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(72) Inventors LOWELL RAVEN GRUBE
WILLIS RAY CAMPBELL

(19)

(54) CROP MATERIAL ROLL FORMING MACHINE HAVING AN IMPROVED TWINE WRAPPING MECHANISM

(71) We, SPERRY CORPORATION formerly SPERRY RAND CORPORATION, a Corporation organised and existing under the laws of the State of Delaware, United States of America, of 1290 Avenue of the Americas, New York, New York 10019, United States of America do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:

This invention relates to crop material roll forming machines and is concerned with improved mechanisms for wrapping twine around rolls of crop material formed within such machines.

In recent years, the practice of harvesting crop material such as hay by forming it into large rolls through the use of large roll or round balers has become increasingly popular. One type of large round baler forms a swath or windrow of hay into a large cylindrical roll or round bale while the latter is supported on the ground. Another type of large round baler picks up the swath or windrow of hay and forms it into a large round bale off the ground. Both of these types of large round balers generally have a mechanism for applying or wrapping twine or similar binding material around the bale once it has reached its desired maximum size. The twine is then severed and the wrapped bale is discharged from the machine.

One type of twine wrapping mechanism associated with large round balers is disclosed in British Patent Specification No. 1,477,716 and comprises an elongated tube which oscillates to dispense twine across the bale forming region of the machine. As the dispensing tube is returned to its rest position, the twine is drawn over a cutting knife to sever the twine extending from the end of the tube. This severing operation requires that the twine be in a tight or taut condition because a loosely held twine cannot be severed satisfactorily. Furthermore, once the twine is severed, the free or tail end of the twine is uncontrolled and may slip back within the dispensing tube or may become engangled with the components of the machine, thereby hampering the wrapping operation of the next bale.

Another type of twine wrapping mechanism associated with large round balers is disclosed in U.S. Patent Specification No. 3,913,473 which shows a hydraulic cylinder that drives a twine dispensing tube back and forth across the bale forming region. As the dispensing tube returns to its rest position it actuates a twine cut-off mechanism whereupon an anvil swings upwardly, engaging the twine and moving the latter against a knife to sever the twine extending from the end of the tube. After severance, the free end of the twine remains clamped between the knife and the anvil. Should the hydraulic cylinder or hydraulic lines leak, the dispensing tube creeps away from its rest position and can be damaged or cause damage to other components of the round baler. Furthermore, the anvil can slip away from its abutting engagement with the knife, releasing the free end of the twine which might cause problems in the wrapping operation of the next bale.

According to the invention there is provided a wrapping mechanism of a crop material roll forming machine having a frame and a roll forming region for forming a roll of crop material such as hay, the mechanism comprising an elongated tube pivotally mounted on the frame and adapted to dispense a wrapping element such as twine across the roll forming region in a predetermined path, drive means for driving the elongated dispensing tube from a rest position along its predetermined path, severing means mounted on the frame in the vicinity of the predetermined path for receiving a portion of the wrapping element, the severing means including a striker plate and a knife which is movable from a first position to a second position wherein the knife engages the striker plate, latch means mounted on the frame for movement from a tube-receiving position to a tube-holding position wherein the dispensing tube is positively retained in its rest position, and means interconnecting the severing means and the

latch means such that the knife of the severing means is moved from its first position to its second position for severing the twine as the latch means move from the tube-receiving position to the tube-holding position when the dispensing tube is driven into the latch means, forcing the latter to be moved from the tube-receiving to the tube-holding position.

Preferably, the latch means include an upright support member mounted on the frame adjacent the roll forming region, a plate pivotally mounted on the upper end of the upright member and having an open slot adapted to receive the elongated dispensing tube, the plate being movable between a tube-receiving position wherein the open slot of the plate is disposed within the predetermined path of the dispensing tube and a tube-holding position wherein the plate is disposed in an upright position for positively retaining the dispensing tube in its rest position, the interconnecting means including a rod having one of its ends pivotally connected to the knife and the other one of its ends pivotally connected to the latch means such that movement of the latch means between the tube-receiving and tube-holding positions causes a corresponding movement of the knife between its first and second positions.

A crop material roll forming machine having a wrapping mechanism according to the invention will now be described, by way of example, with reference to the accompanying drawings, in which:–

Figure 1 is a side view of the machine, showing a hydraulic cylinder for actuating a twine wrapping mechanism,

Figure 2 is a fragmentary view showing a component for manually operating the twine wrapping mechanism of the machine,

Figure 3 is an enlarged fragmentary plan view of the portion of the machine seen on line 3-3 of Figure 1,

Figure 4 is a fragmentary view on the line 4-4 of Figure 3,

Figure 5 is an enlarged plan view, partly in section, of a breakaway mechanism which is associated with the hydraulic cylinder in Figure 3, and

Figure 6 is an enlarged diagrammatic view of a portion of the twine wrapping mechanism.

In the following description, references to "right-hand" and "left-hand" relate to an observer standing at the rear of the machine and facing in the direction of forward travel, which is towards the right in Figure 1.

Referring to Figure 1, the crop material roll forming machine 10 is provided with a base frame 12 having right-hand and left-hand sides (the right-hand side being omitted for clarity) between which extends a roll forming region 14 and within which a completed roll R is illustrated. The frame 12 is supported and made mobile by right-hand and left-hand ground-engaging wheels 16 (only the left-hand wheel 16 being shown) rotatably mounted on spindles 18 connected to and extending outwardly from respective opposite sides of the frame 12.

The machine 10 is adapted to be connected to a tractor (not shown) by means of a tongue 20 the rear end of which is connected to a horizontal beam 22 of the frame 12. The beam 22 extends transversely between and interconnects the opposite sides of the frame 12.

Extending forwardly from the lower front portion of the mobile frame 12 of the machine 10 is a pick-up 24. The pick-up 24 is adapted to engage, elevate and rearwardly feed a swath or windrow of crop material into the roll forming region 14 of the machine 10. The crop material fed by the pick-up 24 is passed rearwardly to the front end of a lower apron 26.

The lower apron 26 is formed by a series of endless flexible lug-bearing chains 28 which are uniformly spaced in a transverse direction and which extend around front drive sprockets 30 mounted on a front shaft 32 rotatably supported between the sides of the frame 12 at the front thereof. The chains 28 also pass around rear idler sprockets 34 mounted on a shaft 36 rotatably supported between the sides of the frame 12 and the rear thereof.

Mounted upon longitudinally spaced transverse members 38 of the base frame 12 is a floor 40. The floor 40 is rigid and generally horizontal. The upper courses of the lower apron chains 28 move in a rearward direction above the floor 40 to convey the crop material received from the pick-up 24 towards the rear of the machine 10.

The lower course of an upper apron assembly 42 engages and directs the crop material reaching the rear end of the frame 12 into an upward and forward direction to effect, in combination with the lower apron 26, rolling of the crop material into the roll R in the direction of the arrow A of Figure 1. During roll forming, as the lower and upper courses of the upper apron assembly 42 move respectively in the directions of the arrows A and B in Figure 1, the lower course of the upper apron assembly 42 is capable of moving outwardly as the roll R increases in diameter. This outward movement is accommodated by idler sprockets 44 and 46 which support portions of the upper course of the apron assembly 42 and which are mounted on arms 48, 50. The arms 48, 50 are disposed adjacent each side of the frame 12 and are supported on a common transverse shaft 52 rotatably mounted between the sides of frame 12. The arms 48, 50 are biased by extension springs (not shown)

which are mounted along the frame sides and which normally position the upper apron 42 in a contracted condition but are yieldable to allow the aforementioned outward movement of the lower course of the apron assembly 42 during roll formation.

The upper apron assembly 42 also extends about front drive sprockets 54 mounted on a shaft 56 rotatably supported between the sides of the frame 12.

The base frame 12 also supports a rear upper frame or tailgate assembly 58 which is pivotally connected at 60 to the upper portions of the sides of the frame. The tailgate assembly 58 is pivoted clockwise from its lower roll forming position, shown in Figure 1, to an upper discharge position (not shown) by a pair of hydraulic cylinders 62 (only the left-hand cylinder 62 being shown) respectively mounted on and extending along the sides of the frame 10. The tailgate 58 rotatably supports upper, rear, and lower idler sprockets 64, 66 and 68 respectively around which the upper apron assembly 42 also extends.

For providing rotary power to the pick-up 24 and the lower and upper aprons 26, 42, an input driveline (not shown) extends beside the tongue 20. The input driveline is adapted for connection at its forward end to the power take-off (PTO) shaft of the tractor. The hydraulic cylinders of the machine are connected to hydraulic sources on the tractor.

In order that the roll R retains its shape when discharged from the machine 10, the machine is provided with a supply of twine, located on the right-hand sidewall of the frame 12. The twine is applied to the roll R by a twine wrapping mechanism 70 just before the upper frame or tailgate assembly 58 is pivoted to its upper position for discharge of the roll R from the machine 10.

The wrapping mechanism 70 includes a twine dispensing assembly 72 and components for actuating the assembly 72. The wrapping mechanism 70 includes twine severing means 74 and latch means 76, the latter being connected to the severing means 74 and cooperating with the twine dispensing assembly 72 for effecting control of the severing means 74 in response to movement of the dispensing assembly 72 for severing the twine after the roll has been wrapped with twine.

The twine dispensing assembly 72 is positioned forwardly of the roll forming region 14 and includes an elongate dispensing tube 78 having a twine tensioning device 79 attached to its lower free end for applying tension to the twine as it is dispensed across the bale forming region 14. Twine from the supply is guided by means not shown through the upper end of the tube 78 with a short length of twine extending or dangling from the opposite free end of the tube 78.

The upper, i.e. twine receiving, end of the tube 78 is fixed by brackets 80 (see Figure 6) to one side of a segment plate 82 having an outer peripheral toothed portion 83. The plate 82 is mounted on one end of a rotatably supported shaft 84 which extends normal to the plate 82. The shaft 84 protrudes through the upper end portion of an upright support member 86 secured to the transverse frame member 22 and is rotatably supported within two bearings: one bearing 88 is secured to the upright member 86 by a bracket 90 and the other bearing 92 is supported within the upright member 86. The mounting of the tube 78 on the plate 82 is such that upon rotation of the shaft 84 and the plate 82, the lower free end of the tube 78 moves in a predetermined path across the roll forming region 14.

The above-described mounting of the dispensing tube 78 enables the free end of the tube to be moved along its predetermined path by a selected one of two different actuating components: namely a manually operable component 94 (Figure 2) and a power driven component having a hydraulic cylinder 96, as shown in Figure 1.

For manual operation of the twine dispensing tube 78, the manually operable component 94 includes a drive shaft 98 journalled for rotation within a bearing 100 supported on the top edge of the upright member 86. One end of the drive shaft 98 supports a gear 102 which meshes with the toothed portion 83 of the plate 82 whereas the other end of the drive shaft 98 is connected to one yoke of a universal joint 104 whose other yoke is mounted on the end of a rod 106. The rod 106 extends within a telescopic sleeve 108 which is secured to a crank handle 110 having a knob 112. The sleeve 108 is supported on a member 114 which extends upwardly from the forward portion of the tongue 20. A cotter pin 116 extends through apertures provided in the sleeve 108 and the rod 106 such that manual rotation of the crank handle 110 rotates the gear 102 which drives the toothed portion 83 and thereby rotates the plate 82 and the shaft 84, resulting in pivotal movement of the dispensing tube 78 along its predetermined path.

The twine dispensing tube 78 is also adapted to be actuated automatically by the hydraulic cylinder 96. As best seen in Figure 3, a pin 118 pivotally supports the lower end of the hydraulic cylinder 96 in a bracket 120 secured to the transverse frame member 22. The upper, piston end of the cylinder 96 is pivotally connected by a pin 122 to a breakaway mechanism 124, (best seen in Figure 5) which interconnects the hydraulic cylinder 96 and the twine dispensing assembly 72. The purpose of the breakaway

mechanism 124 is to disconnect the cylinder 96 from the assembly 72 under conditions wherein the torque on the shaft 84 exceeds a predetermined value. The breakaway mechanism 124 is beneficial in preventing damage to the components of the dispensing assembly 72, as well as damage to the other components of the wrapping mechanism 70, such as the severing means 74 and the latch means 76.

With reference to Figure 5, the breakaway mechanism 124 comprises a first lever 126, a second lever 128 and means 130 for coupling the first lever 126 to the second lever 128. The first lever 126 has one end fixedly mounted to a sleeve 132 and the second lever 128 has its corresponding end mounted to a hub 134 which is adapted to be passed over the sleeve 132 and retained thereon by a snap ring 135. The other end of the second lever 128 is secured to a stub member 136 (for example by welding) so as to define a slot 138 accommodating the other end of the first lever 126. The coupling means 130 include an internally threaded tube 140 housing a coil spring 142 and an engaging ball 144. The tube 140 is secured within a bore provided in the stub member 136 such that the engaging ball 144 is urged into engagement with the first lever, 126, the force of engagement depending on the adjustment of a bolt 146 threaded in the tube 140 and compressing the spring 142. Thus adjustment of the bolt 146 presets the predetermined torque at which the breakaway mechanism 124 reacts. The engaging ball 144 is of a diameter greater than the width of the slot 138 between the stub member 136 and the lever 128 such that the ball 144 will not be lost but is confined within the slot 138 even upon movement of the first lever 126 away from the slot 138.

When the hydraulic cylinder 96 is utilised to actuate the dispensing tube 78 of the dispensing assembly 72, the sleeve 132 is passed over the shaft 84 and retained thereon by retaining bolts 148. Hydraulic hoses 150 (Figure 1) from the hydraulic cylinder 96 are connected to the hydraulic system of the tractor (not shown) for powering the cylinder 96. Preferably, the hydraulic cylinder 96 is of the double acting type so that as the piston rod of the cylinder 96 is extended it moves the second lever 128 which is coupled to the first lever 126 by the coupling means 130, thereby rotating the shaft 84 in a clockwise direction as viewed in Figure 6. As the shaft 84 rotates in a clockwise direction, the plate 82 rotates therewith resulting in a corresponding pivotal movement of the dispensing tube 78. Retraction of the piston rod of the hydraulic cylinder 96 rotates the shaft 84 and the plate 82 in a counterclockwise direction as viewed in Figure 6, with corresponding pivotal movement of the dispensing tube 78. Should the dispensing tube 78 encounter any impassable obstacles that would create a torque load in excess of the predetermined value set by the compression load of the spring 142 on the ball 144, the breakaway mechanism 124 reacts by uncoupling the first lever 126 from the second lever 128 so that the first lever 128 pivots with the hub 134 around the sleeve 132.

In preparation for the roll wrapping operation, once the roll R has reached its desired size, the operator normally stops further forward movement of the machine 10 to interrupt the flow of crop material delivered by the pick-up mechanism 24. Concurrently, the operator actuates the twine dispensing assembly 72, either by the hydraulic cylinder 96 or the manual handle 94. The twine dispensing tube 78 is thus swung along its predetermined arcuate path from the left-hand to the right-hand side of the machine and then returned to its initial rest position on the left-hand side of the machine. In its initial rest position, the tube 78 is disposed generally parallel to the transverse frame member 22, forwardly of the bale forming region 14, with the lower, free end of the tube 78 disposed adjacent the left-hand side of the machine 10. The predetermined arcuate path of movement of the tube 78 is best described as being first a slightly rearward and generally downward movement towards the right-hand side of the bale forming region 14 and then in a generally upward and slightly forward movement to its rest position. The dispensing tube 78, at least during a portion of its cyclic movement, is guided along the underside of a tubular member 170 which will be described in connection with the description of the severing means 74.

As the tube 78 swings back and forth across the bale forming region 14, the twine is deposited on the lower apron 26 or, if there is still crop material moving into the machine, the twine is deposited thereon and is intermeshed therewith. The twine is then carried rearwardly into the bale forming region 14 wherein it is wrapped around the roll R as the roll is rotated. Since the dispensing tube 78 swings from one side to the other side of the machine as the roll R is rotated, the winding of the twine will be in the form of a spiral.

Preparation for severing the twine occurs as the tube 78 approaches the end of its return cycle wherein the twine is brought into the vicinity of the severing means 74. Referring to Figure 4, the severing means 74 include a striker plate 152, a severing knife 154 and a guide shield 156 which is attached by screws 158 to the left-hand sidewall of the machine. The guide shield 156 projects over the striker plate 152 and

the knife 154, and has an angled front edge (see Figure 3) tapered so as to guide the twine over the striker plate 152 as the tube 78 approaches its return cycle. The striker plate 152 is rigidly attached by bolts 160 to a transverse stub member 162 secured to the left-hand sidewall of the machine, below the guide shield 156. The knife 154 is pivotally mounted rearwardly of the striker plate 152 and is movable away from and towards the striker plate 152. The knife 154 cooperates with the plate 152 to provide a cutting action. The knife 154 includes a blade 164 attached by bolts 166 to one end of an arm 168 which is secured to a tubular hub 170 pivotally mounted on a shaft 172. The tubular hub 170 surrounds the shaft 172 which extends transversely between the opposite sidewalls of the machine and which is mounted at each of its ends within the respective sidewalls.

The latch means 76 are provided for coordinating the pivotal movement of the knife 156 towards and away from the striker plate 152 in response to pivotal movement of the dispensing tube 78 from its rest position. As best seen in Figure 4, the latch means 76 are supported on the upper end of an upright member 174 which is attached by fastening elements 176 to the transverse frame member 22. The latch means 76 include a flat, rectangular latch plate 178 having edge formed with a tube-receiving slot 180 and its opposite edge provided with a pair of positioning notches 182, 184. A bar 185 is secured to the end of the plate 178 adjacent the slot 180 and projects outwardly therefrom. The latch plate 178 is secured to one end of a short transverse shaft 186 which is rotatably mounted in the upper end portion of the upright member 174. The other end of the shaft 186 supports a crank arm 188. A biasing lever 190 is provided with an abutting knob 192 that projects outwardly from one side thereof towards the latch plate 178 for registering with one of the positioning notches 182, 184 of the latch plate 178. One end of the lever 190 is connected by a spring 194 to the upper portion of the upright member 174, whereas the other end of the lever 190 is pivotally mounted on the upright member 174 by a pin 196 located below the shaft 186.

An interconnecting rod 198 is provided for coordinating the movement of the knife 154 with the movement of the latch plate 178. The knife 154 is pivoted towards the striker plate 152 as the latch plate 178 is moved from its tube receiving position to its tube holding position, respectively shown in solid lines and broken lines in Figure 4. The rod 198 is connected at its lower end to a crank arm 200, secured to the tubular hub 170, and extends upwardly and forwardly therefrom between portions of the left-hand sidewall of the machine. The upper end of the rod 198 carries a nut 201 and extends through an eye bolt 202 and a spring 204. The spring 204 is coiled about the rod 198 and confined in a state of compression between the eye bolt 202 and a retaining nut 206 threaded on the end of the rod 198. The eye bolt 202 is fastened to the crank arm 188 for movement therewith as the latter pivots on the shaft 186.

During the roll forming operation, the dispensing tube is normally in its rest position, disposed generally parallel to the transverse frame member 22, with its lower or dispensing end held in the slot 180 as the latch plate 178 is in its tube holding position shown in broken lines in Figure 4. In this tube-holding position of the latch plate 178, the knife 154 abuts the striker plate 152 with the free end of the twine clamped therebetween.

When the roll R has been formed, the operator actuates the twine dispensing assembly 72 whereupon the twine dispensing tube 78 is pivoted from its rest position along its predetermined path. As the tube 78 moves rearwardly, the latch plate 178 pivots rearwardly to its tube-receiving position wherein the abutting knob 192 registers with the notch 184 to retain the latch 178 in this position. Further, as the latch plate 178 pivots, the crank arm 188 pivots, forcing the eye bolt 202 against the nut 201 which in turn forces the rod 198 and crank arm 200 downwardly, thereby moving the knife 154 away from the striker plate 152. As the knife 154 moves away from the striker plate 152, the free end of the twine is released therefrom and is free to be carried by the dispensing tube 78 back and forth across the roll forming region 14. As the tube 78 approaches its rest position, on its return cycle, the twine is guided over the striker plate 152 by the guide shield 156. Then, as the tube 78 is driven into the latch plate 178, the plate 178 pivots forwardly to its rest position, wherein the abutting knob 192 registers with the retaining notch 182. This forward pivotal movement of the latch plate 178 pivots the crank arm 188 and the eyebolt 202 forwardly, compressing the spring 204 against the retaining nut 206 which forces the rod 198 and crank arm 200 forwardly and upwardly, resulting in the knife 154 being moved towards the striker plate 152. The spring 204 urges the knife 154 against the striker plate 152 to pinch the twine therebetween. The rotation of the roll R as shown by the arrow A in Figure 1, pulls the twine over the knife 154, resulting in severance of the twine. The portion of the twine rearwardly of the cut is pulled into the roll forming region 14 by the rotating roll R, while the forward end of the severed twine remains clamped between the knife 154 and

the striker plate 152 as the dispensing tube 78 remains in its rest position.

The machine illustrated in the accompanying drawings is identical to that disclosed in our co-pending Application No. 35525/77 (Serial No. 1 584 678).

WHAT WE CLAIM IS :–

1. A wrapping mechanism of a crop material roll forming machine having a frame and a roll forming region for forming a roll of crop material such as hay, the mechanism comprising an elongated tube pivotally mounted on the frame and adapted to dispense a wrapping element such as twine across the roll forming region in a predetermined path, drive means for driving the elongated dispensing tube from a rest position along its predetermined path, severing means mounted on the frame in the vicinity of the predetermined path for receiving a portion of the wrapping element, the severing means including a striker plate and a knife which is movable from a first position to a second position wherein the knife engages the striker plate, latch means mounted on the frame for movement from a tube-receiving position to a tube-holding position wherein the dispensing tube is positively retained in its rest position, and means interconnecting the severing means and the latch means such that the knife of the severing means is moved from its first position to its second position for severing the twine as the latch means move from the tube-receiving position to the tube-holding position when the dispensing tube is driven into the latch means, forcing the latter to be moved from the tube-receiving to the tube-holding position.

2. A wrapping mechanism according to claim 1, wherein the latch means include an upright support member mounted on the frame adjacent the roll forming region, a plate pivotally mounted on the upper end of the upright member and having an open slot adapted to receive the elongated dispensing tube, the plate being movable between a tube-receiving position wherein the open slot of the plate is disposed within the predetermined path of the dispensing tube and a tube-holding position wherein the plate is disposed in an upright position for positively retaining the dispensing tube in its rest position, the interconnecting means including a rod having one of its ends pivotally connected to the knife and the other one of its ends pivotally connected to the latch means such that movement of the latch means between the tube-receiving and tube-holding positions causes a corresponding movement of the knife between its first and second positions.

3. A wrapping mechanism according to claim 1 or 2, wherein the latch means further include biasing means for positively retaining the plate in its tube-receiving or tube-holding position.

4. A wrapping mechanism according to claim 3, wherein the biasing means include an arm having an abutment knob thereon and a spring, the arm being pivotally mounted at one end on the upright member below the plate, the spring being connected to the free end of the arm and to the upright member at a position above the pivotal mounting of the other end of the arm so as to urge the abutment knob of the arm into abutting engagement with either one of a pair of notches, provided in the lower edge of the plate, in the tube-receiving and tube-holding positions of the latch means, respectively.

5. A wrapping mechanism according to any of the preceding claims, wherein a shaft extends transversely across the roll forming region adjacent the predetermined path to provide a guide for a portion of the tube, the knife being rotatably mounted on a portion of the shaft.

6. A wrapping mechanism according to claim 5, wherein the knife, the striker plate and the latch means are positioned along the same side of the roll forming region.

7. A wrapping mechanism according to any of the preceding claims, wherein the striker plate is mounted in a stationary position adjacent one side of the roll forming region and forwardly of the knife, the knife being pivotally mounted so as to be pivotable towards and away from the striker plate.

Agent for the Applicants
J. SINGLETON
Chartered Patent Agent

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1584679 COMPLETE SPECIFICATION

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Sheet 1

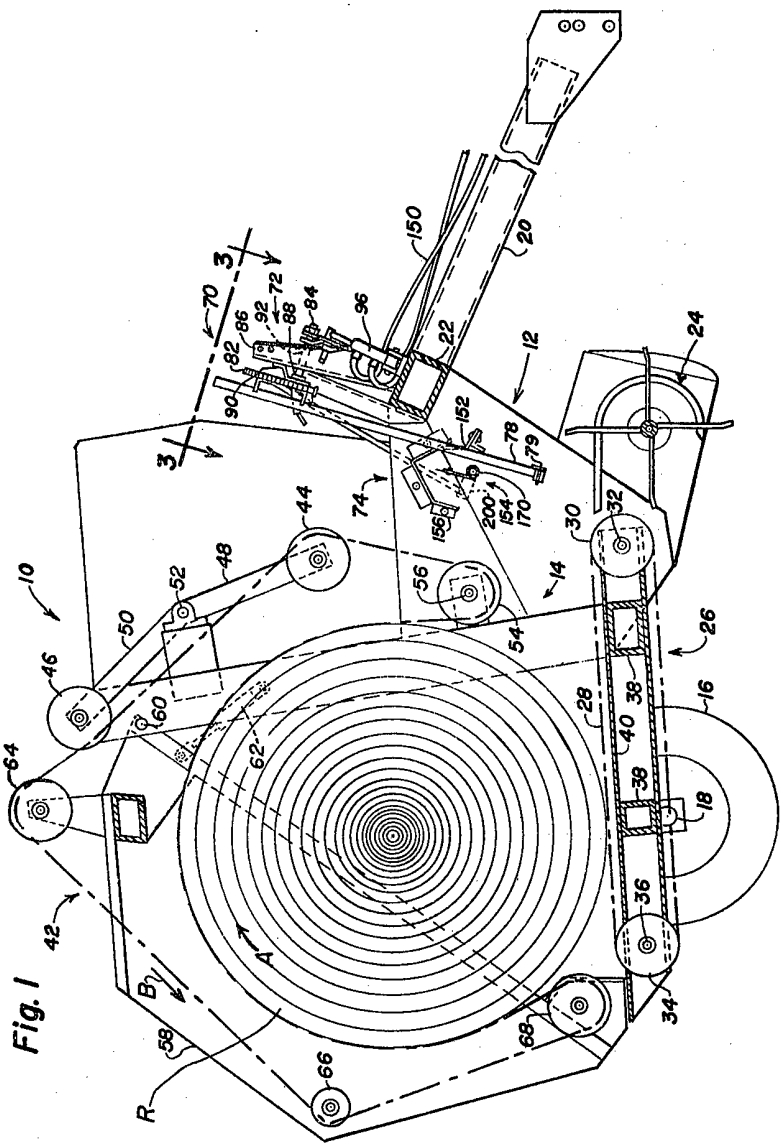

Fig. 1

1584679 COMPLETE SPECIFICATION

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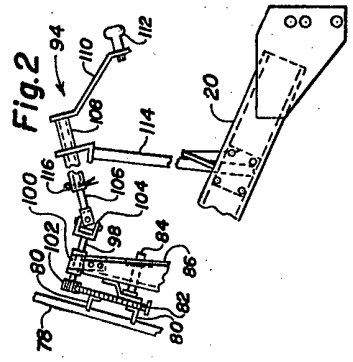

Fig. 2

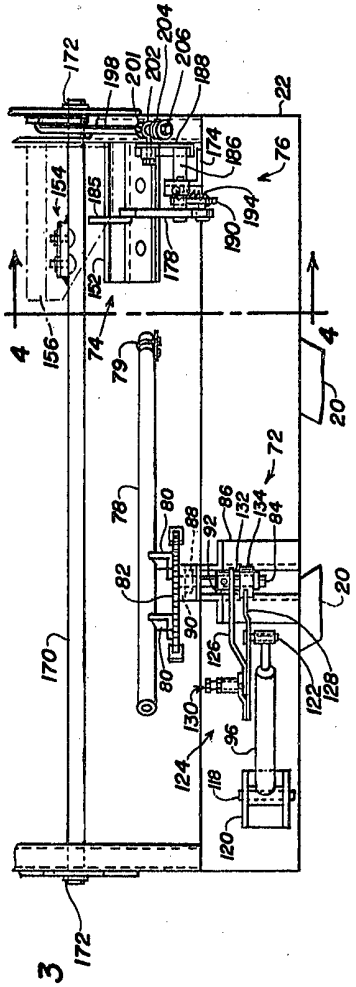

Fig. 3

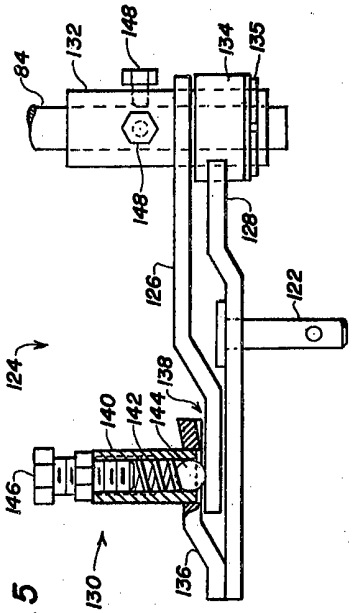

Fig. 5

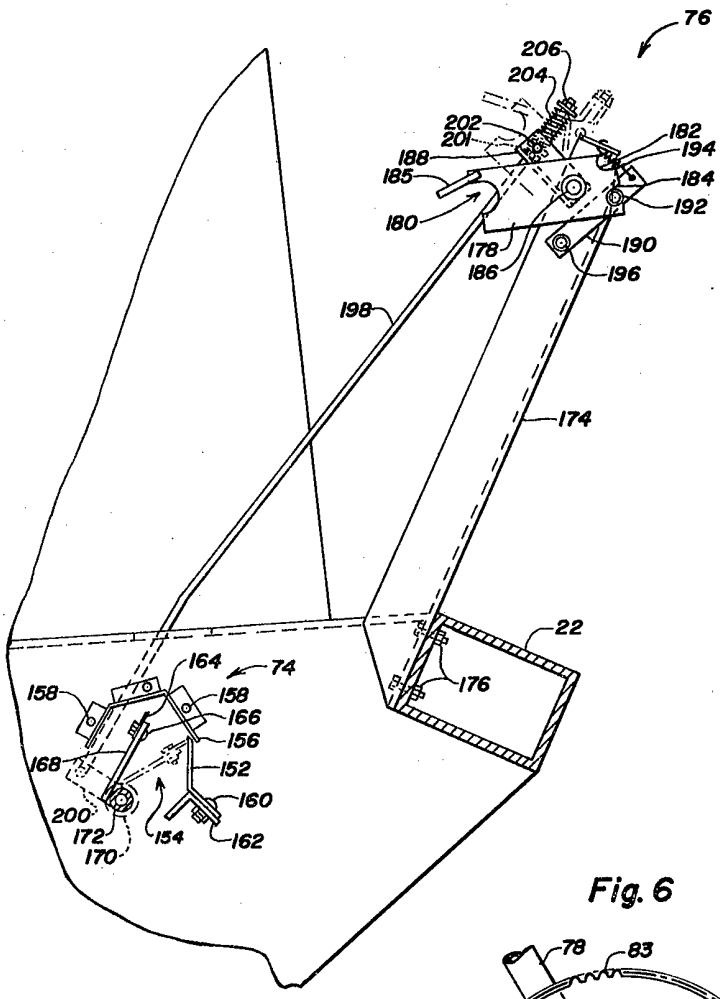
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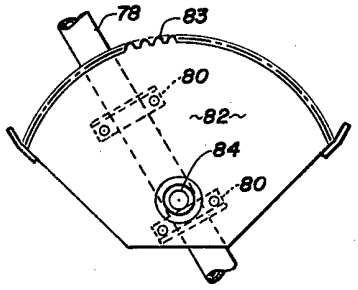
Fig. 6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