be adjusted by 0.5kg per m² at any time during operation from minimum to maximum settings.

22 A vehicle including a spreader assembly for the controlled delivery of granular materials such as aggregates from the vehicle to a hopper in said assembly; wherein the assembly comprises; an opening to said hopper which receives said materials from said vehicle; a discharge opening from said hopper;
a gate adjacent said discharge opening capable of regulating the discharge of
the granular material;

control means for adjusting the rate and/or quantity (weight or volume) of
said materials delivered from said hopper; wherein said control means includes
a computer having means to receive at least one input parameter and means to
convert said at least one input parameter into an output parameter for
performing at least one mechanical activity in the assembly which controls the
delivery rate and/or quantity of said granular material; wherein the rate or
quantity at which said material is delivered is dependent upon said at least one
input parameter.

23 A vehicle including a spreader assembly according to claim 22 wherein the
assembly is detachably fixed to the vehicle.

24 A spreader assembly for the controlled delivery to a surface of granular
materials such as aggregates from a hopper in communication with a source of
said materials external to said assembly; wherein the assembly comprises;
an opening to said hopper which receives said materials from said materials
source,
a discharge opening from said hopper;
a gate adjacent said discharge opening;

control means for adjusting the rate and or quantity (weight or volume) of said
materials delivered from said hopper; wherein said control means is responsive
to a sensor which delivers at least one input parameter to said computer and
means to convert said at least one input parameter into an output for adjusting
the size of the discharge opening; wherein, the rate or quantity at which said
material is delivered is dependent upon said at least one input parameter and the adjustment of said discharge opening.

25 A spreader assembly according to claim 22 wherein the assembly is attached to a vehicle and the sensor detects speed of said vehicle.

26 A control system for use in the controlled delivery of granular materials such as aggregates from a vehicle mounted spreader assembly including a hopper for holding and discharging said materials from said hopper; wherein the control system comprises;

- a programmable logic computer (PLC) for adjusting the delivery rate and/or quantity of said materials delivered from said hopper;
- a sensor for detecting the speed of a vehicle to which the assembly is attached;
- said control system further comprising a computer input having means to receive at least one input parameter and means to convert said at least one input parameter into at least one mechanical activity performed by said apparatus and which regulates the discharge of said materials delivered from the vehicle responsive to said input; wherein said rate or quantity at which said material is delivered is dependent upon said at least one input parameter.

27 An assembly for the controlled delivery of granular materials such as aggregates from a hopper for receiving and holding said materials to a surface exterior of said apparatus; wherein the apparatus comprises;

- a control assembly for adjusting the rate and or quantity of said materials delivered from said apparatus; wherein said control assembly includes;
- a sensor which senses forward motion of said assembly,
a computer in communication with said sensor and having means to receive at least one input parameter and means to convert said at least one input parameter into a mechanical activity performed by said apparatus, which controls the flow of materials delivered by said apparatus;

5 mechanical rams operably connected to said computer and to at least one gate associated with said hopper; wherein, said at least one gates selectively open and close to control the rate and/or quantity at which said material is delivered responsive to said at least one input to said computer.

28 A method for controlled delivery of a granular material from a vehicle mounted spreader assembly to a pavement surface, wherein the assembly comprises

a hopper which receives said materials from said materials source,

da discharge opening from said hopper;

15 a gate adjacent said discharge opening;

control means for adjusting the rate and or quantity (weight or volume) of said materials delivered from said hopper; wherein said control means includes a computer having means to receive at least one input parameter and means to convert said at least one input parameter into an output parameter for performing at least one mechanical activity in the assembly; wherein the method comprises the steps of;

20 rate or quantity at which said material is delivered is dependent upon said at least one input parameter and said mechanical activity; wherein the method comprises the steps of;

25 a) inputting vehicle parameters into said computer;
b) calibrating operation of said spreader assembly;

c) selecting an aggregate size for delivery by said hopper;

d) selecting spread rate weight and allowing conversion to a raw proportional
   gate position;

e) adjusting values by compensating for tilt and/or road speed;

f) obtaining a repeatable set value for spread rate of aggregate.

29 A method according to claim 28 including the steps of setting operating
   parameters including, discharge rate of said material from said hoper in m³/unit
   area, speed of said vehicle, dimensions of said hopper opening, spread rate of
   material in kg/m².

30 A method according to claim 29 wherein, the spread rate may be adjusted
   0.5kg per m² at any time from minimum to maximum settings.

31 A method according to claim 30 wherein least one gate on said hopper is
   adjusted responsive to said at least one input parameter so that said
   predetermined amount of material is discharged from said assembly.

32 A method according to claim 31 wherein one or more gates are adjusted to
   adjust an opening in a hopper thereby adjusting the discharge rate of the
   aggregate from said assembly.

33 A spreader assembly according to claim 24 wherein the control means is a
   programmable logic computer.
Programmable Logic Controller

Truck Safety Check Program
Operator console switches and selections are checked to ensure operation is available. If all safeties are OK an indication lamp is set ON, else an error message is displayed and the proportional gate is disabled from operating.

Truck Parameters Program
Convert preset truck parameters by calculation
Road Speed =
Tyre Circ x Diff Ratio x Road Speed Pulses / Pulses per rev.

Truck Calibration Program
Adjustment of proportional gate calibration for daily checks. Day Zero adjustment is carried out following speed rate and tests prior to commencing job.

Truck Operation Program
Calculation of Proportional Gate Control position
Aggregate size is selected by the operator. The program is then loaded with the corresponding recipe parameters. Spread rate weight is selected by the operator.
The weight selected by operator is then converted to the raw proportional gate position. The result is then compensated for the Tilt feedback value. Proportional gate Tilt compensated position is then calculated by a ratio of the raw proportional gate position and the truck tilt angle. The road speed compensated value is then calculated by a ratio of the proportional gate tilt compensated position and the calculated road speed. The result provides the operating set value for the proportional gate. This set value then provides an accurate, repeatable spread rate of aggregate on the ground.

Material Gates 1 to 9
Open/Closed command switches
Each material gate is controlled by an individual selector switch with an on-off Master switch to control all gates.

Operating Parameters Display
Truck current operating status
Selected aggregate recipe and weight
Recipe details
Error or fault messages

Operator Console

Operating Commands & Selections
Recipe Selection
Spread rate selection
Parameter entry

Proportional Gate Position Control
Open & Close Command Signals
Position is controlled by the calculated set value compared to the position feedback signal

Material Gates 1 to 9
Drive Cylinders
Close – direct command signal to close solenoid valves for material gates 1 to 9
Open – timed pulse open signal to open solenoid valves for material gates 1 to 9 via PLC

FIG 8
INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl.: E01C 19/15, 19/20, 19/18, 19/12

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)

IPC(7): E01C 19/15, 19/20, 19/18, 19/12

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

AU: E01C 19/15, 19/20, 19/18, 19/12

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

Derwent Patents File: Dwpi with keywords (speed+ or velocity or motion+)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

<table>
<thead>
<tr>
<th>Category*</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>DE 3625114 A (AMAZONEN-WERKE) 4 February 1988. All document.</td>
<td>1-33</td>
</tr>
<tr>
<td>X</td>
<td>FR 2271339 A (BECK) 16 January 1976. All document.</td>
<td>1-33</td>
</tr>
<tr>
<td>X</td>
<td>FR 2286085 A (VIBRATECHNIQUES SA) 28 May 1976. All document.</td>
<td>1-33</td>
</tr>
<tr>
<td>X</td>
<td>FR 2531732 A (ACMAR SA) 17 February 1984. All document</td>
<td>1-33</td>
</tr>
<tr>
<td>X</td>
<td>FR 2572433 A (FEBVRE) 2 May 1986. All document</td>
<td>1-33</td>
</tr>
</tbody>
</table>

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

"L": document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O": document referring to an oral disclosure, use, exhibition or other means

"P": document published prior to the international filing date but later than the priority date claimed

"T": later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X": document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y": document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&": document member of the same patent family

Date of the actual completion of the international search: 26 August 2002

Date of mailing of the international search report: 3 SEP 2002

Name and mailing address of the ISA/AU:

AUSTRALIAN PATENT OFFICE
PO BOX 200, WODEN ACT 2606, AUSTRALIA
E-mail address: pct@ipaaustralia.gov.au
Facsimile No. (02) 6283 3929

Authorized officer:

DAVID LEE
Telephone No.: (02) 6283 2107

Form PCT/ISA/210 (second sheet) (July 1998)
<table>
<thead>
<tr>
<th>Category</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>US 4230280 A (LEIGH et al) 28 October 1980. All document.</td>
<td>1-33</td>
</tr>
<tr>
<td>X</td>
<td>US 5842649 A (BECK et al) 1 December 1998. All document.</td>
<td>1-33</td>
</tr>
<tr>
<td>X</td>
<td>SE 8501451 A (DYNAPAC AB) 26 September 1986. All document. See Derwent English language abstract, accession no. 87-077630, class Q41.</td>
<td>1-33</td>
</tr>
</tbody>
</table>
This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>DE 3625114</td>
<td>EP 255630</td>
</tr>
<tr>
<td>FR 2271339</td>
<td>NONE</td>
</tr>
<tr>
<td>FR 2286085</td>
<td>NONE</td>
</tr>
<tr>
<td>FR 2513732</td>
<td>NONE</td>
</tr>
<tr>
<td>FR 2572433</td>
<td>NONE</td>
</tr>
<tr>
<td>EP 997064</td>
<td>AU 57189/99</td>
</tr>
<tr>
<td>US 4230280</td>
<td>CA 1127269</td>
</tr>
<tr>
<td>US 5842649</td>
<td>CA 2236398</td>
</tr>
<tr>
<td>SE 8501451</td>
<td>NONE</td>
</tr>
<tr>
<td>WO 9935336</td>
<td>FR 2773183</td>
</tr>
<tr>
<td></td>
<td>FR 2775699</td>
</tr>
</tbody>
</table>

END OF ANNEX