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(54) **APPARATUS FOR INITIATING AUTOMATIC FEED OF BALE WRAPPING MATERIAL**

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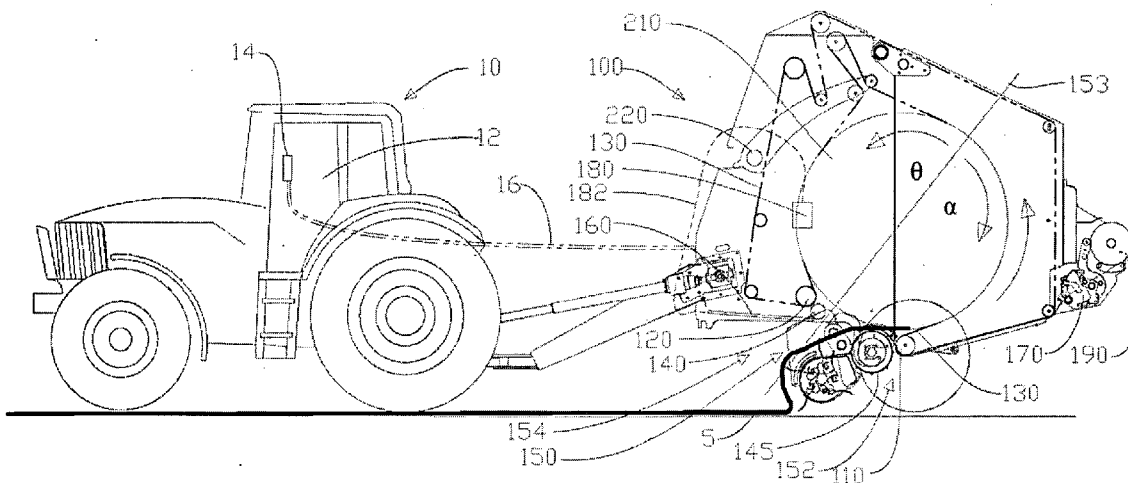
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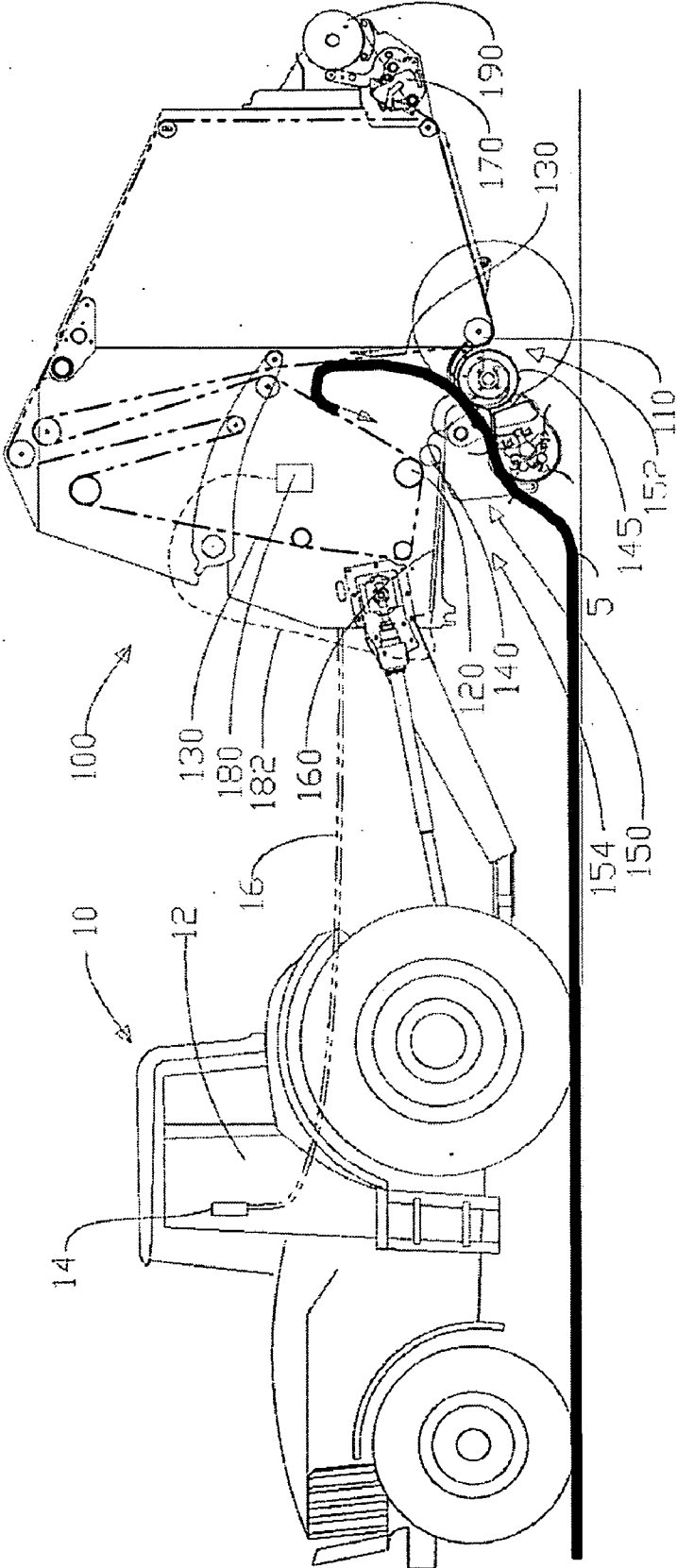
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(57) **ABSTRACT**

Large cylindrical bales of hay, straw, or other forage or fodder are usually wrapped with a filament-type product, typically twine, or a sheet-type product, typically netwrap material, after a bale has reached a predetermined size. A method and apparatus are disclosed that permits the bale to continue to form during part of the wrapping process. A delay occurs between the initiation of the wrapping step and the alarm for the operator to stop the forward movement of the baler. By inserting the wrap material to an entry throat of the baler, new crop material may be added to the bale while the leading edge of the wrap material travels around the bale. The operator is notified only when the feed of additional crop material needs to be stopped for the wrapping operation to conclude. The present invention is applicable to the use of sheet or filament wrapping materials for binding round bales.





(Prior art)

Figure 1

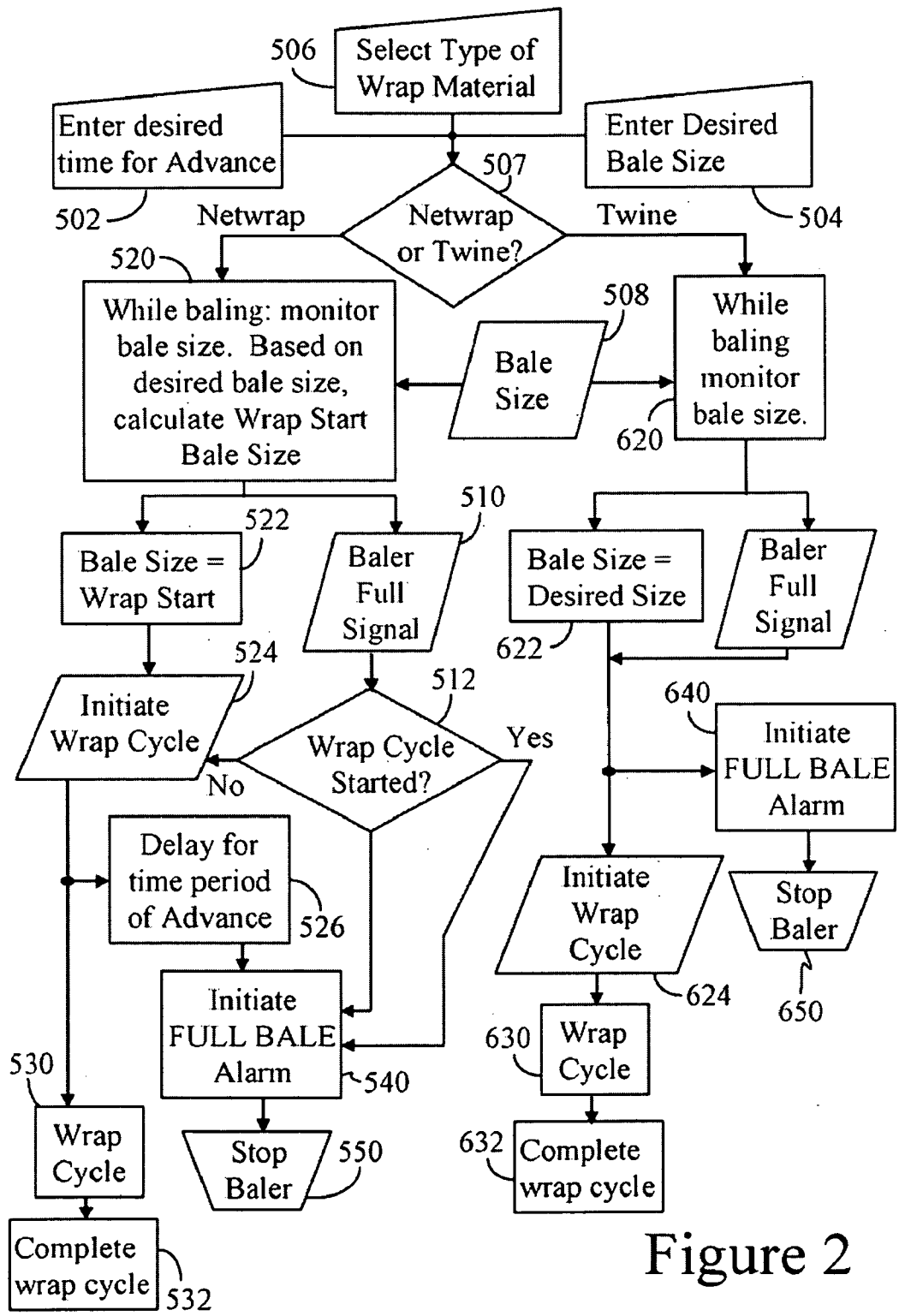


Figure 2

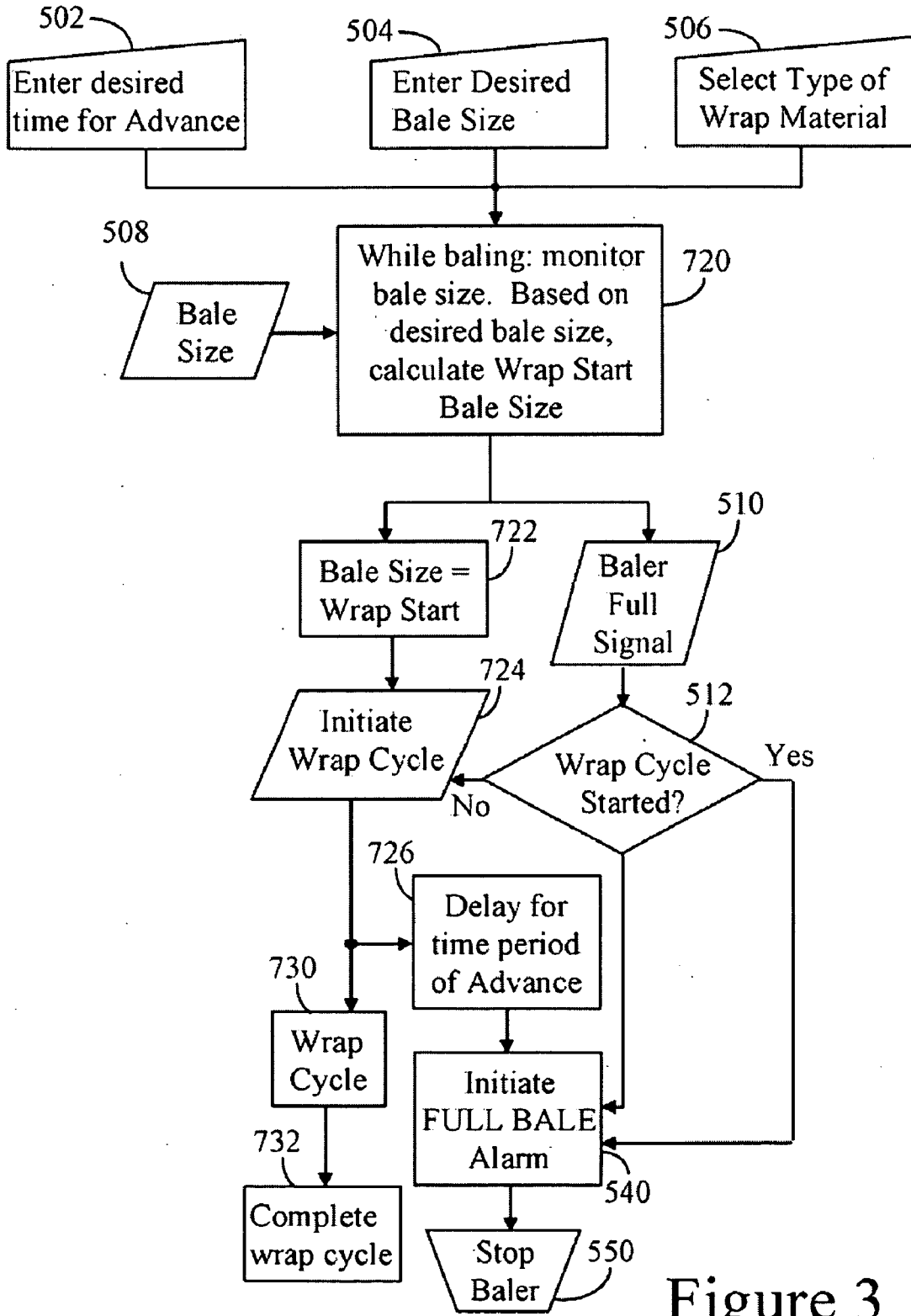


Figure 3

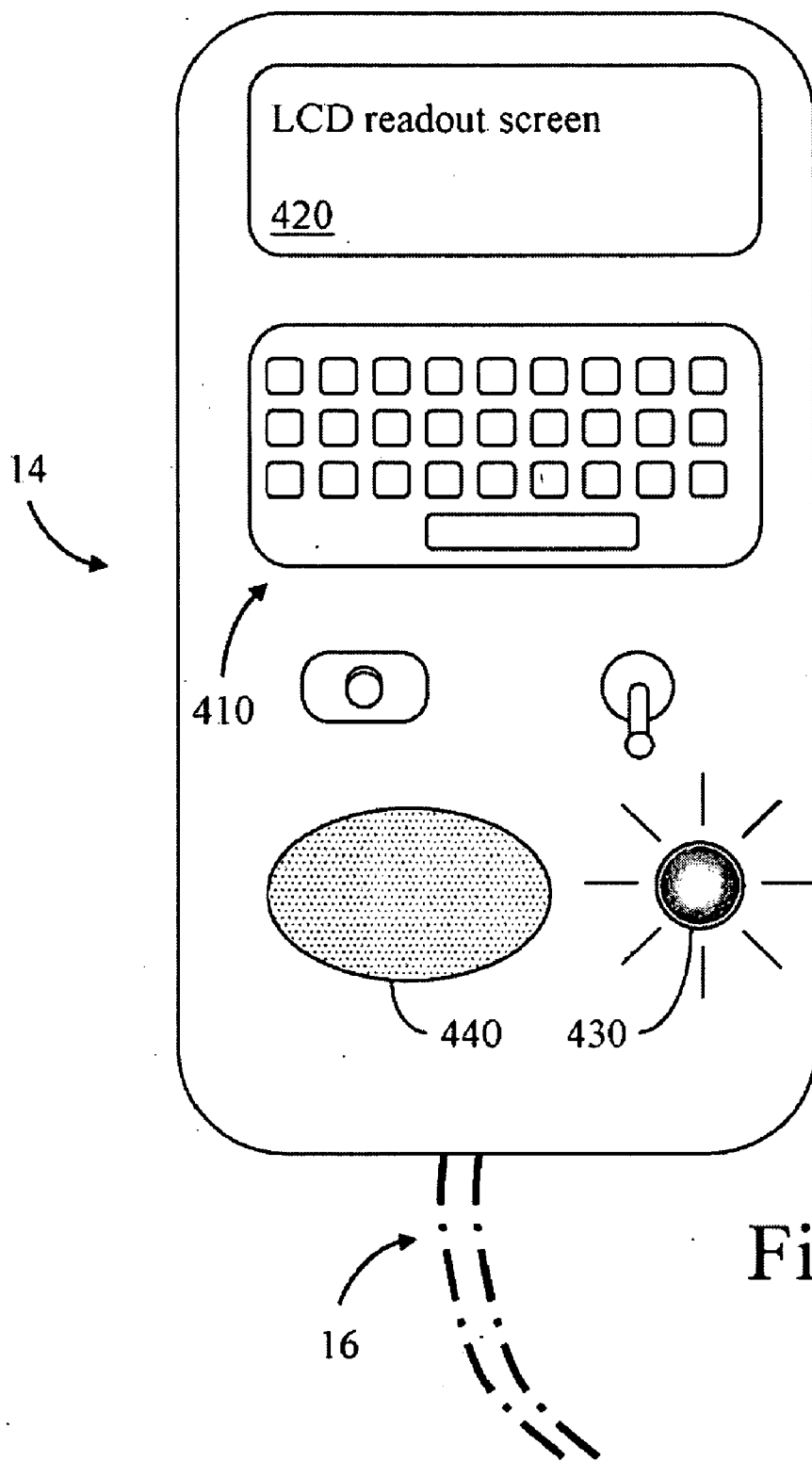


Figure 4

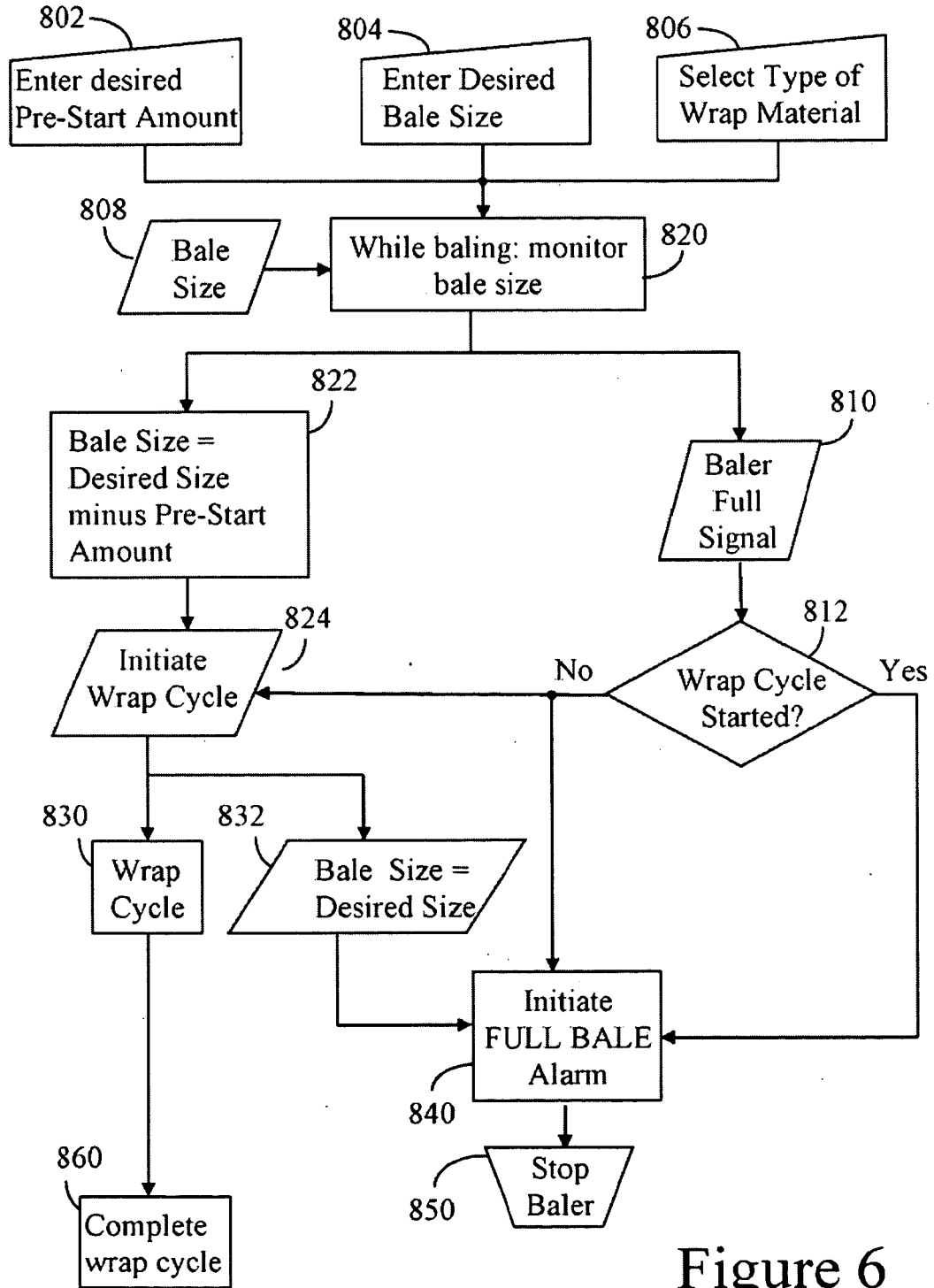


Figure 6

APPARATUS FOR INITIATING AUTOMATIC FEED OF BALE WRAPPING MATERIAL

TECHNICAL FIELD

[0001] The principles disclosed relate to improvements to round balers used for harvest of agricultural crops. More particularly, the invention relates to improved operation of the mechanism that feeds sheet type wrapping material such as netwrap or plastic, or filament type wrapping material such as, twine, to a formed cylindrical bale for wrapping the bale. The invention further relates to a method of operating the feed mechanism.

BACKGROUND

[0002] Round balers are well known, designed to form agricultural crops into cylindrical packages. All such balers include some type of mechanism for wrapping the formed bales with a wrap material including netwrap, which is a sheet material typically in the form of light, very thin web material, or twine, that is a filament. Round balers generally fall into two categories: fixed chamber balers or variable chamber balers. The fixed chamber balers generally include rollers or short sections of flat belts in fixed locations to define the bale chamber. This configuration provides many optional entry points for the wrapping material, provided at any transition between the rollers or belts. The variable chamber balers typically include flat belts that form a variable size bale-forming chamber, and the entry point for the wrapping material is generally limited to the in-feed area or throat. FIG. 1 is a schematic of a typical variable chamber baler 100, as disclosed in commonly assigned U.S. Ser. No. 10/719,460, Filed: Nov. 21, 2003 entitled NETWRAP FEED AND CUT MECHANISM herein incorporated by reference, connected to a towing vehicle, such as a tractor 10. The tractor 10 includes an operator station 12 where information related to the performance of the baler is typically communicated to an operator, with controller 14, which includes a display and audio alarm. In operation, the tractor 10 tows the baler across the ground to feed the crop material 5 to throat 150 defined by a bottom belt roller 110, and an upper roller 120; both supporting the bale forming belts 130. The throat 150 typically also includes other rollers such as a starting roller 140 and drum roller 145 that assist in moving the crop material. Many configurations are known, but each includes what can be defined as an entry side 152 and an exit side 154. The entry side 152 is to be defined by the travel direction of the bale forming belts and crop material 5. For instance in the example illustrated in FIG. 1, the bale forming belts 130 are illustrated to travel in a direction that the outer circumference of the forming bale will move in a counter-clockwise direction. The crop material 5 will enter the throat 150 and be moved toward the bottom belt roller 110 at the entry side 152 of the throat. Balers have been designed to rotate the forming bale in the opposite direction, in which case the entry side of the throat would be defined by the upper roller 120.

[0003] The exit side 154 of the throat is defined by the upper roller 120, the point at which the bale forming belts 130 leave contact with the outer circumference of the forming bale. Most variable chamber balers operate so that the bale rotates in this manner, and due to the configuration of the supporting frame, a twine mechanism 160 is typically located near the exit side of the throat as shown. The twine 182 is fed from a supply roll 180 through the twine mechanism 160, such that

the loose end of the twine is inserted to the nip point where the formed bale contacts the bottom belt roller 110 or, in this case, drum roller 145, from above any incoming material 5. An alternative configuration example is shown in U.S. Pat. No. 4,502,646, by Meiers. In both cases, the twine will begin restraining the crop material in the throat area as soon as it begins to feed, and any material fed into the baler, after the twine has started to wrap the bale, will be located on top of the twine, and will not be restrained by the twine. Thus, the typical method of operation of the baler has required the operator to stop the forward travel of the tractor and baler, to discontinue feeding material into the baler, before the twine mechanism starts to apply twine to the bale. At times this operation was slightly modified by the operator, by continuing to feed material in to the baler during a portion of the wrap cycle as the loose end of the twine was initially inserted, to assist in restraining the twine to the formed bale. However if an excessive amount of hay were fed into the baler at the same time as the twine was being fed, the resulting amount of un-restrained hay would negatively affect the appearance of the resulting bale. Thus, the amount of time that both crop material and twine are fed is minimized, to reduce the amount of crop material on the outside of the twine.

[0004] A desirable bale will typically be wrapped with a significant amount of twine that was applied under significant tension. In order to produce a desirable bale, the twine mechanism will go through two basic movements:

- [0005] 1. wrap cycle initiation and
- [0006] 2. the wrap cycle.

The wrap cycle initiation consists of the first movement from a home position, where the twine tie mechanism is positioned to minimize contact with the incoming crop, to a start-feed position where the loose end is inserted to the nip point. The wrap cycle consists of the reverse motion where the twine tie mechanism moves slowly back to its home position. The twine tie actuators are typically simple mechanical components, not capable of operating at significantly different speeds. Thus, the wrap cycle initiation typically takes a significant amount of time.

[0007] The coordination of initiating feed of twine, with discontinuing feed of crop material will maximize productivity of the baling operation: i.e. if the feeding of crop material is stopped before the twine mechanism begins to operate, the baler will be rotating the bale for several seconds, during the wrap cycle initiation, with no incoming crop material and no twine feeding. Balers typically include a bale size sensor that provides a bale size signal that is transferred through wire harness 16 to controller 14. The controller 14 is also typically operatively connected to an actuator for the twine mechanism. When the bale has reached the desired size an alarm or signal is transmitted to the operator, indicating that the forward travel of the baler should be stopped, to stop feeding material into the baler, at the same time the twine tie actuator is energized to start the twine tie cycle. These events typically happen at the same time, or with some selectable time delay between the alarm and the start of the twine tie cycle. Selectable delays ranging from 0 to 5 seconds have been provided, to allow the operator to have time to stop the baler before the twine cycle starts, while minimizing the delay that would result if the operator were required to stop the baler and to initiate the twine tie cycle at the same time. The selectable time delay allows the operators to compensate for variations in ground speed, ground conditions, and tractor capability.

[0008] Netwrap mechanisms, for wrapping bales with netwrap material **190**, have been developed to feed the wrapping material to either the entry side or the exit side of the throat. A netwrap mechanism **170** that feeds the wrapping material to the entry side is illustrated in FIG. 1. Other mechanisms are illustrated in H. D. Antsey et al. U.S. Pat. No. 4,697,402 and Van Zee U.S. Pat. No. 5,129,208 both of which are herein incorporated by reference, while a mechanism that feeds netwrap material **190** to the exit side of the throat is disclosed in Underhill U.S. Pat. No. 5,036,642.

[0009] In the arrangement that inserts the netwrap material **190** at the exit side, the inserted netwrap material **190** will cover any crop material **5** coming into the baler, as soon as it begins to feed onto the bale, similar to the function of the twine mechanism. In the arrangement that inserts the netwrap material **190** at the entry side, where the netting is inserted underneath any incoming crop material, the netting will not cover incoming material until the forming bale has made nearly a complete rotation, wherein the starting edge of the netwrap material **190** will move from the entry side of the throat, around the circumference of the bale, and back to the exit side of the throat, which can take between 3 and 10 seconds, depending on the bale size and speed of operation of the baler. With netwrap material **190** that covers the full length of the bale, the bale needs to rotate only one and one-half to two rotations to achieve acceptable coverage. Thus, the duration of the wrap cycle is very short.

[0010] Control systems for the netwrap function typically parallel that of the twine tie function, wherein there is a bale size sensor that provides a signal to the operator to stop the baler, while at the same time initiating the wrap cycle. With this control technique, crop material is not fed during any portion of the wrap cycle, including those portions where the mechanism is moving from the home position to a feed position, and where the wrap material is moving around the portion of the bale's circumference that does not affect the incoming crop material. The speed of the wrap cycle will affect the productivity of the baling operation, and can be evaluated by the amount of time that crop material is not being fed into the baler. There is an opportunity to improve baling productivity by providing a control system to minimize the time required to complete the bale wrapping process, by allowing crop material to feed during a portion of the wrap cycle.

[0011] There is a need, therefore, for a more efficient process for bale-wrapping wherein crop material may be fed into the bale during at least some of the bale-wrapping cycle without compromising the integrity of the resulting bale.

SUMMARY OF THE INVENTION

[0012] The present invention provides a method of operating a bale wrapping mechanism, to allow a portion of the tie cycle to be performed while crop material is being fed into the baler, in a manner that the cycle time is reduced.

[0013] An object of the present invention is to provide a method and apparatus for increasing the efficiency of the baling operation by permitting the bale to continue to be formed by allowing additional crop material to enter the bale, while the bale wrapping step is in progress.

[0014] An additional object of the present invention is to provide a method and apparatus wherein no crop material making up a cylindrical bale lies outside the bale's wrap material.

[0015] To effect these advantages, the baler is preferably configured such that the wrap material is inserted into the bale closer, in an angular sense, to the entry side of the round baler's throat than to the exit side of the round baler's throat. When the bale begins to be wrapped, the wrap material feeds out on top of the outer surface of the bale. Until the leading edge of the wrap material reaches the exit side of the throat, where the existing bale meets the incoming crop material, the wrap material lies on the outside of the bale. Therefore, during the time when the leading edge of the wrap material travels from the insertion point to the exit side of the round baler's throat, forward progress may be made by the round baler and additional crop material may be added to the bale.

[0016] An example of a process utilizing this invention is as follows. The cylindrical bale size, which can be a length dimension such as a diameter, or a weight, is continually sensed and compared to a predetermined size at which to begin wrapping the bale with wrap material. When the instantaneous bale size equals the predetermined size at which to begin wrapping the bale, a signal is given to the bale wrapping mechanism, the wrapping mechanism moves into position, and the wrapping process begins while material continues to be added to the bale.

[0017] When the leading edge of the wrap material reaches a point at which a predetermined duration of time will bring the leading edge of the wrap material to the exit side of the round baler's throat, a signal is given to the operator of the round baler to stop the forward progress of the round baler. The predetermined duration of time is intended to be sufficient for the operator to halt the forward progress of the baler before the leading edge of the wrap material reaches the exit side of the baler's throat. With no more crop material entering the round baler, the wrap material remains on the outside of the bale around the entire circumference of the cylindrical bale.

[0018] It is clearly seen how, in the above example, the objects of the instant invention are met.

BRIEF DESCRIPTION OF THE DRAWINGS

[0019] FIG. 1 is a prior art schematic of a cylindrical baler as it is towed by a tractor to feed crop material;

[0020] FIG. 2 is a flow chart showing the method of operation of the present invention;

[0021] FIG. 3 is a flow chart showing an alternative method of operation of the present invention;

[0022] FIG. 4 is an elevation view of the controller;

[0023] FIG. 5 is a side elevation view of the baler showing a bale being formed; and

[0024] FIG. 6 is a flow chart showing an alternative method of operation of the present invention.

DETAILED DESCRIPTION

[0025] FIG. 2 illustrates a flow chart of the method of operating a round baler for two different wrapping materials: filament, which will herein be referred to as twine but could include other types of filaments and sheet, which will herein be referred to as netwrap but could include other types of sheets including plastic. The method of operation of the present invention, for applying netwrap material **190**, can be used with any type of baler, including variable chamber balers **100** or fixed chamber balers. It is particularly useful for balers configured such that the netwrap material **190** is inserted closer to the entry side of the throat **152** than to the

exit side of the throat **154**. This relative location is defined by the direction of rotation of the baler, and is illustrated, in FIG. **5**, referencing line **153** passing through the center of the bale **210** and the center of the throat **150**, where any location in the rotational direction of arc α from the center of the throat **150** to 180° from the center of the throat **150** will be closer to the entry side **152** than to the exit side **154**, while any location in the rotational direction of arc θ from 180° from the center of the throat **150** to the center of the throat **150** will be closer to the exit side than to the entry side

[0026] As defined in FIG. **1**, for the variable chamber baler **100**, the insertion point is at the entry side of the throat **152**, between the incoming crop material **5** and the entry side of the throat **152**. For other types of balers, in which there are other wrap-entry points are utilized, this method would also be applicable.

[0027] In this application, the term bale size means a measurable, physical characteristic of the cylindrical bale. Examples of such measurable, physical characteristics are diameter and weight.

[0028] FIG. **2** further illustrates a separate method of operation for applying twine **182**, similar to prior art techniques, with balers configured so that the twine **182** is inserted at the exit side of the throat **154**. As described in the prior art description above, where there is no delay between the time the twine starts to wrap the bale, and the time the twine is restraining the crop material in the throat area, and where it is desirable to insure that that the twine will be installed on top of all the crop material, this method is intended to insure that the baler is stopped before twine begins to wrap the bale. Looking to FIG. **2**, the method of operation of the wrap cycle begins when the operator selects an Advance Time at step **502**, a Desired Bale Size at step **504**, and type of wrap material at step **506**. If netwrap material **190** is selected, the controller **14** will monitor and compare the bale size signal **508** to a calculated wrap start bale size at step **520**.

[0029] The bale size signal **508** can be produced by any type of switch or sensor capable of measuring the bale size. A typical arrangement uses a bale diameter rotary potentiometer **220** (see FIG. **5**) to measure rotation of a belt tensioner. The position of the rotary potentiometer **220** is related to the outer diameter of the bale. The output from the rotary potentiometer **220** or other bale size sensor is monitored by the control system, and a bale size display is provided to the operator. The operator can typically select a desired bale size **508**, which is then defined as the full bale condition. The output from the bale diameter rotary potentiometer **220** is recognized by the controller **14** as the bale size **508** signal.

[0030] If the comparator block **507** detects that netwrap material **190** has been chosen as the wrap material by the operator in the material entry step **506**, the process follows generally down the left hand side of FIG. **2**. The wrap start bale size **520** can be the same as the desired bale size **504**, or can be defined by the controller **14** to be slightly less than the desired bale size **504**, to compensate for the amount of material that will be fed into the baler after the Full Bale alarm **540** is activated, as a result of the amount of time required for the operator to respond to the signal and to stop the forward travel of the baler.

[0031] At the comparator step **522**, when the bale size is determined to be equal to the wrap start size, the wrap cycle is initiated at step **524**. The wrap cycle **530** will be initiated, while a delay period with a duration equal to the Advance time **502** set previously by the operator, is implemented at

step **526**. After the delay period the Full bale alarm is activated at step **540**, which will inform the operator to manually stop the forward travel of the baler at step **550**, stopping the feed of crop material **5** to the baler. Such an alarm may be audible, visible, or a combination of the two. When the Advance time is set properly, the baler will stop at step **550** shortly before the wrap cycle is completed at step **532**. With a netwrap system that feeds material to the incoming side of the throat **150**, the time duration between stopping the baler at step **550** and completing the wrap cycle at step **532** can be minimal, and the productivity of the baling operation maximized.

[0032] This method allows the feed mechanism to complete its first process of feeding the netwrap material **190** from the storage location to the bale, and allows the netwrap wrap material **190** to travel from the entry side **152** of the throat **150**, where it was inserted, to near the exit side **154** of the throat **150**, before alerting the operator to stop feeding crop material **5**. The time required for the netting material to reach the exit side **154** of the throat **150** will vary between machines, and will vary as a result of differing operating conditions, such as differing operating speeds. Thus, this embodiment allows the operator to select a delay period to match his conditions, at step **502**. Ideally this delay will result in synchronizing the times that the netwrap material **190** arrives at the exit side **154** of the throat **150** and the time that crop material **5** stops feeding. In this manner, the time duration in which crop material **5** is not being fed into the baler is minimized, and productivity of the baler is maximized.

[0033] The delay period of step **526** provides the potential for an operator to continue feeding crop material into the baler, after the wrap cycle is started. If the desired bale size **504** is set close to the maximum bale size, and the delay period is set high, there is a possibility that the crop material will be fed at a rate such that the baler could be overfilled, before the full bale alarm is activated. Thus, a separate full bale signal **510** is monitored at step **512**. If the full bale signal **510** is activated, the wrap cycle and full bale alarm will be immediately initiated at steps **524** and **540**, respectively.

[0034] FIG. **2** also illustrates a traditional method of control when applying twine: if twine is selected at step **506** the bale size **508** will be monitored **620** by the controller **14**, as described earlier. At step **622**, when the bale size is equal to the desired size, the twine tie wrap cycle is immediately initiated at step **624**. In order to insure the twine will be installed on top of all the crop material, the Full Bale Alarm is initiated simultaneously at step **640**. The baler is stopped at step **650** while the wrap cycle **630** continues and terminates at step **632**. As a result there is a significant amount of time between the point at which the baler is stopped at step **550**, when no material is being fed into the baler, and the time the wrap cycle is complete, at step **632**.

[0035] The method illustrated by steps **520** through **550**, as described for application of netwrap above, could also be used for applying twine. The Advance time set at step **502** would allow the crop material to continue feeding while the twine tie mechanism was moving from its home position, to the position where the twine begins to wrap the bale. The appropriate advance time for operation with the twine tie may differ from the advance time for operation with netwrap. However, an operator could manually adjust the advance time when selecting between twine or netwrap, and both systems could be operated to utilize an advance time. When applying twine the delay would result in synchronizing the times that

the twine **182** begins to feed and the time that crop material **5** stops feeding. In this manner, the time duration in which crop material **5** is not being fed into the baler is minimized, and productivity of the baler is maximized.

[0036] FIG. 3 illustrates an alternative embodiment of the method of the present invention, incorporating an advance time for both netwrap and twine, wherein the controller **14** will attempt to compensate for variations in the rate of crop material **5** flow to avoid instances of overfilling the baler, and to more accurately control the resulting bale size. In this embodiment the operator again makes three selections: Advance time at **502**, Desired Bale Size at **504**, and Type of Wrap Material at **506**. The entered advance time could include a unique advance time for netwrap and a unique advance time for twine, or a single setting. Step **720** monitors the bale size signal **508** and calculates a dynamic wrap start bale size based on the rate of growth of the bale, the desired bale size and the selected type of wrap material, wherein the controller could automatically adjust to compensate between the characteristics of netwrap versus twine. Using this technique the controller will automatically compensate for variations in the crop material **5** rate of flow into the baler, which can result from variations in the ground speed of the baler and/or variations in the density of the windrow of the crop material. An alternative method of compensating for the bale formation speed includes calculating an average bale growth rate based on data recorded during recently formed bales **210** (see FIG. 5). Many other techniques can be developed, useful to establish a bale growth rate that can be used as a function to vary the dynamic wrap start size. The controller will continue monitoring the bale size signal **508** until the bale size equals the wrap start size at step **722**, at which time the wrap cycle will be initiated at step **724**. Similar to the sequence described in FIG. 2, a delay period with a duration equal to the Advance time set previously by the operator, is implemented at step **726**. After the delay period the Full bale alarm is activated at step **540**, which will inform the operator to manually stop the forward travel of the baler at step **550**, stopping the feed of crop material **5** to the baler.

[0037] FIG. 6 illustrates an alternate embodiment of the present invention that does not utilize time duration as a variable in the control algorithm, wherein an operator will be able to specify a pre-start amount. The pre-start amount will be preferably be a numerical factor that correlates to the diameter of the bale; i.e. five may equate to five inches of bale diameter. This factor could correlate to other measurements of bale size, including bale weight. If the bale size is measured as weight, then the desired bale size and pre-start amount will also correlate to weight, while if the bale size is measured as a dimension, then the bale size and pre-start amount will also correlate to the diameter. The numerical value entered may indicate a percentage or a value with units such as inches or pounds.

[0038] In this embodiment the operator again makes three selections: Pre-Start Amount at **802**, Desired Bale Size at **804**, and Type of Wrap Material at **806**. Step **820** monitors the bale size signal **808**. The controller will continue monitoring the bale size signal **808** until the bale size equals the Desired Size minus the Pre-Start Amount at step **822**. For instance, if the Desired Bale Size is correlated to a bale diameter and was set to sixty inches, and the Pre-Start Amount set to five inches, the wrap cycle will be initiated at step **824** after the Bale Size=fifty-five inches, as detected at step **822**.

[0039] In parallel, the baler full signal will be monitored continually at step **810** in the event there is a malfunction of the bale size mechanism, and will immediately initiate a wrap cycle and full bale alarm if a bale full signal is detected at step **812**.

[0040] The operator will adjust the Pre-Start Amount to a value that matches expectations, as affected by the baling rate and the amount of crop material in the windrow. As long as the Baler Full Signal has not been detected, the Full Bale alarm will be activated at step **840**, after the Bale Size equals the Desired Size as detected at step **832**, and after the wrap cycle has been initiated at step **824**. The operator will then stop the forward travel of the baler at step **850**, stopping the feed of crop material **5** to the baler, and the wrap cycle will complete at step **860**.

[0041] In FIG. 4, the controller **14** is shown. The controller **14** has a keypad **410** for entering the advance time or pre-start amount, desired bale size, type of wrap material, and other operator inputs. A Liquid Crystal Display (LCD) **420** facilitates the entry of data and choices. Alarms and notices may be expressed visually, via a light **430** and/or audibly, via a speaker **440**.

[0042] A bale **210** is shown being formed inside a variable chamber baler **100** in FIG. 5. The wrap material **190** is fed into the variable chamber baler **100** close to the entry side **152** of the throat **150**.

[0043] With regard to the forgoing description, it is to be understood that changes may be made in detail, especially in matters of the types of sensors employed and the complexity of techniques useful for adjusting the delay period. For instance, the delay period at step **526** and **726** could be dependent on a physical measurement of the amount of netwrap material **190** that is dispensed from the supply roll, or a physical measurement that the netwrap material **190** has reached a certain point around the formed bale. Variations in controlling the delay period do not depart from the scope of the present invention. It is intended that these specific and depicted aspects be considered exemplary only, with a true scope and spirit of the invention be indicated by the broad meaning of the following claims.

1-18. (canceled)

19. An apparatus for simultaneous cylindrical bale forming and bale wrapping in a round baler, the apparatus comprising:

- (a) a wrap material mechanism for inserting and feeding a wrap material onto a cylindrical bale of crop material being formed in the round baler;
- (b) a controller for signaling an operator to cease a feed of the crop material into the round baler; and
- (c) a timer for measuring a delay between initiating a wrapping of the cylindrical bale and the signaling of the operator, wherein the initiating of the wrapping occurs before the signaling of the operator.

20. The apparatus of claim **19** additionally comprising a sensor for measuring a size of the cylindrical bale and producing a signal relative to the size of the cylindrical bale.

21. The apparatus of claim **20** additionally comprising a comparator for comparing the size of the cylindrical bale to a predetermined size at which to initiate the wrapping of the cylindrical bale.

22. The apparatus of claim **19** wherein the controller comprises a speaker to provide an audible alarm.

23. The apparatus of claim **19** wherein the controller comprises a visual alarm.

24. The apparatus of claim 19 wherein the controller comprises a keypad for an operator to enter required data.

25. The apparatus of claim 19 wherein the controller comprises a readout.

26. The apparatus of claim 19 additionally comprising a bale wrap material insertion point closer, in an angular sense, to an entry point of a throat of the round baler than to an exit point of the throat of the round baler, where an angle measuring proximity of the insertion point to the entry point of the throat is the angle starting at the entry point of the throat and continuing in a direction of bale rotation.

27-32. (canceled)

33. The apparatus of claim 19 wherein the round baler additionally comprises:

- (a) a first mechanism to feed a sheet-type wrap material;
- (b) a second mechanism positioned to feed a filament type wrap material; and
- (c) a selector for varying the delay period in response to selection of either the first or second wrapping mechanisms.

34. An apparatus for simultaneous cylindrical bale forming and bale wrapping in a round baler, the apparatus comprising:

- (a) a sensor for sensing a physical characteristic of the cylindrical bale;
- (b) a comparator for comparing the sensed physical characteristic to a first predetermined value and generating a bale signal when the sensed physical characteristic becomes equal to the first predetermined value;
- (c) a wrap material mechanism for inserting and feeding a wrap material onto a cylindrical bale of crop material being formed in the round baler, said insertion being initiated when the bale signal is generated; and
- (d) a controller for generating an operator signal for signaling an operator to cease a feed of the crop material into the round baler, said operator signal being generated when the physical characteristic of the cylindrical bale reaches a second predetermined value.

35. The apparatus of claim 34 wherein the sensor for sensing the physical characteristic of the cylindrical bale comprises a length sensor for sensing a value related to a diameter of the cylindrical bale.

36. The method of claim 34 wherein the sensor for sensing the physical characteristic of the cylindrical bale comprises a weight sensor for sensing a weight of the cylindrical bale.

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