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(54) **BALE ACCUMULATOR AND BALE ACCUMULATION METHODS**

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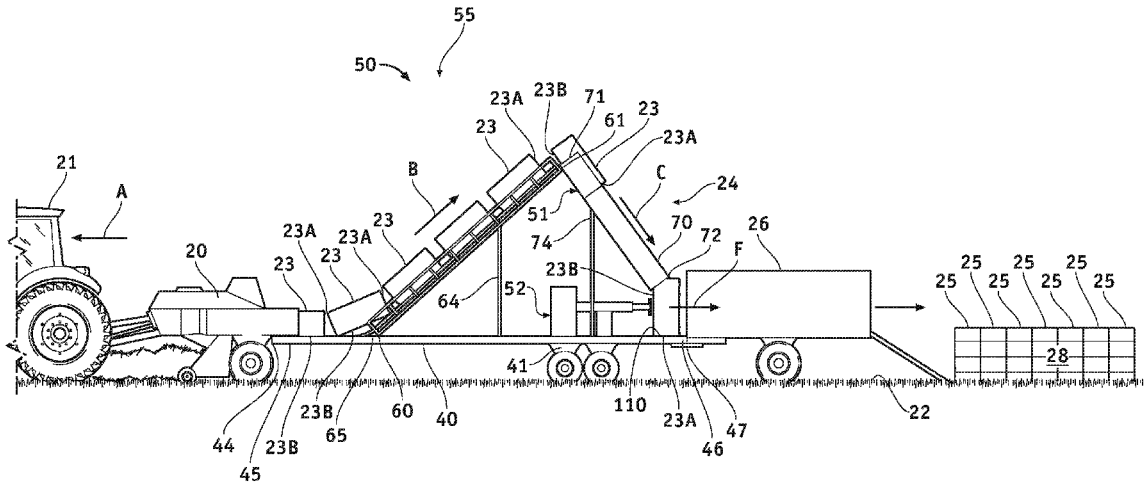
(57) **ABSTRACT**

A bale accumulator for grouping bales for group baling includes a platform, a depositor mounted adjacent to the platform for sequentially depositing bale sets onto the platform, each bale set when deposited onto the platform comprises a pair of bales positioned upright and side-by-side in a packing orientation so that their corresponding long sides are axially juxtaposed, and a packer apparatus mounted adjacent to the platform for packing one bale set at a time from the platform into a group baler trailing the platform each time a bale set is deposited onto the platform from the depositor without changing the packing orientation of the bales of each bale set.



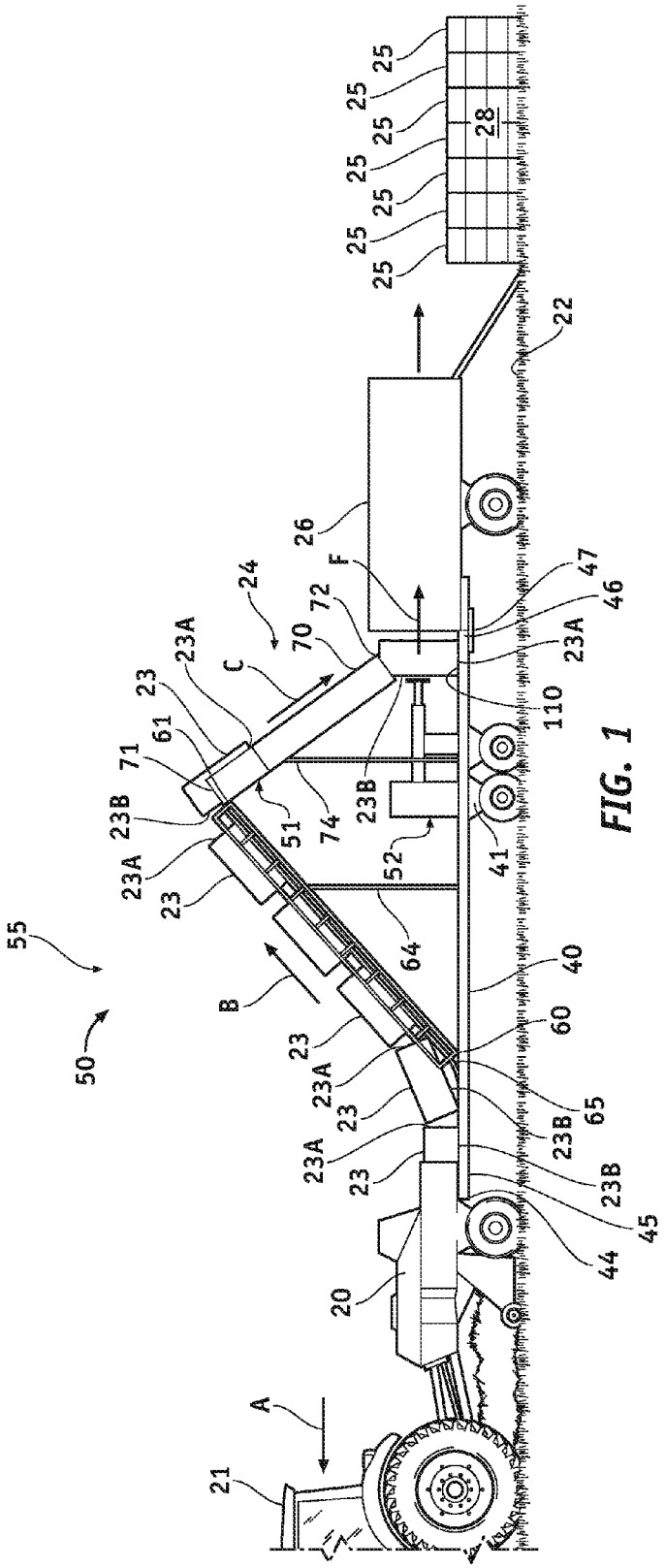

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FIG. 1

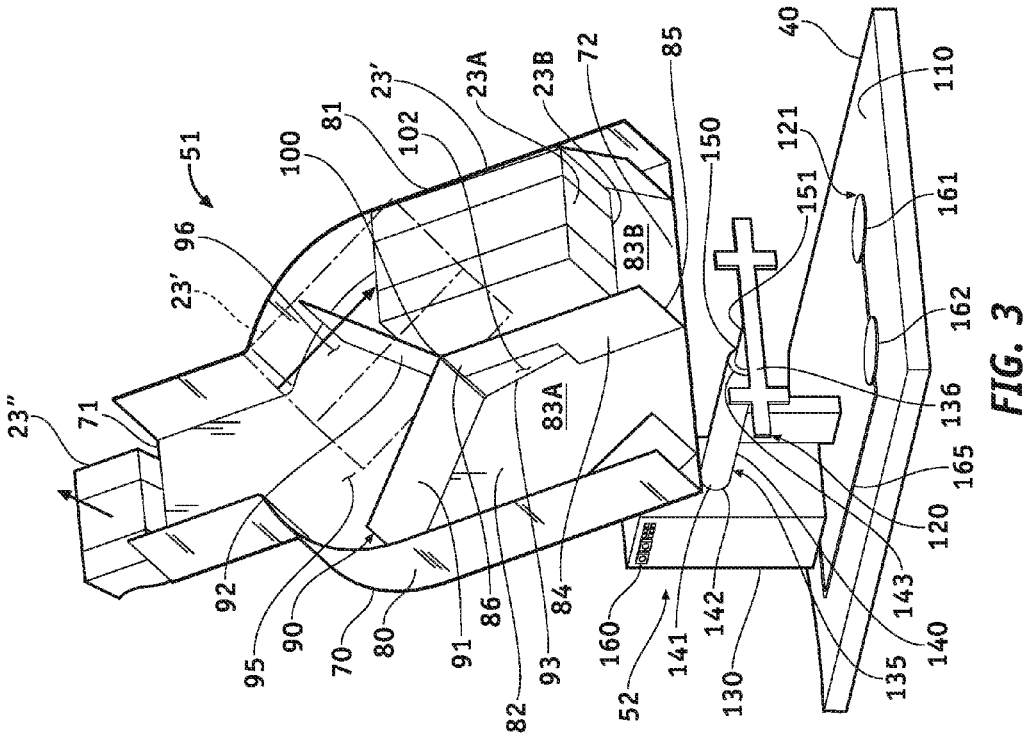
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FIG. 3

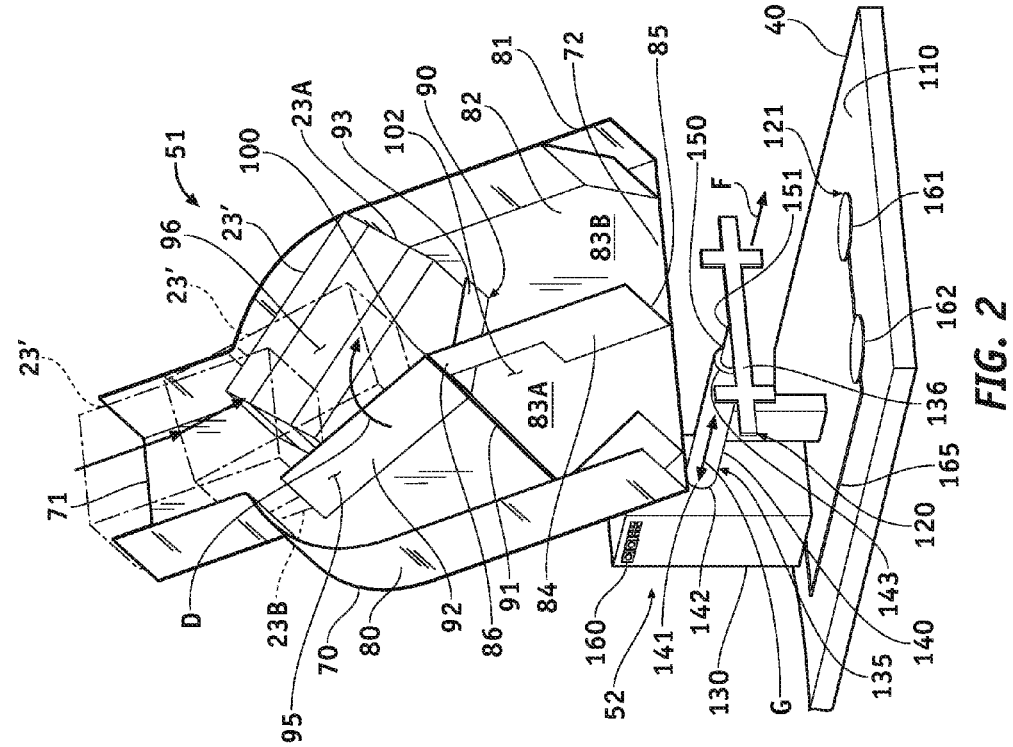
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FIG. 2

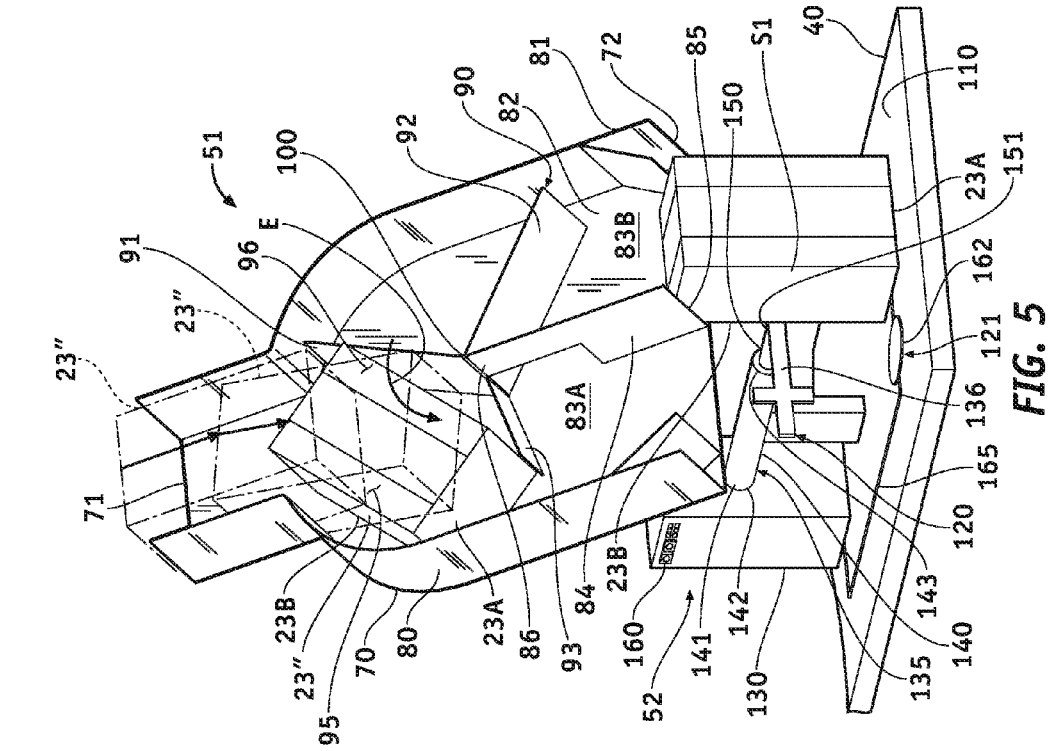
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FIG. 5

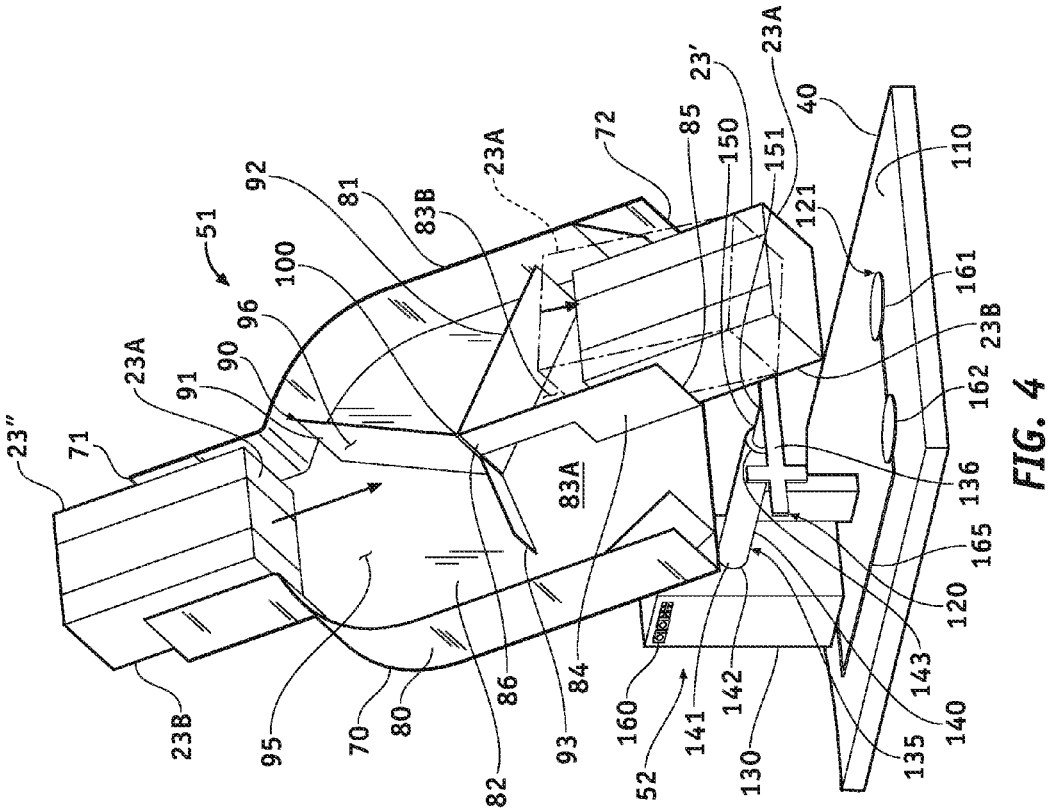
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FIG. 4

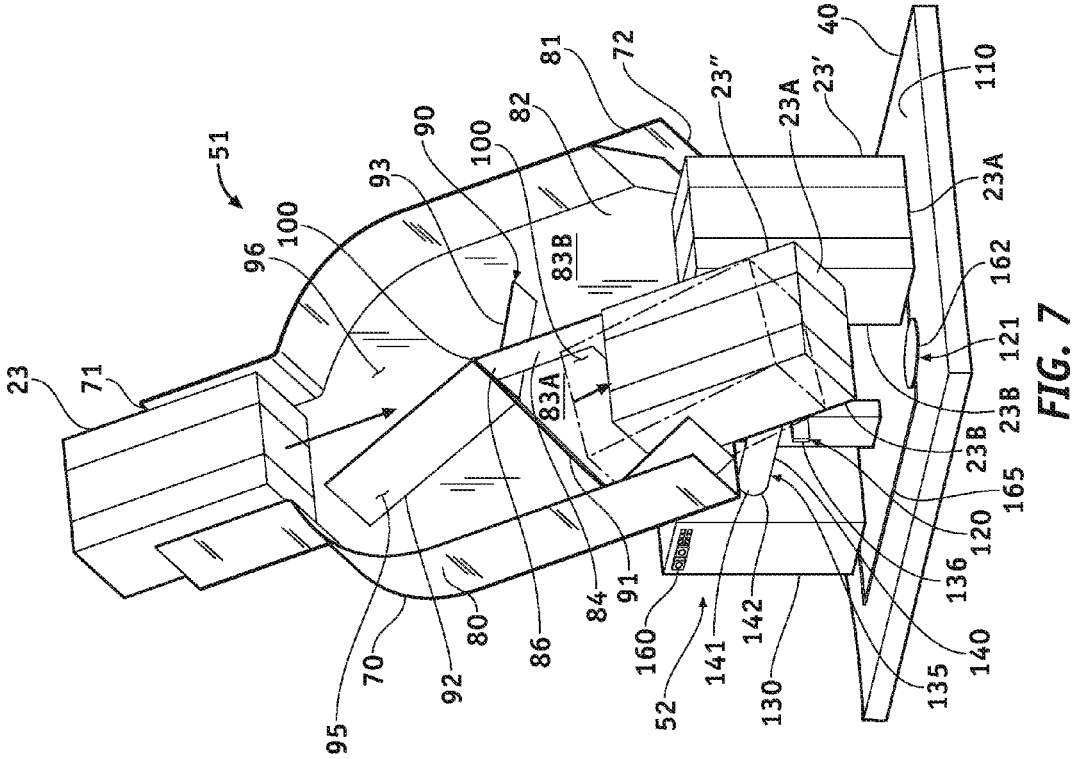
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FIG. 7

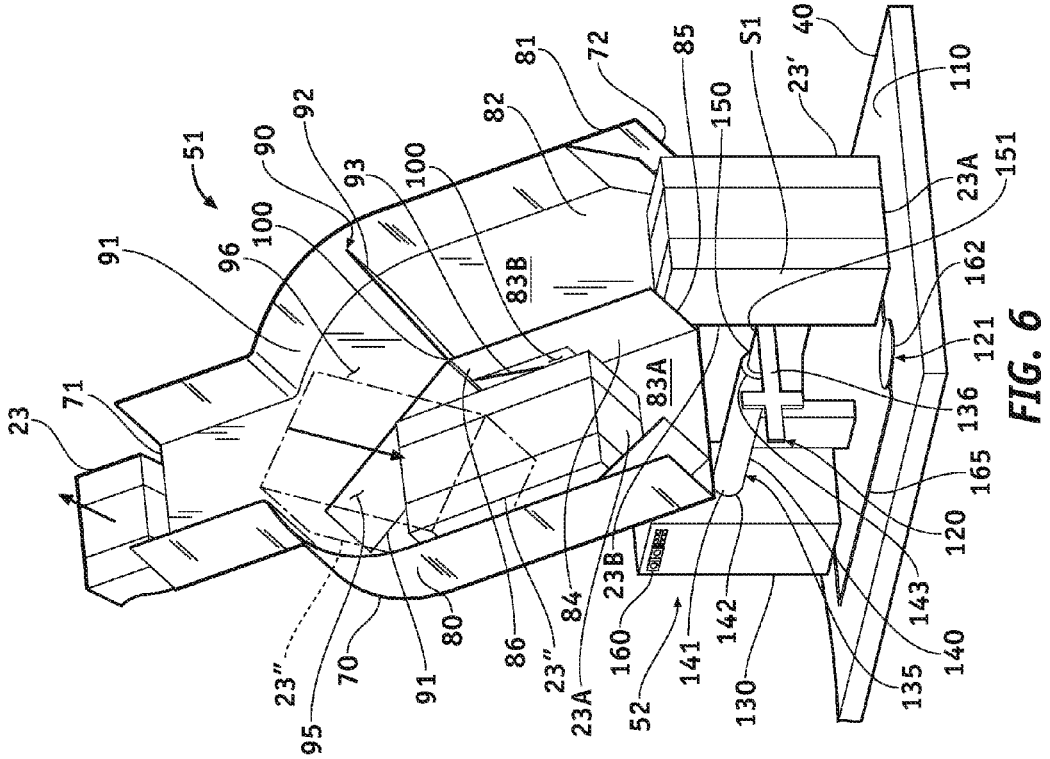
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FIG. 6

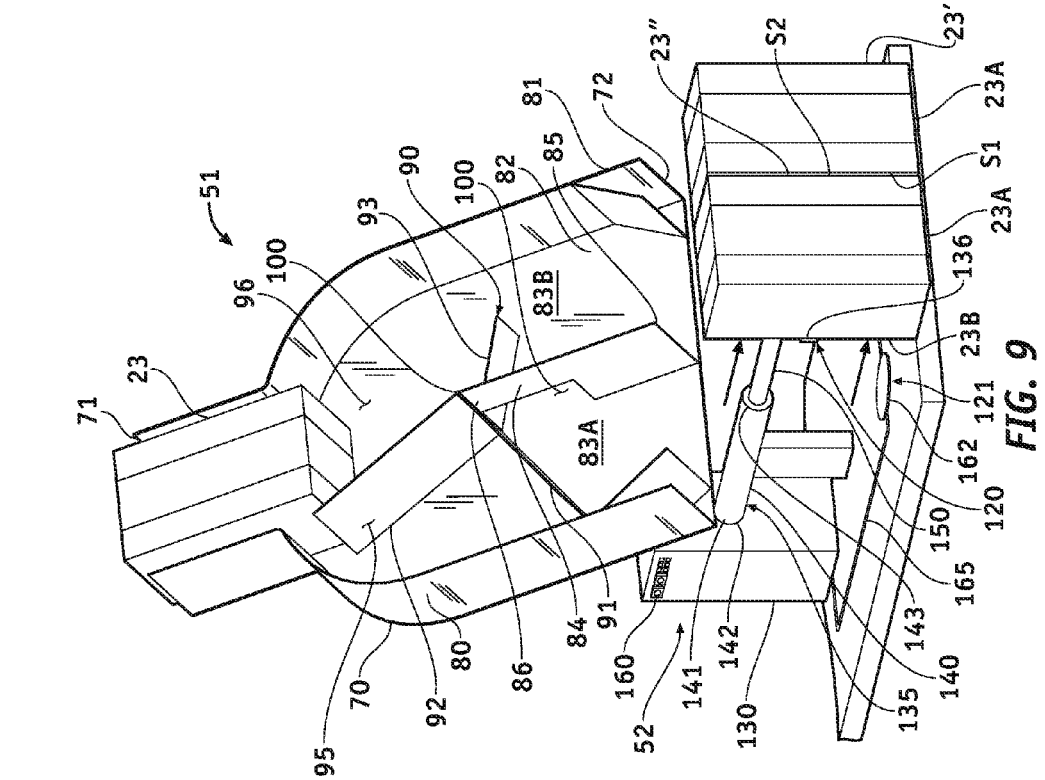
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FIG. 9

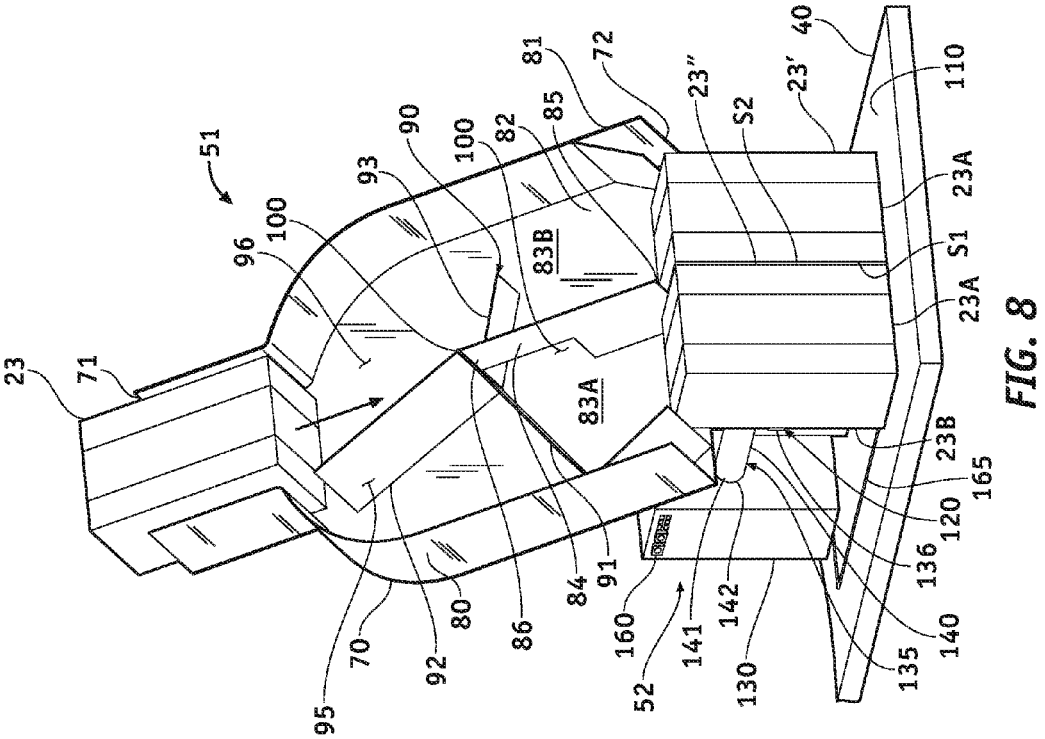
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FIG. 8

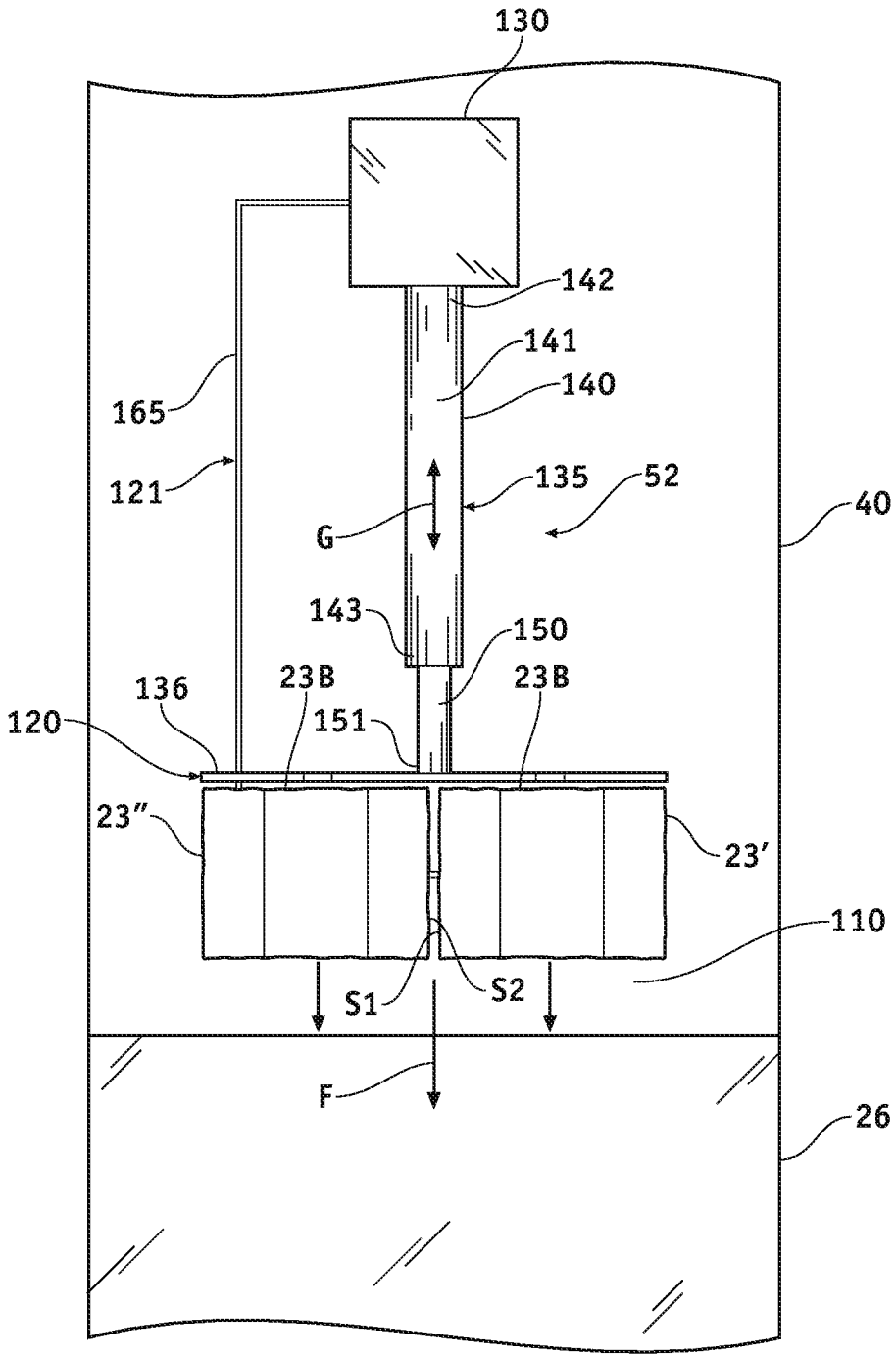
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FIG. 10

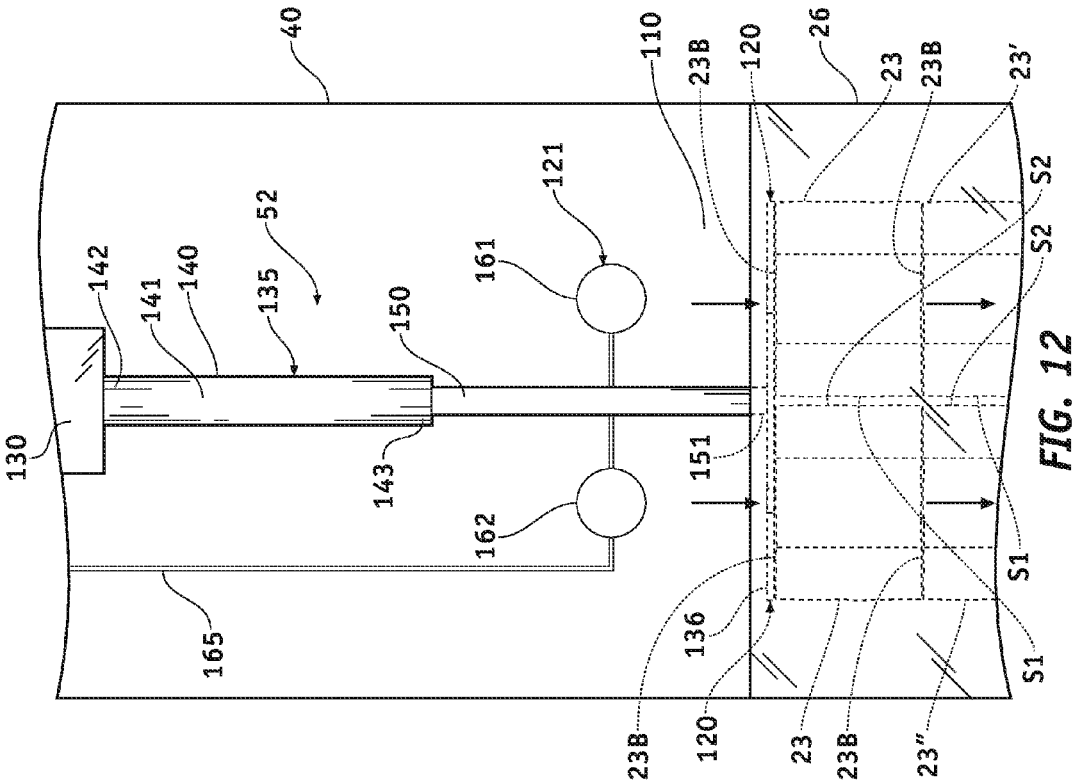
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FIG. 12

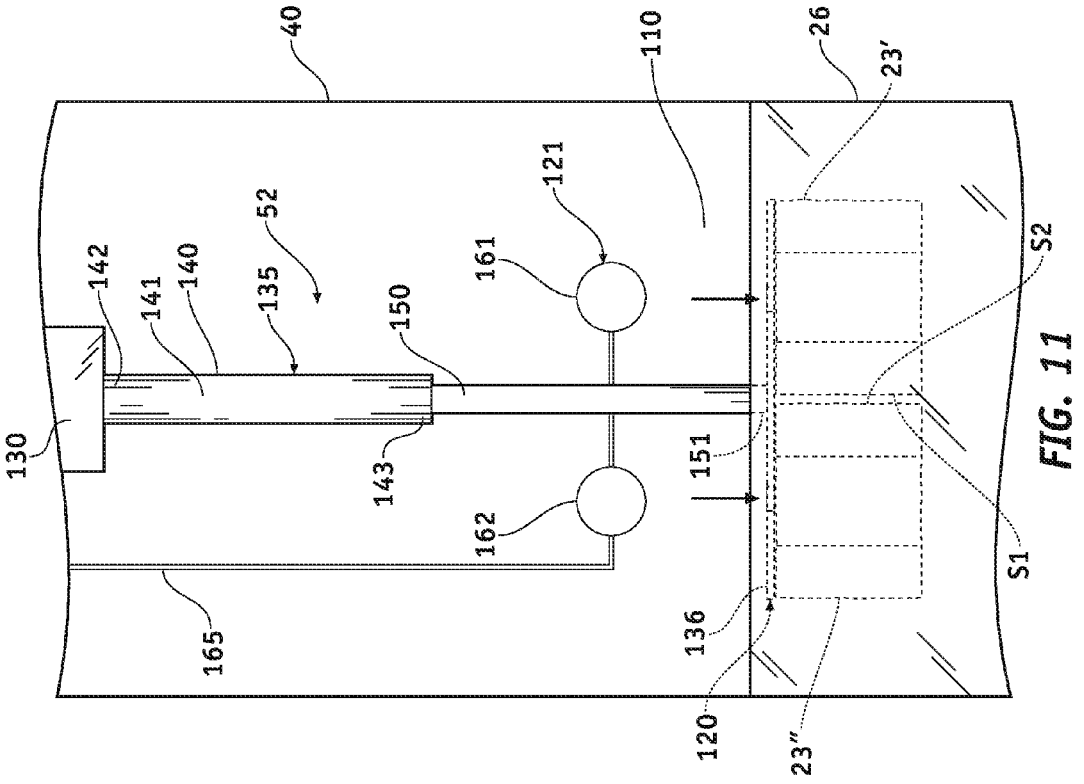
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FIG. 11

BALE ACCUMULATOR AND BALE ACCUMULATION METHODS

FIELD OF THE INVENTION

[0001] The present invention relates to farm machinery.

[0002] More particularly, the present invention relates to group balers for baling groups of bales of compressed crop material.

[0003] In a further and more specific aspect, the present invention relates to apparatus and methods for accumulating and packing bales into a group baler.

BACKGROUND OF THE INVENTION

[0004] A baler is a piece of farm equipment used to compress cut cropped material, such as hay, straw, cotton, etc., into compact bales for handling, transport, and storage. A variety of balers are commonly available for producing cylindrical or rectangular bales of various sizes bound with twine, strapping, netting, or wire.

[0005] Round balers are commonly used in industrialized countries. In the operation of a round baler, crop material is rolled up inside the baler into a roll of predetermined size, which is bound by twin or netting and then deposited from the rear of the baler onto the ground for further handling. Round bales require specific treatment for transport and handling because of their ability to roll. In the operation of a rectangular baler, crop material is gathered up inside the baler into a rectangle of predetermined size, which is bound by twine or netting and then deposited from the rear of the baler onto the ground for further handling.

[0006] Rectangular bales are easier to handle and transport compared to round bales because they inherently resist rolling and can be easily stacked for transport and storage, and group baled by a group baler. In the use of a group baler, which is often referred to as a bundler or a grouper, bales are packed into the group baler in a predetermined pattern. After a predetermined number of bales are packed into the group baler, the bales are bound together, such as by twine, netting, wire, plastic strapping, or steel strapping, into a group bale, which is then deposited onto the field. Although group balers are useful for creating groups of bound bales that are safe to transport and easy to store, loading a group baler is difficult and cumbersome, often requiring specialized equipment and manpower at substantial cost to the farmer.

SUMMARY OF THE INVENTION

[0007] According to the principle of the invention, a bale accumulator for grouping bales for group baling includes a platform, a depositor mounted adjacent to the platform for sequentially depositing bale sets onto the platform, each bale set when deposited onto the platform includes a pair of bales positioned upright and side-by-side in a packing orientation so that their corresponding long sides are axially juxtaposed, and a packer apparatus mounted adjacent to the platform for packing one bale set at a time from the platform into a group baler trailing the platform each time a bale set is deposited onto the platform from the depositor without changing the packing orientation of the bales of each bale set. The packer apparatus includes a ram for ramming a bale set along a linear drive path from the platform into the group baler each time the ram actuates, and a sensor apparatus operatively coupled to the ram and to the platform, wherein the ram actuates each time the sensor apparatus senses a bale set deposited onto the platform. The ram includes a drive assembly drivenly coupled to a frame. The frame is driven by the drive assembly from a starting position to a ramming position, for engaging and ramming a bale set from the platform into the group baler along the linear drive path, and back to the starting position from the ramming position, each time the drive assembly actuates. The drive assembly is a cylinder assembly including a cylinder and an operating rod. The frame is mounted on the operating rod, the operating rod is mounted partially within the cylinder for movement in reciprocal directions, and the frame moves in reciprocal directions between the starting and ramming positions upon actuation of the operating rod in reciprocal directions. The depositor is upright relative to the platform for sequentially gravity depositing bale sets onto the platform.

[0008] According to the principle of the invention, a bale accumulator for grouping bales for group baling includes a platform, a frame mounted adjacent to the platform, and a packer apparatus mounted adjacent to the platform. The frame includes a pair of bale-receiving areas for alternately depositing bales onto the platform into bale sets, each bale set when deposited onto the platform includes a pair of bales positioned upright and side-by-side in a packing orientation so that their corresponding long sides are juxtaposed, and a gate, the gate is movable between alternate positions for alternately directing bales into the bale-receiving areas, and the gate moves alternately from one to the other of the alternate positions each time a bale passes the gate. The packer apparatus is for packing one bale set at a time from the platform into a group baler trailing the platform each time a bale set is deposited onto the platform from the bale-receiving areas of the frame without changing the packing orientation of the bales of each bale set. The packer apparatus includes a ram for ramming a bale set along a linear drive path from the platform into the group baler each time the ram actuates, and a sensor apparatus operatively coupled to the ram and to the platform, wherein the ram actuates each time the sensor apparatus senses a bale set deposited onto the platform. The ram includes a drive assembly drivenly coupled to a frame. The frame is driven by the drive assembly from a starting position to a ramming position, for engaging and ramming a bale set from the platform into the group baler along the linear drive path, and back to the starting position from the ramming position, each time the drive assembly actuates. The drive assembly is a cylinder assembly including a cylinder and an operating rod. The frame is mounted on the operating rod, the operating rod is mounted partially within the cylinder for movement in reciprocal directions, and the frame moves in reciprocal directions between the starting and ramming positions upon actuation of the operating rod in reciprocal directions. The bale-receiving areas of the frame are upright relative to the platform for gravity depositing bale sets onto the platform.

[0009] According to the principle of the invention, a bale-accumulation method includes providing a platform, associated with a ram, and a group baler trailing the platform, sequentially depositing bale sets onto the platform between the ram and the group baler, each one of the bale sets when deposited onto the platform includes a pair of bales positioned upright and side-by-side in a packing orientation so that their corresponding long sides are juxtaposed, and actuating the ram packing one bale set at a time from the platform into the group baler each time a bale set is deposited onto the platform without changing the packing

orientation of the bales of each bale set. The step of sequentially depositing bale sets onto the platform between the ram and the group baler further includes providing a frame including bale-receiving areas for alternately depositing bales onto the platform between the ram and the group baler when bales are applied alternately to the bale-receiving areas, and applying bales alternately to the bale-receiving areas. The step of applying bales alternately to the bale-receiving areas further includes gravity feeding bales alternately to the bale-receiving areas. The step of actuating the ram packing one bale set at a time from the platform into the group baler each time a bale set is deposited onto the platform without changing the packing orientation of the bales of each bale set further includes providing a sensor apparatus operatively coupled to the ram and to the platform via a control unit, and the control unit automatically actuating the ram each time the sensor apparatus senses a bale set deposited onto the platform.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] Referring to the drawings:

[0011] FIG. **1** is a side elevation view of a baler, towed behind a tractor, shown partially, for gathering and compressing cut cropped material from a field into compact bales, an accumulator, towed behind the baler, for receiving the bales from the baler, grouping the bales into bale sets ahead of a group baler towed behind the accumulator, and packing the bale sets, one bale set at a time as each one is formed, into the group baler for group baling a predetermined number of bale sets **25** into a compact group bale that is deposited from the rear of the group baler onto the field;

[0012] FIGS. **2-8** illustrate a sequence of steps of accumulating bales into a bale set via the accumulator of FIG. **1**; and

[0013] FIGS. **9-12** illustrate a sequence of steps of packing bale sets into a group baler via the accumulator of FIG. **1**.

DETAILED DESCRIPTION

[0014] Turning now to the drawings, in which like reference characters indicate corresponding elements throughout the several views, attention is first directed to FIG. **1**, in which there is seen a side elevation view of a baler **20**, towed behind a tractor **21**, shown partially, for gathering and compressing cut cropped material from field **22** into compact bales **23**, an accumulator **24**, towed behind baler **20**, for receiving bales **23** from baler **20**, grouping or otherwise accumulating bales **23** into bale sets **25**, one bale set **25** at a time, ahead of a group baler **26** towed behind accumulator **24**, and packing bale sets **25**, one bale set **25** at a time as each one is formed, into group baler **26** for group baling a predetermined number of bale sets **25** into a compact group bale **28** that is deposited from the rear of group baler **26** onto field **22** for further handling. Baler **20**, tractor **21**, and group baler **26** are conventional and well known to the skilled farmer. Skilled farmers routinely refer to group baler **26** as bundlers or groupers.

[0015] Baler **20** is hitched to and trails tractor **21**, accumulator **24** is hitched to and trails baler **20**, and group baler **26** is hitched to and trails accumulator **24**. Baler **20**, accumulator **24**, and group baler **26** are wheeled machines, which enables them to roll in series across the field when advanced by tractor **21**. In use, the entire machine implement assembly of baler **20**, accumulator **24**, and group baler **26** is towed by tractor **21** forwardly in the direction of arrowed line A across field **22** for gathering and baling the cut cropped material from field into bales **23** via baler **20**, grouping/accumulating bales **23** into bale sets **25** via accumulator **24** and packing group baler **26** with bale sets **25** one-by-one via accumulator **24** as each bale set **25** is formed, and, after filling group baler **26** with its inherent, selected, or predetermined capacity of bale sets **25**, group baling baler bales sets **25** into group bale **28** via group baler **26** and depositing group bale **28** via group baler **26** from the rear of group baler **26** onto field **22** for further handling. Each bale set **25** includes a pair of upright bales **23** positioned side-by side, and group bale **28** includes seven bale sets packed together in a row, namely in-line from front to back. The bales **23** of each bale set **25** are not baled together individually. Rather, bale sets **25** are packed un-baled into group baler **26**, which then group bales bale sets **25** together into group bale **28** and deposits group bale **28** onto field **22**.

[0016] With continuing reference to FIG. **2**, accumulator **24** includes elongate platform **40**, conveyor **50**, depositor **51**, and packer apparatus **52**. Platform **40**, a heavy-duty decked frame, is mounted atop a wheeled chassis **41** for enabling wheeled movement of accumulator **24** across field **22**. Conveyor **50**, depositor **51**, and packer apparatus **52** are carried or otherwise supported by platform **40**.

[0017] Platform **40** includes leading end **44** hitched to the rear of baler **20** via hitch **45**, and trailing end **46** hitched to the front of group baler **26** via hitch **47**. Conveyor **50** and depositor **51** are mounted atop platform **40** between leading end **44** and trailing end **46**. Conveyor **50** is between baler **20** and depositor **51**, and depositor **51** is between conveyor **50** and group baler **26**. Conveyor **50** is for picking up bales one-by-one from baler **20** and conveying them one-by-one to depositor **51** and applying them one-by-one into depositor **51**, depositor **51** is for accepting bales **23** from conveyor **50** one-by-one and sequentially depositing bales **23** one-by-one onto platform **40** in bale sets **25** ahead of group baler **26**, each bale set **25** when deposited onto platform **54** from depositor **51** being a pair of bales **23** positioned upright and side-by-side in a packing orientation without being baled together so that their corresponding long sides are axially juxtaposed, and packer apparatus **52** is for packing each bale set **25**, one at a time as each bale set **25** is formed, from platform **40** into group baler **26** trailing platform **40** each time a bale set **25** is deposited onto platform **40** from depositor **50** without changing the packing orientation of the bales **23** of each bale set **25**. Packing bale sets **25** into group baler **26** from accumulator **24** without changing the packing orientation of the bales **23** after depositing them onto platform **40** is cost-efficient and expeditious, eliminating the need for complex and costly auxiliary bale-reorienting equipment.

[0018] Conveyor **50** is for conveying bales **23**, one-by-one, from baler **20** to depositor **51**. Conveyor **50** is a well-known and conventional motor-driven belt conveyor having an inlet end **60** and an opposed outlet end **61**. Inlet end **60** is mounted, such as with mechanical fasteners, welding, or the like, atop platform **40** adjacent to leading end **44** to the rear of baler **20**, and inclines upwardly and forwardly in the direction of arrowed line B at an inclined angle of from 40-50 degrees toward depositor **51** from inlet end **60** to outlet end **61**. An upright support **64** connected to platform **40** and to conveyor **50** between its inlet and outlet ends **60** and **61** supports conveyor **50** in its inclined orien-

tation. Conveyor **50** rotates a belt **65** when conveyor **50** is actuated. Belt **65** is a part of conveyor **50**. Bales **23** formed one-by-one by baler **20** exit the rear of baler **20** one-by-one, and are applied one-by-one onto rotating belt **65** at inlet end **60**, and rotating belt **65**, in turn, conveys bales **23**, one behind the other, upwardly and forwardly in the direction of arrowed line B from inlet end **60** of conveyer **50** to elevated outlet end **61** of conveyor **50**, where they are deposited, one after the other, into depositor **51** for accumulation into bale sets **25** on platform **40**. Depositor **51** gravity feeds bales **23** one-by-one from elevated outlet end **61** of conveyor **50** into bale sets **25** on platform **40**.

[0019] Bales **23** are rectangular. Accordingly, baler **20** is a conventional type that produces rectangular bales of a preselected size. In this example, bales **23** formed one-by-one by baler **20** exit the rear of baler **20** one-by-one end first and resting on one of their long sides in what is a resting orientation, and are applied one-by-one in this resting orientation, namely, end **25**A first resting on the one of its long sides **23**B, onto rotating belt **65** at inlet end **60**. Rotating belt **65** takes up and conveys bales **23**, one behind the other, upwardly and forwardly in the direction of arrowed line B from inlet end **60** of conveyer **50** to elevated outlet end **61** of conveyor **50**, where they are dropped end **23**A first, one after the other, into depositor **51**. Each bale **23** drops and slides through depositor in the resting orientation, which is end **23**A first sliding downwardly on depositor **51** on the one of its long sides **23**B. Depositor **51** accumulates bales **23** one-by-one and gravity deposits bale sets **25** onto platform **40**. Bales **23** can be small rectangular bales, bales that are light enough for one person to handle, about 45 to 60 pounds, or comparatively larger bales depending on the type of baler employed.

[0020] Depositor **51** includes a frame **70** having an elevated inlet end **71** proximate to outlet end **61** of conveyor **50** and an opposed outlet end **72** lowered toward platform **40** ahead of the entrance to group baler **26**. Inlet end **71** is mounted to outlet end **61** of conveyor **50**, such as with mechanical fasteners, welding, or the like, and inclines downwardly in the direction of arrowed line C at an inclined angle of from 50-60 degrees toward group baler **26** from inlet end **71** to outlet end **72**. An upright support **74** connected to platform **40** and to frame **70** between its inlet and outlet ends **71** and **72** supports frame **70** in its inclined orientation. Elevated inlet end **71** accepts bales **23** one-by-one from outlet end **61** of conveyor **50**. Bales **23** drop one-by-one downwardly through depositor **51** via gravity from inlet end **71** to outlet end **72** and are deposited one-by-one onto platform **40** from outlet end **72** into bale sets **25**, which are formed by depositor **51** sequentially. Depositor **51** accumulates bales **23** sequentially into bale sets **25** for depositing into group baler **26**. In other words, depositor **51** gravity feeds/delivers bales **23** onto platform **40** sequentially into bale sets **25**.

[0021] Referring to FIGS. **2-8**, frame **70** is an open chute consisting of opposite sidewalls **80** and **81** joined to either side of a flat base or floor **82**, which together define inlet and outlet ends **71** and **72** and which concurrently extend from inlet end **71** to outlet end **72**. Frame **70** is narrow at inlet end **71**, and widens downwardly therefrom to a widened area to outlet end **72** so as to define a pair of opposite, side-by-side bale-receiving areas **83**A and **83**B on either side of a central divider **84** of frame **70** at the widened area defined by frame **70**. Divider **84** extends outwardly from floor **92** between sidewalls **80** and **81**, and extends upwardly from a lower end **85** at outlet end **72** of frame **70** to an upper end **86** at the middle of the widened area defined by frame **70** between inlet end **71** and outlet end **72**. A bale director or gate **90** is positioned centrally in the frame **70** widened area and is mounted rotationally via hinge **100** to upper end **86** of divider **94**. Gate **90** includes a pair of diverting arms **91** and **92** and a trigger arm **93** that radiate outwardly from hinge **100**. Arms **91**, **92**, and **93** are angularly offset. Hinge **100** enables gate **90** to rotate between an initial position in FIG. **2** and an alternate position in FIG. **5**. Hinge **100** is a conventional and well-known stop hinge, which disables gate from rotating beyond its initial position in FIG. **2** for diverting bales into bale-receiving area **83**B and at the same time obstructing bales from passing into bale-receiving area **83**A from inlet end **71**, and its alternate position in FIG. **5** for diverting bales into bale-receiving area **83**A and at the same time obstructing bales from passing into bale-receiving area **83**B from inlet end **71**.

[0022] Diverting arm **91** is angled downwardly from hinge **100** into bale-receiving area **83**A, diverting arm **92** is angled upwardly from hinge **100** toward sidewall **80** toward one side of inlet end **71** closing entrance **95** into bale-receiving area **83**A from inlet end **71** while at the same time opening entrance **96** into bale-receiving area **83**B from inlet end **71**, and trigger arm **93** is angled downwardly from hinge **100** into bale-receiving area **83**B in the path of bales through bale-receiving area **83**B, when gate **90** is in its initial position in FIG. **2**. In operation from this initial position of gate **90**, a bale **23'** is dropped end first into inlet end **71** of frame **70** from outlet end **61** of conveyor **50** of FIG. **1**. Bale **23'** falls slidingly by gravity end **23**A first through inlet end **71** and strikes diverting arm **92** closing entrance **95** to bale-receiving area **83**A, which diverts the bale **23'** end **23**A first into bale-receiving area **83**B through entrance **96** thereto. The end **23**A of bale **23'** strikes trigger arm **93** in the path of bale **23'** through bale-receiving area **83**B when bale **23'** falls slidingly by gravity through bale-receiving area **83**B, which rotates gate **90** in the direction of arcuate arrowed line D in FIG. **2** in response from its initial position in FIG. **2** toward its alternate position in FIG. **5**. As bale **23'** drops slidingly downward through bale-receiving area **83**B in FIGS. **3** and **4** and gate **90** rotates from its initial position in the direction of arrowed line D in response toward its alternate position in FIG. **5**, trigger arm **93** rotates out of the way of the path of bale **23'** through bale-receiving area **83**B from bale-receiving area **83**B into bale-receiving area **83**A through an opening **102** between divider **84**, hinge **100**, and floor **82** so as to extend downwardly from hinge **100** into bale-receiving area **83**A in the path of bales through bale-receiving area **83**A enabling bale **23'** to drop end **23**A down through outlet end **72** from bale-receiving area **83**B upright onto a landing area **110** of platform **40** in FIG. **5** under outlet end **72**. At the same time, diverting arm **92** rotates downwardly into bale-receiving area **83**B and diverting arm **91** rotates upwardly toward sidewall **81** to the opposite side of inlet end **71** obstructing the path of bales into bale-receiving area **83**B through entrance **96** thereto from inlet end **71**. Hinge **100** arrests gate **100** from rotating beyond its alternate position in FIG. **5**.

[0023] Diverting arm **92** is angled downwardly from hinge **100** into bale-receiving area **83**B, diverting arm **91** is angled upwardly from hinge **100** to the opposite side of inlet end **71** toward sidewall **81** closing entrance **96** into bale-receiving

area **83**B from inlet end **71** while at the same time opening entrance **95** into bale-receiving area **83**A from inlet end **71**, and trigger arm **93** is angled downwardly from hinge **100** into bale-receiving area **83**A in the path of bales through bale-receiving area **83**A, when gate **90** is in its alternate position in FIG. **5**. In operation from this alternate position of gate **90**, the next bale **23"** is dropped end **23**A first into inlet end **71** of frame **70** from outlet end **61** of conveyor **50** of FIG. **1**. Bale **23"** falls slidingly by gravity end **23**A first through inlet end **71** and strikes diverting arm **91** closing entrance **96** to bale-receiving area **83**B in FIG. **5** which diverts the bale **23"** end first into bale-receiving area **83**A through entrance **95** thereto. The end **23**A of bale **23"** strikes trigger arm **93** in the path of bale **23"** through bale-receiving area **83**A when bale **23"** falls slidingly by gravity through bale-receiving area **83**A, which rotates gate **90** in the direction of arcuate arrowed line E in FIG. **5** in response from its alternate position in FIG. **5** toward its initial position in FIGS. **2** and **7**. As bale **23"** drops slidingly downward through bale-receiving area **83**A in FIGS. **6** and **7** and gate **90** rotates from its initial position in the direction of arrowed line E in response toward its initial position in FIG. **7**, trigger arm **93** rotates out of the way of the path of bale **23"** through bale-receiving area **83**A from bale-receiving area **83**A into bale-receiving area **83**B through opening **102** between divider **84**, hinge **100**, and floor **82** so as to extend downwardly from hinge **100** into bale-receiving area **83**B in the path of bales through bale-receiving area **83**B enabling bale **23"** to drop end **23**A down through outlet end **72** from bale-receiving area **83**A upright onto landing area **110** of platform **40** in FIG. **8** under outlet end **72** alongside bale **23'** so as to form a bale set **25**. At the same time, diverting arm **91** rotates downwardly into bale-receiving area **83**A and diverting arm **92** rotates upwardly toward sidewall **80** to the one side of inlet end **71** obstructing the path of bales into bale-receiving area **83**A through entrance **95** thereto from inlet end **71**. Hinge **100** arrests gate **100** from rotating beyond its initial position in FIGS. **7** and **8**.

[0024] In FIG. **8**, bale set **25** when deposited onto landing area **110** of platform **40** includes a pair of bales **23'** and **23"** positioned upright on their respective ends **23**A on landing area **110** side-by-side in a packing orientation so that their corresponding or opposite long sides S**1** and S**2**, respectively, are juxtaposed. Each bale set **25** is deposited onto landing area **110** of platform **40** from depositor **51** in this way, in which gate **90** is movable rotationally between alternate positions, an initial position in FIG. **2** and an alternate position in FIG. **5**, for alternately directing bales **23** into the bale-receiving areas **83**A and **83**B, and wherein gate **90** moves alternately from one to the other of the alternate positions each time a bale **23** passes gate **90**, for alternately dropping the bales **23**, one beside the other, being in-line or otherwise axially-aligned from side-to-side and not from front-to-rear, onto landing area **110** of platform **40** ahead of the entrance to group baler **26**.

[0025] In FIG. **2**, packer apparatus **52** includes a ram **120** for ramming bale sets **25** (FIG. **1**), one at a time as each is deposited on landing area **110** ahead of the entrance to group baler **26**, along a horizontal linear drive path F from landing area **110** of platform **40** into group baler **26** through the entrance thereof trailing landing area **110** each time ram **120** actuates. Packer apparatus **52** further includes a sensor apparatus **121** operatively coupled to ram **120** and to landing area **110** of platform **40**, wherein ram **120** actuates for ramming one bale set **25** from landing area **110** into group baler **26** each time sensor apparatus **121** senses a bale set **25** deposited onto landing area **110** of platform **40**.

[0026] Ram **120** is mounted rigidly to a stanchion **130** mounted atop platform **40** to the rear of landing area **110**. Ram **120** is mounted rigidly to stanchion **13** with mechanical fasteners, welding, or the like, and stanchion **130** is mounted atop platform **40** with mechanical fasteners, welding, or the like. Ram **120** is positioned at an elevated location relative to platform **40** to the rear of landing area **110** and includes a drive assembly **135** coupled drivenly to a frame **136** sized to concurrently engage the back sides of each pair of bales **23** of each bale set **25** deposited onto landing area **110**. Drive assembly **135** extends forwardly from stanchion **130** to frame **136** located immediately to the rear of landing area **110**. Frame **136** is driven by drive assembly **135** in reciprocal directions indicated by the double arrowed line G in FIGS. **2** and **10** along linear drive path F from a starting position in FIGS. **1**-**8** and **10** to a ramming position in FIGS. **9**, **11**, and **12**, for engaging and ramming a bale set **25** from landing area **110** of platform **40** into group baler **26** along linear drive path F in FIGS. **11** and **12**, and back to the starting position in FIGS. **1**-**8** and **10** from the ramming position in FIGS. **9**, **11**, and **12**, each time ram **120** drive assembly **135** actuates.

[0027] In this example, drive assembly **135** is a cylinder assembly **140**. Cylinder assembly **140** is a hydraulic cylinder assembly that includes a cylinder **141** and an operating rod **150**. Cylinder **141** has an inner end **142** mounted rigidly to stanchion **130**, and extends forward from inner end **142** to outer end **143**. Frame **136** is mounted on outer end **151** of operating rod **150**, such as with mechanical fasteners, welding, or the like, that is, in turn, mounted partially within cylinder **141** through outer end **142** for movement in reciprocal directions indicated by double arrowed line G along linear drive path F. Each time ram **120** actuates, operating rod **151** is actuated reciprocally by cylinder **141**. Frame **136** moves reciprocally in the directions of double arrowed line G along linear drive path F in FIGS. **2** and **10** between the starting position in FIGS. **1**-**8** and **10** and the ramming position in FIGS. **9**, **11**, and **12** when operating rod **150** actuates, namely, upon actuation of operating rod **150** in reciprocal directions along double arrowed line G via cylinder **141**. Frame **136** is in its starting position when operating rod **150** is in a retracted position in cylinder **141** in FIGS. **1**-**8** and **10**. Frame **136** is in its ramming position when operating rod **150** is in an extended from cylinder **141** in FIGS. **9**, **11**, and **12**.

[0028] In FIG. **2**, sensor apparatus **121** includes a control unit **160** operatively coupled to sensors **161** and **162** for receiving and responding to output signals from sensors **161** and **162**, and is operatively coupled to ram **120** for actuating ram **120** in response to output signals from sensors **161** and **162** sensing a bale set **25** deposited onto landing area **110** of platform **40**. Control unit **53** is a processor, and is operatively coupled to sensors **161** and **162** and to ram **120** drive assembly **135** with conventional electrical wiring **165**. Control unit **160** provides an operative coupling between drive assembly **135** and sensors **161** and **162**.

[0029] Sensor **161** is under and is registered with outlet end **72** of bale-receiving area **83**B, and sensor **162** is under and is registered with outlet end **72** of bale-receiving area **83**A. Sensor **161** is for sensing the presence of a bale **23** deposited onto landing area **110** from bale-receiving area

83B. Sensor **162** is for sensing the presence of a bale **23** deposited onto landing area **110** from bale-receiving area **83**A. Sensors **161** and **162** are pressure sensors each for sensing the pressure exerted by a deposited bale **23** on landing area **110**. Sensor **161** is installed on landing area **110** beneath inlet end **72** of bale-receiving area **83**B of depositor **51**, and sensor **162** is installed on landing area **110** beneath inlet end **72** of bale-receiving area **83**A. Electrical wiring **165** electrically connects sensors **161** and **162** to control unit **160** and control unit **160** to drive assembly **135**, and is formed in platform **40** and stanchion **130**. Electrical wiring **165** extends along platform from sensors **161** and **162** to stanchion **130**, upwardly through stanchion **130** to control unit **160** and from control unit **160** through stanchion **130** to drive assembly **135**, all of which are powered by conventional onboard power systems or from power systems of tractor **21** in FIG. **1**.

[0030] The end **23**A of a bale **23** is applied onto landing area **110** atop sensor **161** when the bale **23** is applied to landing area **120** from bale-receiving area **83**B. Sensor **161** pressure senses a bale **23** when it is applied end **23**A first onto landing area **110** atop sensor **161** from bale-receiving area **83**B and issues a signal to control unit **160** in response. The end **23**A of a bale **23** is applied onto landing area **120** atop sensor **162** when the bale **23** is applied to landing area **110** from bale-receiving area **83**A. Sensor **162** pressure senses a bale **23** when it is applied end **23**A first onto landing area **110** atop sensor **162** from bale-receiving area **83**A and issues a signal to control unit **160** in response.

[0031] In the operation of accumulator **24** from the initial position of gate **90** in FIG. **2**, bale **23'** is dropped end first into inlet end **71** of frame **70** from outlet end **61** of conveyor **50** of FIG. **1**. Bale **23'** falls slidingly by gravity end **23**A first on its side **23**B on floor **82** through inlet end **71** and strikes diverting arm **92** closing entrance **95** to bale-receiving area **83**A, which diverts the bale **23'** end **23**A first into bale-receiving area **83**B through entrance **96** thereto. The end **23**A of bale **23'** strikes trigger arm **93** in the path of bale **23'** through bale-receiving area **83**B when bale **23'** falls slidingly by gravity on its side **23**B on floor **82** through bale-receiving area **83**B, which rotates gate **90** in the direction of arcuate arrowed line D in FIG. **2** in response from its initial position in FIG. **2** toward its alternate position in FIG. **5**. As bale **23'** drops slidingly downward end **23**A first on its side **23**B on floor **82** through bale-receiving area **83**B in FIGS. **3** and **4** and gate **90** rotates from its initial position in the direction of arrowed line D in response toward its alternate position in FIG. **5**, trigger arm **93** rotates out of the way of the path of bale **23'** through bale-receiving area **83**B from bale-receiving area **83**B into bale-receiving area **83**A through opening **102** so as to extend downwardly from hinge **100** into bale-receiving area **83**A in the path of bales through bale-receiving area **83**A enabling bale **23'** to drop end **23**A down through outlet end **72** from bale-receiving area **83**B upright onto landing area **110** of platform **40** in FIG. **5** atop sensor **161** immediately in front of one side of frame **136**, and at the same time diverting arm **92** rotates downwardly into bale-receiving area **83**B and diverting arm **91** rotates upwardly toward sidewall **81** to the opposite side of inlet end **71** obstructing the path of bales into bale-receiving area **83**B through entrance **96** thereto from inlet end **71**. Sensor **161** pressure senses bale **23'** when it is applied end **23**A first onto landing area **110** atop sensor **161** from bale-receiving area **83**B and issues a signal to control unit **160** in response. Again, hinge **100** arrests gate **100** from rotating beyond its alternate position in FIG. **5**.

[0032] Now with gate **90** in the alternate position in FIG. **5**, the next bale **23"** is dropped end **23**A first into inlet end **71** of frame **70** from outlet end **61** of conveyor **50** of FIG. **1**. Bale **23"** falls slidingly by gravity end **23**A first on its side **23**B on floor **82** through inlet end **71** and strikes diverting arm **91** closing the entrance to bale-receiving area **83**B in FIG. **5**, which diverts the bale **23"** end **23**A first into bale-receiving area **83**A through the entrance thereof. The end of bale **23"** strikes trigger arm **93** in the path of bale **23"** through bale-receiving area **83**A when bale **23"** falls slidingly by gravity through bale-receiving area **83**A on its side **23**B on floor **82**, which rotates gate **90** in the direction of arcuate arrowed line E in FIG. **5** in response from its alternate position in FIG. **5** toward its initial position in FIGS. **2** and **7**. As bale **23"** drops slidingly downward through bale-receiving area **83**A in FIGS. **6** and **7** end **23**A first on its side **23**B on floor **82** and gate **90** rotates from its initial position in the direction of arrowed line E in response toward its initial position in FIG. **7**, trigger arm **93** rotates out of the way of the path of bale **23"** through bale-receiving area **83**A from bale-receiving area **83**A into bale-receiving area **83**B through opening **102** between divider **84**, hinge **100**, and floor **82** so as to extend downwardly from hinge **100** into bale-receiving area **83**B in the path of bales through bale-receiving area **83**B enabling bale **23"** to drop end **23**A down through outlet end **72** from bale-receiving area **83**A upright onto landing area **110** of platform **40** in FIG. **8** atop sensor **162** immediately in front of the opposing side of frame **136** alongside bale **23'** so as to form bale set **25**, and at the same time diverting arm **91** rotates downwardly into bale-receiving area **83**A and diverting arm **92** rotates upwardly toward sidewall **80** to the one side of inlet end **71** obstructing the path of bales into bale-receiving area **83**A through entrance **95** thereto from inlet end **71**. Again, hinge **100** arrests gate **100** from rotating beyond its initial position in FIGS. **7** and **8**. Sensor **162** pressure senses bale **23"** when it is applied end **23**A first onto landing area **110** atop sensor **162** from bale-receiving area **83**A and issues a signal to control unit **160** in response, which actuates ram **120** in response ramming bale set **25** in FIGS. **8** and **10** along linear drive path F from landing area **110** of platform **40** into group baler **26** in FIG. **11**.

[0033] Drive assembly **135** actuates when ram **120** actuates. Frame **136** is driven by drive assembly **135** from its starting position in FIG. **10** against the back sides of bales **23'** and **23"** of bale set **25** to its ramming position in FIG. **11**, for engaging and ramming bale set **25** from landing area **110** of platform **40** into group baler **26** along linear drive path F, and back to the starting position of frame **136** from its ramming position, when drive assembly **135** actuates. When frame **136** is moved from is starting position to its ramming position, it engages the back sides of the respective bales, namely, sides **253** of the respective bales **23'** and **23"**, and slides them ends **23**A down across platform **40** rearwardly into group baler **25** without changing the packing orientation of bales **23'** and **23"**.

[0034] Control unit **160** resets when ram **120** actuates, and the described bale accumulation and packing process continues for the next bale set **25** and each subsequent next bale set **25**, the next bale set **25** being shown is it would appear packed into group baler **26** directly against and in-line with,

from the front to the rear, the previously-packed bale set **25**. When each subsequent bale set **25** of bales **23** is packed into group packer **26** against the previous-packed bale set **25** as in FIG. **12**, the bale sets **25** are incrementally advanced into group baler **26**, and this packing process repeats until the predetermined number of bale sets **25** are packed into group baler **26**, which is seven in this example.

[0035] In the present embodiment, bales **23** are applied to depositor **51** beginning with gate **90** in its initial position, in which the bales are applied onto landing area **120** in the order of from bale-receiving area **83**B to bale-receiving area **83**A in which signals are sent to control unit **160** correspondingly first from sensor **161** and then from sensor **162** in response. If desired, bales **23** can be applied to depositor **51** beginning with gate **90** in its alternate position, in which the bales are applied onto landing area **120** in the order of from bale-receiving area **83**A to bale-receiving area **83**B in which signals are sent to control unit **160** correspondingly first from sensor **162** and then from sensor **161** in response. Sensor apparatus **121** senses a bale set **25** deposited onto landing area **110** of platform **40** each time a corresponding pair of signals are sent to control unit **160**, whether first from sensor **161** and then from sensor **162**, or first from sensor **162** and then from sensor **161**, sensor apparatus **121** senses a bale set **25** deposited onto landing area **110** of platform **40**.

[0036] The bale sets **25** are in-line with one another and axially aligned, from the front to the rear, when they are packed into group baler **26**. Group baler **26** group bales the bale sets **25** into group bale **28** and deposits group bale **28** outwardly from the rear of group baler **26** onto field **22** for further handling when group baler **26** is filled with its capacity of bale sets **25**. The process continues for each subsequent group bale.

[0037] In sum, and referring in relevant part to FIGS. **1-12**, an accumulator for grouping bales **23** for group baling is disclosed, which includes platform **40**, depositor **51** mounted adjacent to platform **40** for sequentially depositing bale sets **25** onto platform **40**, each bale set **25** when deposited onto platform **40** includes a pair of bales **23'** and **23"** positioned upright and side-by-side in a packing orientation so that their corresponding long sides S**1** and S**2** are axially juxtaposed, and packer apparatus **52** mounted adjacent to platform **40** for packing one bale set **25** at a time from platform **40** into group baler **26** trailing platform **40** each time a bale set **25** is deposited onto platform **40** from depositor **51** without changing the packing orientation of the bales **23'** and **23"** of each bale set **25**. The packer apparatus **52** includes ram **120** for ramming a bale set **25** along linear drive path F from platform **40** into group baler **26** each time ram **120** actuates, and sensor apparatus **121** operatively coupled to ram **120** and to platform **40**, wherein ram **120** actuates each time sensor apparatus **121** senses a bale set **25** deposited onto platform **40**. Ram **120** includes drive assembly **135** drivenly coupled to frame **136**. Frame **136** is driven by drive assembly **135** from the starting position to the ramming position, for engaging and ramming a bale set **25** from platform **40** into group baler **26** along linear drive path F, and back to the starting position from the ramming position, each time drive assembly **135** actuates. Drive assembly **135** is a cylinder assembly **140** including cylinder **141** and operating rod **150**. Frame **136** is mounted on operating rod **150**, operating rod **150** is mounted partially within cylinder **141** for movement in reciprocal directions, and frame **136** moves in reciprocal directions between the starting and ramming positions upon actuation of operating rod **150** in reciprocal directions. Depositor **51** is upright relative to platform **40** for sequentially gravity depositing bale sets **25** onto platform **40**. Depositor **51** includes frame **70** mounted adjacent to platform **40**. Frame **70** includes a pair of bale-receiving areas **83**A and **83**B for alternately depositing bales **23** onto platform **40** into bale sets **25**, and gate **90**. Gate **90** is movable between alternate positions for alternately directing bales **23** into bale-receiving areas **83**A and **83**B, and gate **90** moves alternately from one to the other of the alternate positions each time a bale **23** passes gate **90**.

[0038] A bale-accumulation method according to the invention includes sequentially depositing bale sets **25** onto landing area **110** of platform **40** between ram **120** and group baler **26**, actuating ram **120** packing one bale set **25** at a time from landing area **110** of platform **40** into group baler **26** each time a bale set **25** is deposited onto landing area **110** of platform **40** without changing the packing orientation of the bales **23** of each bale set **25**. This bale set packing process is repeated for each bale set **25** until the predetermined number of bale sets **25** are packed into group baler **26**, and group baler **26** group bales the bale sets **25** into group bale **28** and deposits group bale **28** outwardly from the rear of group baler **26** onto field **22** in FIG. **1** in response. The step of sequentially depositing bale sets **25** onto landing area **110** of platform **40** between ram **120** and group baler **26** further includes providing frame **70** including bale-receiving areas **83**A and **83**B for alternately depositing bales **23** onto landing area **110** of platform **40** between ram **120** and group baler **26** when bales **23** are applied alternately to bale-receiving areas **83**A and **83**B, and applying bales alternately to bale-receiving areas **83**A and **83**B, such as beginning with bale-receiving area **83**B starting with gate **90** in its initial position, or beginning with bale-receiving area **83**A starting with gate **90** in its alternate position. Applying bales **23** alternately to bale-receiving areas **83**A and **83** preferably includes gravity feeding bales **23** alternately to bale-receiving areas **83**A and **83**B as disclosed herein, without having to use a machine conveyor. The step of actuating ram **120** packing one bale set **25** at a time from landing area **110** of platform **40** into group baler **2** each time a bale set **25** is deposited onto landing area **110** of platform **40** without changing the packing orientation of the bales **23** of each bale set **25** includes providing sensor apparatus **121** operatively coupled to ram **120** and to landing area **110** of platform **40** via control unit **160**, and control unit **160** automatically actuating ram **120** each time sensor apparatus **121** senses a bale set **25** deposited onto landing area **110** of platform **40**.

[0039] The invention has been described above with reference to illustrative embodiments. However, those skilled in the art will recognize that changes and modifications may be made to the embodiments without departing from the nature and scope of the invention. Various changes and modifications to the embodiments herein chosen for purposes of illustration will readily occur to those skilled in the art. To the extent that such modifications and variations do not depart from the spirit of the invention, they are intended to be included within the scope thereof.

[0040] Having fully described the invention in such clear and concise terms as to enable those skilled in the art to understand and practice the same, the invention claimed is:

1. A bale accumulator for grouping bales for group baling, comprising:

a platform, the platform includes a landing area;

a group baler, the group baler trails the platform and the landing area is ahead of the group baler;

a depositor mounted adjacent to the platform for sequentially depositing bale sets onto the landing area of the platform ahead of the group baler before being packed into the group baler, each bale set when deposited onto the landing area of the platform before being packed into the group baler comprises a pair of bales positioned upright and side-by-side in a packing orientation on the landing area of the platform ahead of the group baler so that their corresponding long sides are axially juxtaposed; and

a packer apparatus mounted adjacent to the platform ahead of the group baler, the packer apparatus for packing one bale set at a time rearwardly along a linear drive path from deposited onto the landing area of the platform ahead of the group baler to into the group baler each time a bale set is deposited onto the landing area of the platform ahead of the group baler from the depositor without changing the packing orientation of the bales of each bale set.

2. The bale accumulator according to claim **1**, wherein the packer apparatus comprises:

a ram for ramming a bale set along the linear drive path from the landing area of the platform to into the group baler each time the ram actuates; and

a first sensor and a second sensor operatively coupled to the ram and to the landing area of the platform via a control unit, wherein the control unit automatically actuates the ram each time the first sensor and the second sensor sense a first bale and a second bale, respectively, deposited onto the landing area of the platform as a bale set.

3. The bale accumulator of claim **2**, wherein the ram comprises:

a drive assembly drivenly coupled to a packer frame;

the packer frame is driven by the drive assembly from a starting position to a ramming position, for engaging and ramming a bale set from deposited onto the landing area of the platform to into the group baler along the linear drive path, and back to the starting position from the ramming position, each time the drive assembly actuates.

4. The bale accumulator according to claim **3**, wherein the drive assembly comprises a cylinder assembly including a cylinder and an operating rod, the packer frame is mounted on the operating rod, the operating rod is mounted partially within the cylinder for movement in reciprocal directions, and the packer frame moves in reciprocal directions between the starting and ramming positions upon actuation of the operating rod in reciprocal directions.

5. The bale accumulator according to claim **1**, wherein the depositor is upright relative to the platform for sequentially gravity depositing bale sets onto the landing area of the platform.

6. A bale accumulator for grouping bales for group baling, comprising:

a platform, the platform includes a landing area;

a group baler, the group baler trails the platform and the landing area is ahead of the group baler;

a depositor frame mounted adjacent to the platform, the depositor frame includes a pair of bale-receiving areas for alternately depositing bales onto the landing area of the platform into bale sets ahead of the group baler before being packed into the group baler, each bale set when deposited onto the landing area of the platform before being packed into the group baler comprises a pair of bales positioned upright and side-by-side in a packing orientation on the landing area ahead of the group baler so that their corresponding long sides are juxtaposed, and a gate, the gate is movable between alternate positions for alternately directing bales into the bale-receiving areas, and the gate moves alternately from one to the other of the alternate positions each time a bale passes the gate; and

a packer apparatus mounted adjacent to the platform ahead of the group baler, the packer apparatus for packing one bale set at a time rearwardly along a linear drive path from deposited onto the landing area of the platform ahead of the group baler to into the group baler each time a bale set is deposited onto the landing area of the platform ahead of the group baler from the bale-receiving areas of the depositor frame without changing the packing orientation of the bales of each bale set.

7. The bale accumulator according to claim **6**, wherein the packer apparatus comprises:

a ram for ramming a bale set along the linear drive path from deposited onto the landing area of the platform to into the group baler each time the ram actuates; and

a first sensor and a second sensor operatively coupled to the ram and to the landing area of the platform via a control unit, wherein the control unit automatically actuates the ram each time the first sensor and the second sensor sense a first bale and a second bale, respectively, deposited onto the landing area of the platform as a bale set.

8. The bale accumulator of claim **7**, wherein the ram comprises:

a drive assembly drivenly coupled to a packer frame;

the packer frame is driven by the drive assembly from a starting position to a ramming position, for engaging and ramming a bale set from deposited onto the landing area of the platform to into the group baler along the linear drive path, and back to the starting position from the ramming position, each time the drive assembly actuates.

9. The bale accumulator according to claim **8**, wherein the drive assembly comprises a cylinder assembly including a cylinder and an operating rod, the packer frame is mounted on the operating rod, the operating rod is mounted partially within the cylinder for movement in reciprocal directions, and the packer frame moves in reciprocal directions between the starting and ramming positions upon actuation of the operating rod in reciprocal directions.

10. The bale accumulator according to claim **6**, wherein the bale-receiving areas of the depositor frame are upright relative to the platform for gravity depositing bale sets onto the landing area of the platform.

11. A bale-accumulation method, comprising:

providing a platform associated with a ram, and a group baler, the platform includes a landing area, the group baler trails the platform, the landing area and the ram are ahead of the group baler, and the landing area of the platform is between the group baler and the ram;

sequentially depositing bale sets onto the landing area of the platform ahead of the group baler between the ram

and the group baler before being deposited into the group baler, each one of the bale sets when deposited onto the landing area of the platform before being deposited into the group baler comprises a pair of bales positioned upright and side-by-side in a packing orientation on the landing area of the platform ahead of the group baler so that their corresponding long sides are juxtaposed; and

actuating the ram packing one bale set at a time rearwardly along a linear drive path from deposited onto the landing area of the platform ahead of the group baler to into the group baler each time a bale set is deposited onto the landing area of the platform without changing the packing orientation of the bales of each bale set.

12. The bale-accumulation method according to claim **11**, wherein the step of sequentially depositing bale sets onto the landing area of the platform between the ram and the group baler further comprises:

providing a depositor frame including bale-receiving areas for alternately depositing bales onto the landing area of platform between the ram and the group baler when bales are applied alternately to the bale-receiving areas; and

applying bales alternately to the bale-receiving areas.

13. The bale-accumulator according to claim **12**, wherein the step of applying bales alternately to the bale-receiving areas further includes gravity feeding bales alternately to the bale-receiving areas.

14. The bale-accumulation method according to claim **12**, wherein the step of actuating the ram packing one bale set at a time from deposited onto the landing area of the platform to into the group baler each time a bale set is deposited onto the landing area of the platform without changing the packing orientation of the bales of each bale set further comprises:

providing a first sensor and a second sensor operatively coupled to the ram and to the landing area of platform via a control unit; and

the control unit automatically actuating the ram each time the first sensor and the second sensor sense a first bale and a second bale, respectively, deposited onto the landing area of the platform as a bale set.

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