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(54) Title: MECHANISM FOR APPLYING TENSION TO A BALE IN THE BALE CASE OF AN AGRICULTURAL BALER

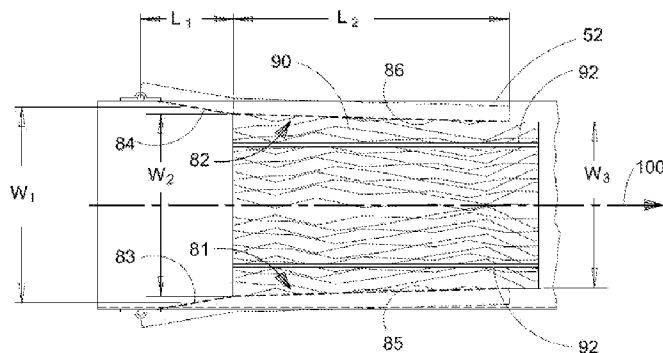


FIG.5

(57) Abstract: A mechanism is disclosed for applying tension to a bale in the bale case of an agricultural baler. Two elongate ten-
sion rails (51,52) are arranged along two opposing sides of the bale case (20). Each tension rail (51,52) is pivotally connected
(53,54) at one end adjacent to the forward end of the bale case (20) and extends rearwards to allow the tension rails (51,52) to be
selectively pivoted inwardly and outward relative to the bale travel axis (100). A positioner mechanism (70) is connected the ten-
sion rails (51,52) for simultaneously moving the tension rails inwardly or outwardly. Each tension rail (51,52) has an offset bend
which divides the rail into two generally planar surfaces (83,85;84,86) that are inclined relative to one another. Two successive
bale compression regions (L1,L2) are defined within the bale case, with the tension rails (51,52) converging more rapidly in the
first than in the second.

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**MECHANISM FOR APPLYING TENSION TO A BALE
IN THE BALE CASE OF AN AGRICULTURAL BALER**

Field of the invention

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This invention relates generally to agricultural balers of the type commonly referred to as square balers that produce bales having a rectangular cross section, and more particularly to a mechanism for applying tension to a
10 bale in the bale case of an agricultural baler to enable the length of bales produced by small square balers to be controlled consistently.

Background of the invention

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Square balers are implements that pick up a swath or windrow of crop material, such as straw or hay, from the ground and deposit it in an infeed housing where it is conveyed by a feed mechanism through an inlet to a bale-
20 forming chamber. Four walls define the bale forming chamber where the crop material is urged rearwards by a reciprocating plunger to form a rectangular package of compacted crop material. The package so formed is automatically tied by a tying mechanism to complete the bale
25 that is then discharged from the chamber by being urged towards the rear by the next bale being successively formed. Completed bales are either deposited on the ground for subsequent retrieval or they are delivered by appropriate means to a trailing wagon hitched to the back of the baler.

30

Pressure for increased efficiency in agricultural operations has led to increased usage of labour saving machinery to receive completed bales from the baler. Bale accumulator systems are one such machine commonly used in
35 connection with small square bales. Use of such equipment has increased the demand on the baler to provide greater

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consistency in bale length so that the bale handling equipment will operate efficiently.

As crop is fed into a baler, each plunger stroke
5 creates what is referred to as a wad or slice. The thickness and density of each slice is directly influenced by the amount of crop material delivered to the plunger for each stroke and the resistance applied to the bale being formed in the chamber behind the plunger. Resistance applied to the
10 bale in the chamber is commonly controlled by variations in the size of the cross section of the chamber through which the crop material is being urged by the plunger by adjusting the position of one or more of the chamber side walls to vary the orifice through which the crop material is
15 extruded. To this end, moveable tension rails, which define a portion of one or more of the walls of the chamber, are used to change the dimensions, i.e., the height and/or the width, of the chamber into which the crop material is being urged. Movement of the tension rails is accomplished by
20 springs or hydraulically.

The tension rails are usually rectilinear and result in the width or height of the chamber being reduced at a constant rate along the length of the bale chamber.

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Object of the invention

The present invention seeks to provide a mechanism for controlling bale movement in a bale chamber whereby
30 consistent pressure is applied to the bale exiting the bale case in order to optimise movement of a bale being formed in the bale chamber.

Summary of the invention

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According to the present invention, there is provided a mechanism for applying tension to a bale in the bale case of

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an agricultural baler, the bale case having four sides defining a generally rectangular opening through which a bale is urged along a bale travel axis from a forward end towards a rearward end, said mechanism comprising:

5 a pair of elongate tension rails arranged along two opposing sides of the bale case, each of said pair of tension rails being pivotally connected at one end adjacent to the forward end of the bale case and extending rearwards therefrom in a manner to allow the pair of tension rails to
10 be selectively pivoted inwards and outwards relative to the bale travel axis; and

 a positioner mechanism connected to the tension rails for simultaneously moving the tension rails inwards or outwards with respect to the bale travel axis;

15 wherein each tension rail has an offset bend oriented generally parallel to its pivotal connection to the bale case and displaced rearwards therefrom, the offset bend dividing each tension rail into a generally planar first surface and a generally planar second surface that are
20 angled with respect to each other,

 characterised in that the two first planar surfaces and the two second planar surfaces of the tension rails both converge towards one another and the angle between each first surface and the bale travel axis is greater than the
25 angle between each second surface and the bale travel axis.

 GB 972,562 discloses a mechanism having a pair of elongate tension rails in which each tension rail has an offset bend oriented generally parallel to its pivotal
30 connection to the bale case and displaced rearwards from it. The offset bend divides each tension rail into a generally planar first surface and a generally planar second surface that are angled with respect to each other. The latter patent does not however maintain a consistent pressure on
35 the bale exiting the chamber. Instead, the first planar surfaces converge towards the bale travel axis to form a bale compressing section but the second surfaces diverge

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from it to form a pressure releasing section. Such a configuration therefore offers no assistance in controlling the bale length.

5 Whereas GB 972,562 only uses one pair of tension rails, in the preferred embodiment of the invention, tension rails are provided to constrain the bale both vertically and horizontally and independently operable positioner mechanisms are used for controlling the height and the width
10 of the bale case.

Brief description of the drawings

15 The invention will now be described further, by way of example, with reference to the accompanying drawings, in which:

FIG. 1 is a side view of a typical small square baler having an adjustable bale chamber of the type on which the present invention is useful;

20 FIG. 2 is an enlarged rear perspective view of the baler of FIG. 1 detailing the adjustable bale chamber having one embodiment of the present invention;

25 FIG. 3 presents a side elevation view of the bale case showing the upper and lower tension rails and one of the side tension rails of the present invention;

FIG. 4 presents a plan view of the bale case shown in FIG. 3 showing the orientation of the side tension rails relative to the bale case side walls; and

30 FIG. 5 shows a plan view of the bale case of FIG. 4 illustrating the change in bale case width enabled by the side tension rails of the present invention.

Detailed description of the preferred embodiment(s)

35 Many of the fastening, connection, processes and other means and components utilized in this invention are widely known and used in the field of the invention described, and

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their exact nature or type is not necessary for an understanding and use of the invention by a person skilled in the art, and they will not therefore be discussed in significant detail. Also, any reference herein to the terms
5 "left" or "right," "up" or "down," or "top" or "bottom" are used as a matter of mere convenience, and are determined by standing at the rear of the machine facing in its normal direction of travel. Furthermore, the various components shown or described herein for any specific application of
10 this invention can be varied or altered as anticipated by this invention and the practice of a specific application of any element may already be widely known or used in the art by persons skilled in the art and each will likewise not therefore be discussed in significant detail. When referring
15 to the figures, like parts are numbered the same in all of the figures.

FIG. 1 shows a baler 10 for producing oblong bales (shown as 90 in FIG. 5) having generally rectangular cross-
20 sections, generally referred to as small, square bales. Such bales have typical dimensions of 14" by 18" (approximately 36 cm x 46 cm). The baler 10 includes a frame 12 that is ground-supported by wheels 14 (only one shown). A tongue 16 projects forwards from the frame 12 and is configured for
25 connection to a towing vehicle, such as an agricultural tractor (not shown), which is equipped with a power take-off shaft 19 for delivering motive power to the various driven components in the baler 10. A pick-up 18 is provided in order to take up a swath or windrow of harvested crop from
30 the ground and to deliver it toward the bale case 20. The bale case 20 includes a forward portion 21 and a rearward portion 22. A plunger 17 is reciprocally disposed adjacent to the forward portion 21 of bale case 20 to form crop material into square bales in a conventional manner. These
35 square bales are urged sequentially through the bale case 20, bound with a suitable material such as twine (shown as 92 in FIG. 5), and then discharged from the baler 10.

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Referring now to FIGS. 1 and 2, the bale case 20 is further defined by a pair of generally opposing and parallel sides 31, 32, each bounded by angle-shaped upper corner rails 33, 34 and lower corner rails 35, 36 to form a generally rectangular opening through which bales pass from the front to towards the rear along a bale travel axis (shown as axis 100 in FIGS. 3 and 4). The rectangular shape of bale case 20 generally establishes the cross-sectional rectangular size of the bale. Sides 31, 32 and upper and lower corner rails 33, 34, 35, 36 are typically fixed with respect to frame 12, but may include provisions for adjusting the size of the bale case. Bale case 20 is further defined by an opposing upper tension rail 41 and lower tension rail 42. The elongate upper and lower tension rails 41, 42 are oriented along the upper and lower sides of the bale case, generally parallel to the bale travel axis 100 of the bale chamber 20, and pivotally connected adjacent to their forward-most ends to the baler frame.

20

The upper and lower tension rails 41, 42 are connected to a vertical positioner mechanism 60 that interconnects the baler frame and the upper and lower tension rails 41, 42 in a manner that pivots the tension rails in a coordinated and simultaneous manner to move the rearward ends of the tension rails inwards into the bale case or outwards from the bale case as a means of adjusting the effective height of the bale case and hence the resistance to movement applied to the top and bottom surfaces of a bale moving through the bale case. Upper and lower tension rails may substantially form the upper and lower surfaces of the bale case, or may protrude into the bale case through openings provided in the upper and lower surface of the bale case in designs featuring four planar walls to define the bale case.

35

Vertical positioner mechanism 60 includes a vertical actuator 62, typically a hydraulic cylinder, and a linkage

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64 interconnecting the upper and lower tension rails so that movement of the hydraulic cylinder is translated into coordinated movement of the upper and lower guide rails 41, 42. A manually operated mechanical actuator 62, such as a
5 screw adjuster mechanism or the like, may also be provided in lieu of a hydraulic cylinder.

The bale case of the present invention is also further defined by a pair of generally opposing tension rails 51,
10 52, one disposed on each vertical side 31, 32 of the bale case. Similar to the upper and lower tension rails, the elongate side tension rails 51, 52 are also oriented along the sides of the bale case, generally parallel to the bale travel axis 100 of the bale chamber 20 and pivotally
15 connected adjacent to their forward-most ends to the side walls or the baler frame.

The side tension rails 51, 52 are connected to a side positioner mechanism 70 that interconnects the baler frame
20 and the side tension rails 51, 52 in a manner that pivots the tension rails in a coordinated and simultaneous manner inwards into the bale case or outwardly from the bale case as a means of adjusting the effective width of the bale case and hence the resistance to movement applied on the sides of
25 a bale moving through the bale case.

Side positioner mechanism 70 also includes a side actuator 72, typically a hydraulic cylinder, and a linkage 74 interconnecting the right 52 and left side tension rails
30 51 so that movement of the hydraulic cylinder is translated into coordinated movement of the side tension rails. As with the vertical actuator 62, a manually operated mechanical side actuator 72, such as a screw adjuster mechanism or the like, may also be provided in lieu of a hydraulic cylinder.

35

Side tension rails 51, 52 work in conjunction with upper and lower tension rails 41, 42 to apply pressure to

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all four sides of a bale as it is moved through the base case by action of the plunger. While movement of the upper and lower tension rails is coordinated by their respective interconnecting linkage, and movement of the side tension rails is coordinated by their respective linkage, there is no linkage interconnecting the linkage for the upper/lower tension rails 41, 42 and the linkage for the side tension rails 51, 52. Thus the upper and lower tension rails 41, 42 may be moved independently from the side tension rails 51, 52, even though both pairs may be moved at the same time; there is no fixed relationship between their respective movements.

In one embodiment, vertical actuator 62 and side actuator 72, both being hydraulic cylinders, are hydraulically connected in a manner such that all four tension rails apply approximately equal pressure on the respective sides of the bale in the base case. Application of generally equal pressure on all four sides of the bale improves consistency in bale density and length as well as improving the general appearance of the completed bale.

Referring specifically to FIG. 3, the configuration of the upper and lower tension rails 41, 42 is shown to include a transverse bend in each rail surface facing the bale case that is oriented generally perpendicularly to the longitudinal axis of each rail. FIG. 5 presents a view of the side tension rails, but may be referred to in conjunction with FIG. 3 to illustrate the configuration of the transverse bend in the upper and lower tension rails as well. The result of the transverse bend is the creation of generally planar first zones 83, 84 in the inwards facing surfaces 81, 82 of the tension rails which are adjacent to the pivot points 53, 54 (as shown in FIG. 5, respectively; corresponding to pivots points 43, 44 on the upper and lower tension rails) and extending rearwards for a distance L1.

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The generally planar surfaces of first zones 83, 84 are angularly disposed relative to the generally planar surfaces of second zones 85, 86 on the rails. The surfaces of second zones 85, 86 extend rearwards from the transverse bend to
5 the end of the tension rails, shown as distance L2. The relationship of the angled first zones 83, 84 and second zones 85, 86 with reference to the bale travel axis 100 is such that the first zones 83, 84 are more greatly angled relative to the axis 100 than are the second zones 85, 86.

10

As the upper and lower tension rails are pivotally positioned with respect to the bale case, the angled relationship between the first and second zones creates a first portion in the bale case in which the cross sectional
15 area of the bale case, defined by the upper and lower tension rails, is decreasing from W1 to W2 at a greater rate as a bale travels through the bale case than the rate of change in cross-sectional area experienced by the bale travelling through the second zone, shown as the difference
20 between W2 and W3.

Similarly, FIGS. 4 and 5 show the configuration of the side tension rails 51, 52, and specifically the tension rail surfaces 81, 82 that contact the exterior surface of the
25 bale. Each side tension rail 51, 52 also includes a transverse bend similar to that of the upper and lower tension rails 41, 42. The result is the creation of a generally planar first zone 83, 84 which is adjacent to the pivot points 53, 54, respectively, and which is angularly
30 disposed relative to the generally planar second zones 85, 86 on the rails. As the side tension rails 51, 52 are pivotally positioned with respect to the bale case, the angled relationship between the first and second zones creates a first portion in the bale case, indicated as L1,
35 generally coinciding with the similar first portion created by the converging first zone of the upper and lower tension rails.

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In this first zone, the cross sectional area of the bale case, now defined by the upper and lower tension rails as well as the side tension rails, is decreasing at a
5 greater rate as a bale travels through the bale case than the rate of change in cross-sectional area experienced by the bale travelling through the second zone. This first zone, occurring generally in length L1, of higher tension rail convergence creates a wedge effect at the rear of the
10 bale forming area, providing increased resistance against which the plunger may compress the crop material to form the bale. The less constrictive second zone maintains sufficient pressure on the bale surface to maintain a desirable resistance on the bale.

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CLAIMS

1. A mechanism for applying tension to a bale in the bale case of an agricultural baler, the bale case having
5 four sides defining a generally rectangular opening through which a bale is urged along a bale travel axis from a forward end towards a rearward end, said mechanism comprising:

10 a pair of elongate tension rails (51,52) arranged along two opposing sides of the bale case (20), each of said pair of tension rails (51,52) being pivotally connected (53,54) at one end adjacent to the forward end of the bale case (20) and extending rearwards therefrom in a manner to allow the pair of tension rails (51,52) to be selectively pivoted
15 inwards and outwards relative to the bale travel axis; and

a positioner mechanism (70) connected the tension rails (51,52) for simultaneously moving the tension rails inwards or outwards with respect to the bale travel axis;

20 wherein each tension rail (51,52) has an offset bend oriented generally parallel to its pivotal connection to the bale case and displaced rearwards therefrom, the offset bend dividing each tension rail into a generally planar first surface (83,84) and a generally planar second surface (85,86) that are angled with respect to each other,

25 characterised in that the two first planar surfaces (83,84) and the two second planar surfaces (85,86) of the tension rails both converge towards one another and the angle between each first surface (83,84) and the bale travel axis (100) is greater than the angle between each second
30 surface (85,86) and the bale travel axis (100).

2. A mechanism as claimed in claim 1, further comprising:

35 a second pair of elongate tension rails (41,42) arranged along the other two opposing sides of the bale case (20), each of said second pair of tension rails (41,42) being pivotally connected at one end (43,44) adjacent to the

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forward end of the bale case (20) and extending rearwards therefrom in a manner to allow said second pair of tension rails (41,42) to be selectively pivoted inwards and outwards relative to the bale travel axis; and

5 a second positioner mechanism (60) connected to said second pair of tension rails (41,42) for simultaneously moving said second pair of tension rails (41,42) inwards or outwards with respect to the bale travel axis (100).

10 3. A mechanism as claimed in claim 2, wherein each tension rail (41,42) in said second pair has an offset bend oriented generally parallel to its pivotal connection to the bale case and displaced rearwards therefrom, the offset bend dividing the tension rail into a generally planar first
15 surface and a generally planar second surface that are angled with respect to each other, both the first surfaces of the second pair of tension rails and the second planar surfaces of the second pair of tension rails converge
20 towards one another, the angle between each first surface and the bale travel axis being greater than the angle between each second surface and the bale travel axis.

 4. A mechanism as claimed in claim 2 or 3, wherein the first and second positioner mechanisms (70,60) are
25 independently adjustable.

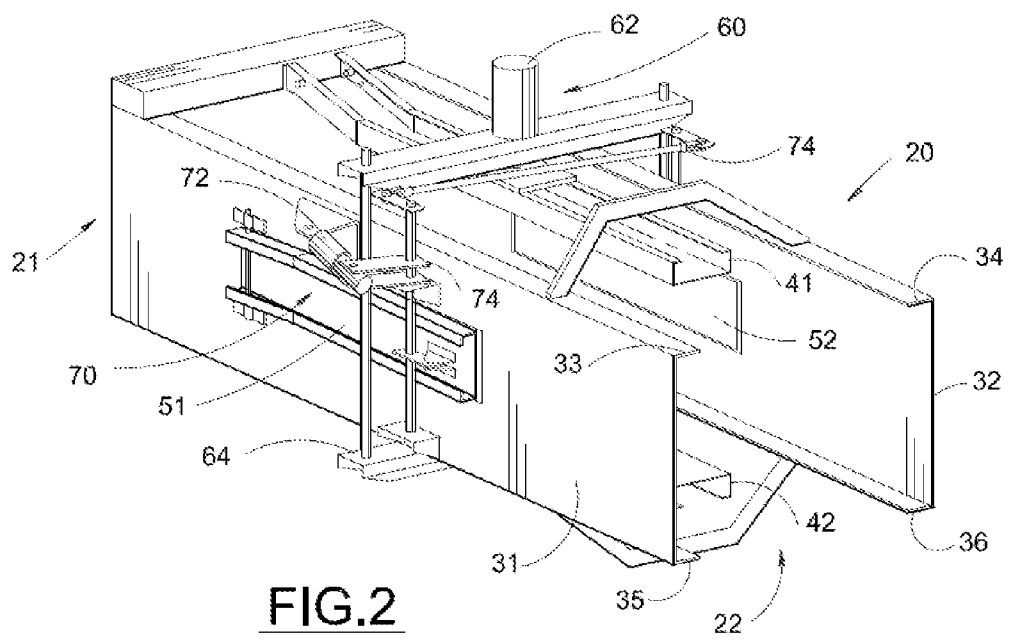
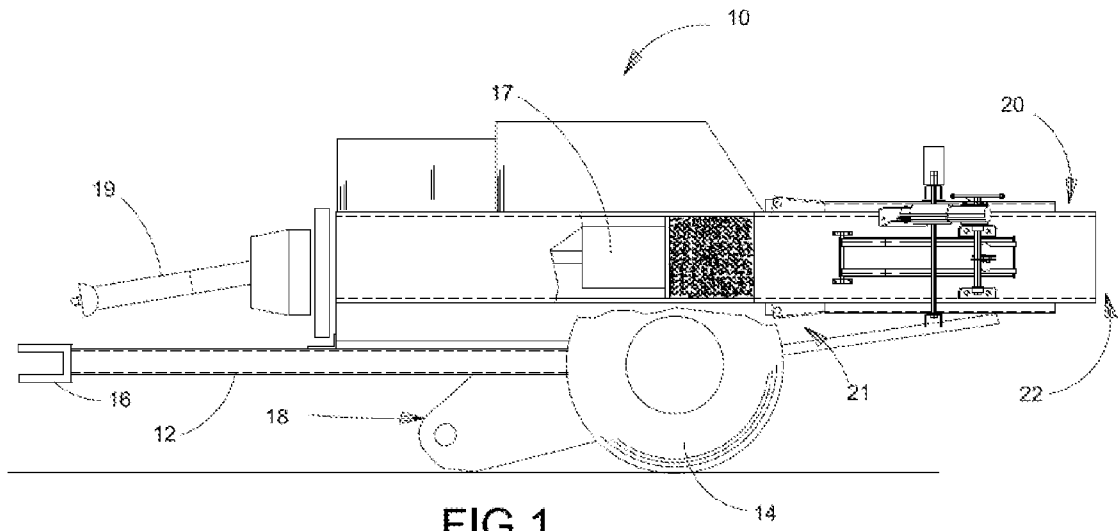
 5. A mechanism as claimed in any preceding claim, wherein the or each positioner mechanism (70,60) comprises a linkage (74, 64) interconnecting the associated pair of
30 tension rails configured to provide coordinated, simultaneous movement of each tension rail relative to the bale travel axis, and an actuator connected to the linkage for selectively positioning the tension rails.

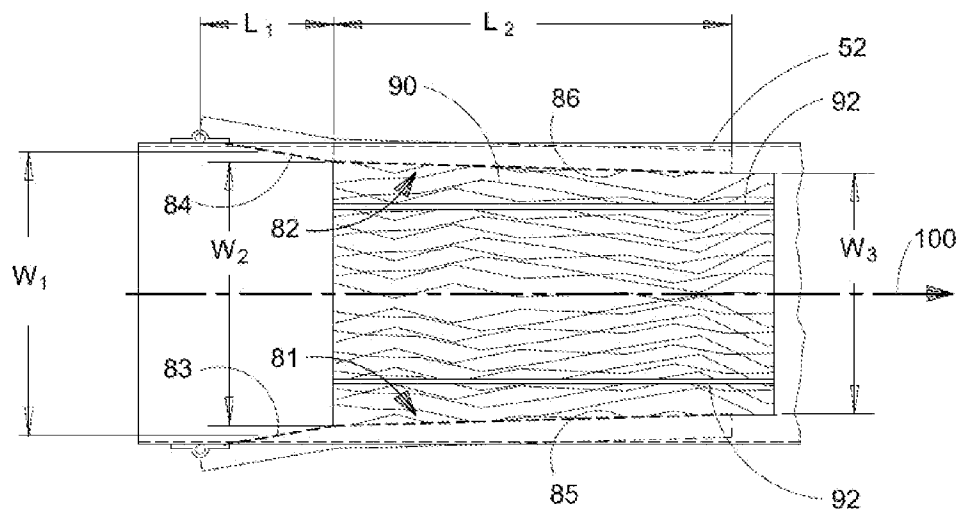
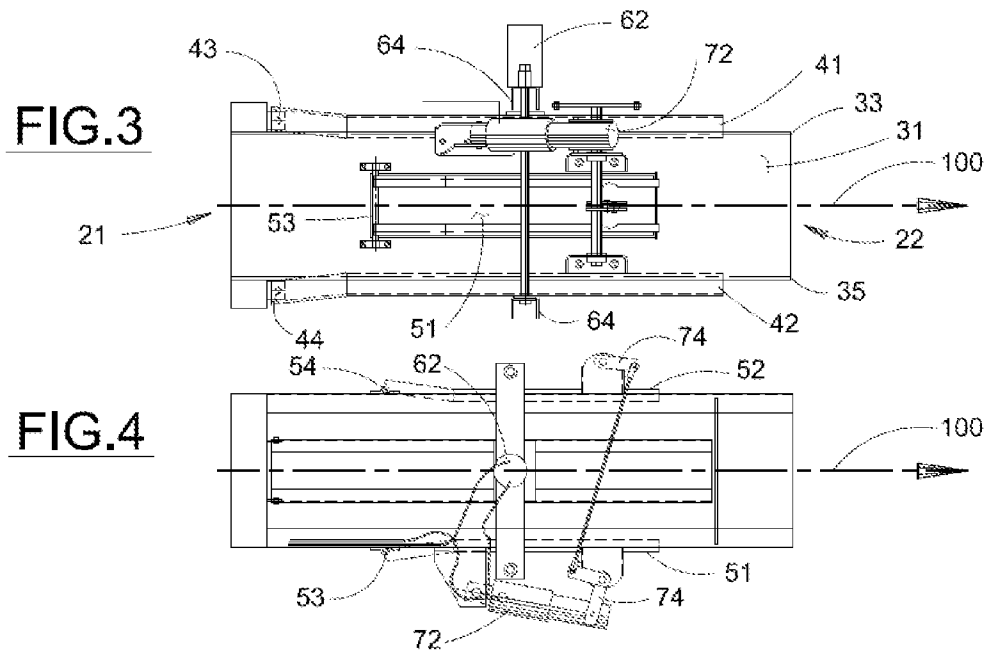
35 6. A mechanism as claimed in Claim 5, wherein the actuator (72,62) or at least one of the positioner mechanisms (70,60) is manually operated.

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7. A mechanism as claimed in Claim 5, wherein the actuator (72,62) or at least one of the positioner mechanisms (70,60) is hydraulically operated.

5 8. A mechanism as claimed in claim 7 having two hydraulic actuators (72,62) for positioning two pairs of tension rails (41,42;51,52), wherein the two hydraulic actuators (72,62) are hydraulically connected in a manner to enable uniform pressure to be simultaneously applied to the
10 sides of a bale in the bale case by the first and the second pair of tension rails.





INTERNATIONAL SEARCH REPORT

International application No
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A. CLASSIFICATION OF SUBJECT MATTER
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ADD.

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
A01F

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

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

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4 125 071 A (YOUNG ROBERT G) 14 November 1978 (1978-11-14) column 6, line 51 - column 8, line 49; figures 1-9	1
X	GB 972 562 A (THIEBAUD BOURGUIGNONNE STEB) 14 October 1964 (1964-10-14) cited in the application page 2, line 46 - page 2, line 112; figures 1-5	1

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

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"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.

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INTERNATIONAL SEARCH REPORT

Information on patent family members

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Patent document cited in search report		Publication date	Patent family member(s)	Publication date
US 4125071	A	14-11-1978	FR 2360241 A1 GB 1574097 A	03-03-1978 03-09-1980
GB 972562	A	14-10-1964	NONE	