Unload rate control for an unloading system in an agricultural harvester

Entladeratensteuerung für ein Entladesystem für eine landwirtschaftliche Erntemaschine

Contrôle de vitesse de décharge pour système de déchargement dans une moissonneuse agricole

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Description

[0001] The present invention relates to agricultural harvesters, and, more particularly, to unloading systems for such harvesters.

[0002] Agricultural work machines, such as combines, are employed in the agricultural industry for various tasks, including harvesting crops. During harvesting operations, typical such agricultural work machines move through a crop field while operating a header at the front of the work machine to cut or gather the crop. The agricultural product, e.g., grain, is then removed from the non-grain crop materials by threshing, separating and cleaning assemblies on the work machine, and then the grain is transferred to the work machine’s hopper for temporary storage.

[0003] At various times during harvesting operations, such as when the work machine’s hopper is full, the operator of the work machine will unload the agricultural product from the work machine using a cantilevered unloading system that is mounted on the work machine. Typically, the agricultural product is unloaded via the unloading system into a mobile agricultural product carrier, such as a tractor pulled hopper wagon (grain cart), a truck, or a tractor-trailer, which delivers the agricultural product to a storage facility or to another transport system. At times, the mobile agricultural product carrier may travel beside the work machine during simultaneous harvesting and unloading operations. Typically, the cantilevered unloading system pivots to swing away from a stowed position to a fixed pivot position, and some systems may be manually adjusted from the fixed pivot position with respect to the fore/aft (lengthwise) position of the unloading point. However, this arrangement limits an operator’s ability to compensate for different grain cart sizes or header widths.

[0004] An unloading system as described above typically includes an unloading auger or and unloading conveyor. Unloading augers are more common, while unloading belt conveyors are becoming more common since they have a higher flow rate capacity which can be important with the ever increasing size of harvesters. Regardless of whether the unloading system is an auger or belt conveyor based system, the inlet end is submerged in the grain and the unloading operation takes place at full rate all of the time. There is no way to control the unload rate, and thus as crops and conditions change, the true unload rate varies and cannot be adjusted. If the unload rate is too high, then overloading of the unloading system structure can occur, especially in long and ultralight unloading systems. This is especially true in rough ground, where undue forces can be applied to the cantilevered unloading system. On the other hand, as the size of harvesters continue to increase, a decreased unload rate which is under the capacity of the unloading system can result in decreased productivity and loss of profit.

[0005] US 4 580 698 A describes a feeder system with a hopper having a movable gate and a conveyor for feeding the output material from the hopper. A weight sensor and a level sensor measure the amount of material on the conveyor and an actuator controlling the position of the gate is controlled to achieve a desired output rate.

[0006] What is needed in the art is an unloading system for an agricultural harvester which allows the unloading system to be run at maximum capacity, while avoiding physical damage to the unloading system from an overload condition.

[0007] This is achieved with the subject matter of claim 1. The dependent claims recite advantageous features of embodiments of the invention.

[0008] An agricultural harvester includes a support frame and a hopper coupled to the support frame. The hopper is configured to store an agricultural product during a harvesting operation. An unloading system is coupled to the support frame. The unloading system is configured to transport agricultural product received from the hopper to an off-machine location. The unloading system includes a metering gate, a transfer conveyance, at least one sensor, and an electrical processing circuit. The metering gate is positioned near a bottom of the hopper and in communication with an interior of the hopper. The transfer conveyance has an inlet end and a discharge end. The inlet end is in communication with the metering gate. The at least one sensor provides an output signal representing an operating parameter associated with an unload rate of agricultural product through the transfer conveyance during an unloading operation. The electrical processing circuit is coupled to an actuator associated with the metering gate and the at least one sensor. The electrical processing circuit controls the actuator and thus a position of the metering gate, dependent upon the output signal. The operating parameter associated with the sensor corresponds to at least one of a terrain over which the agricultural harvester traverses, a fluid pressure of a lift cylinder associated with the transfer conveyance and a position of a telescopic second stage transfer assembly of said transfer conveyance.

[0009] An embodiment of the invention is shown in the drawings, in which:

Fig. 1 is a side view of an agricultural harvester including an embodiment of an unloading system of the present invention;

Fig. 2 is a perspective view of the unloading system shown in Fig. 1;

Fig. 3 is a schematic, elevational view of the unloading system shown in Figs. 1 and 2; and

Fig. 4 is a front view of the agricultural harvester shown in Fig. 1 while operating the unloading system to unload agricultural product from the harvester.

[0010] Referring now to the drawings, and more par-
In the illustrated embodiment, second stage transfer assembly 34 may be a telescopic assembly that is configured to selectively move in three ranges of motion, i.e., elevation E, length L, and rotation R so as to position discharge chute 48 at a desired unloading position (elevation E, length L, and rotational position RP). It is contemplated, however, that some embodiments may include less that all three of these ranges of motion. In the present embodiment, stowed (home) position 28 for second stage transfer assembly 34 may be in terms of a predefined length L, a predefined elevation E and a predefined rotational position RPn of second stage transfer assembly 34.

Base conveyor system 40 of second stage transfer assembly 34 is configured to convey the agricultural product away from first stage delivery system 30 and turret 32, and toward discharge chute 48. Extension conveyor system 44 is configured to extend the reach of unloading system 26 beyond that of base conveyor system 40, and is configured to receive the agricultural product from base conveyor system 40 and to convey the agricultural product away from base conveyor system 40 and into discharge chute 48.

Base support structure 42 is pivotally coupled to turret 32 at proximal end 34-1 via a pivot joint P so as to allow second stage transfer assembly 34 to pivot up or down in order to change the elevation E of (i.e., raise or lower) discharge chute 48. In addition, base support structure 42 is configured to support at least in part base conveyor system 40. For example, one end of base conveyor system 40 may be supported directly by turret 32, whereas the other end of base conveyor system 40 may be supported by base support structure 42.

Extension structure 46 supports extension conveyor system 44, and hence is slidably attached to base support structure 42 and configured to extend from base support structure 42, e.g., in a manner somewhat similar to that of an extension ladder, which provides second stage transfer assembly 34 with telescopic capability.

For further details of an extensible belt conveyor system as described above, reference is hereby made to pending application EP 09146421.6, the disclosure of which is incorporated herein by reference.

Referring now to Fig. 3, and according to an aspect of the present invention, there is shown a schematic illustration of unloading system 26 within combine 10. In addition to the extensible belt conveyor system described above, unloading system 26 also includes a...
metering gate 50 and one or more sensors 52. Metering gate 50 is positioned near a bottom of hopper 24 in communication with an interior of hopper 24.

[0022] Sensors 52 are positioned in association with respective components that can have an affect on the maximum or desired flow rate of agricultural product through unloading system 26. Sensors 52 are coupled with and provide respective output signals to an electrical processing circuit 54. The output signals from sensors 52 represent an operating parameter associated with an unload rate of agricultural product through unloading system 26 during an unloading operation. For example, the operating parameter(s) associated with a respective sensor(s) 52 can correspond to:

- a position of metering gate 50 (sensor 52A);
- a mechanical load applied to metering gate 50 (sensor 52B);
- a position of the transfer conveyance (e.g., deflection of second stage transfer assembly 34 (sensor 52C));
- an electrical load associated with a drive motor of the transfer conveyance (sensor 52D);
- a fluid pressure of a lift cylinder associated with the transfer conveyance (sensor 52E);
- an operating speed of the transfer conveyance (e.g., sensor 52F);
- a scanned amount of the agricultural product carried by the transfer conveyance (e.g., an optical scanner (sensor 52G)); and
- a terrain over which the agricultural harvester traverses (e.g., an accelerometer attached to support frame 12 (sensor 52H)).

[0023] Electrical processing circuit 54 is positioned on combine 10 at any suitable location, such as within operator’s station 14 at any convenient location (See, Fig. 1). In the illustrated embodiment, electrical processing circuit 54 is preferably integral with a vehicle control unit (VCU) located within operator’s station 14. Electrical processing circuit 54 is coupled with an actuating valve 56 forming part of metering gate 50. The valve 56 controls a hydraulic cylinder that moves gate 50. The valve 56 and the cylinder are used as an actuator for moving the gate 50, although other types of actuators can be used, like electric motors. Electrical processing circuit 54 is also coupled with sensor(s) 52 described above. Electrical processing circuit 54 controls a position of metering gate 50, dependent upon the output signal(s) from sensor(s) 52, to effect a predetermined flow rate of the agricultural product through unloading system 26.

[0024] During an unloading operation (Figs. 3 and 4), once discharge chute 48 is appropriately positioned over mobile agricultural product carrier 60, conveyor belt 38 of first stage delivery system 30 is engaged. Grain 62 from hopper 24 falls through metering gate 50 onto conveyor belt 38 and is transported towards base conveyor system 40 of second stage transfer assembly 34. Base conveyor system 40 receives the grain from conveyor belt 38 and conveys it to extension conveyor system 44 of second stage transfer assembly 34. Extension conveyor system 44 then conveys the grain to discharge chute 48, which directs grain 62 downward into mobile agricultural product carrier 60. As the grain 62 is being conveyed, electrical processing circuit 54 receives signals from sensor(s) 52, and controls valve 56 to establish a predetermined, desired and/or maximum flow rate of the grain 62 through unloading system 26.

Claims

1. An agricultural harvester (10) comprising:

- a support frame (12);
- a hopper (24) coupled to said support frame (12), said hopper (24) being configured to store an agricultural product during a harvesting operation; and
- an unloading system (26) comprising a transfer conveyance having an inlet end and a discharge end, the unloading system (26) configured to transport agricultural product received from said hopper (24) to an off-machine location; characterized in that said unloading system (26) comprises:

  - a metering gate (50) positioned for communication with a bottom of the hopper (24), said inlet end of said transfer conveyance in communication with said metering gate (50);
  - at least one sensor (52) providing an output signal representing an operating parameter associated with an unload rate of agricultural product through said transfer conveyance during an unloading operation;
  - an electrical processing circuit (54) coupled to an actuator of said metering gate (50) and said at least one sensor (52), said electrical processing circuit (54) controlling a position of said metering gate (50) dependent upon said output signal by means of said actuator;
  - said operating parameter associated with said at least one sensor (52) corresponds to at least one of:

    - a terrain over which the agricultural harvester (10) traverses,
    - a fluid pressure of a lift cylinder associated with the transfer conveyance and a position of a telescopic second stage transfer assembly (34) of said transfer conveyance.

2. The harvester (10) of claim 1, wherein said electrical
processing circuit (54) controls a position of said metering gate (50) to effect a predetermined flow rate of the agricultural product through said transfer conveyance, dependent upon said output signal.

3. The harvester (10) of claim 1, wherein said transfer conveyance includes at least one of an unloading belt conveyor (38) and an unloading auger.

4. The harvester (10) of claim 1, wherein said transfer conveyance includes an extensible unloading belt conveyor (40).

**Patentansprüche**

1. Landwirtschaftliches Erntefahrzeug (10), umfassend:

   einen Halterahmen (12);
   einen mit dem Halterahmen (12) gekoppelten Laderaum (24), wobei der Laderaum (24) dafür ausgelegt ist, ein landwirtschaftliches Produkt während eines Erntevorgangs zu speichern; und
   ein Entladesystem (26) mit einem Transferbeförderungsmittel mit einem Einlassende und einem Abgabeende, wobei das Entladesystem (26) dafür ausgelegt ist, von dem Laderaum (24) empfangenes landwirtschaftliches Produkt zu einem Ort außerhalb der Maschine zu transportieren;

dadurch gekennzeichnet, dass das Entladesystem (26) Folgendes umfasst:

   eine Zählpforte (50), die für Kommunikation mit einem Boden des Laderaums (24) positioniert ist, wobei sich das an das Einlassende des Transferbeförderungsmittels mit der Zählpforte (50) in Kommunikation befindet;
   mindestens einen Sensor (52), der ein Ausgangssignal liefert, das einen Betriebsparameter repräsentiert, der einer Entladerate landwirtschaftlichen Produkts durch das Transferbeförderungsmittel während eines Entladevorgangs zugeordnet ist;
   eine mit einem Stellglied der Zählpforte (50) und dem mindestens einen Sensor (52) gekoppelte elektrische Verarbeitungsschaltung (54), wobei die elektrische Verarbeitungsschaltung (54) eine Position der Zählpforte (50) abhängig von dem Ausgangssignal mittels des Stellgildes steuert;
   wobei der dem mindestens einen Sensor (52) zugeordneten Betriebsparameter mindestens einem von Folgendem entspricht:

   einem Gelände, das das landwirtschaftliche Erntefahrzeug (10) überquert,
   einem Fluiddruck eines dem Transferbeförderungsmittel zugeordneten Hubzylinders und
einer Position einer teleskopischen Transferbaugruppe der zweiten Stufe (34) des Transferbeförderungsmittels.

2. Landwirtschaftliches Erntefahrzeug (10) nach Anspruch 1, wobei die elektrische Verarbeitungsschaltung (54) eine Position der Zählpforte (50) steuert, um abhängig von dem Ausgangssignal eine vorbestimmte Flussrate des landwirtschaftlichen Produkts durch das Transferbeförderungsmittel zu bewirken.

3. Landwirtschaftliches Erntefahrzeug (10) nach Anspruch 1, wobei das Transferbeförderungsmittel ein Entladeförderband (38) und/oder eine Entladeschnecke umfasst.

4. Landwirtschaftliches Erntefahrzeug (10) nach Anspruch 1, wobei das Transferbeförderungsmittel ein verlängerbares Entladeförderband (40) umfasst.

**Revendications**

1. Moissonneuse agricole (10), comprenant :

   un châssis (12) ;
   une trémie (24) couplée audit châssis (12), ladite trémie (24) étant configurée pour stocker un produit agricole au cours d’une opération de moisson ; et
   un système de déchargement (26) comprenant un transbordeur ayant une extrémité d’entrée et une extrémité de décharge, le système de déchargement (26) étant configuré pour transpor ter un produit agricole reçu depuis ladite trémie (24) vers un emplacement situé hors de la machine ;

caractérisé en ce que ledit système de déchargement (26) comprend :

   une trappe de dosage (50) positionnée pour être en communication avec une partie inférieure de la trémie (24), ladite extrémité d’entrée dudit transbordeur étant en communication avec ladite trappe de dosage (50) ;
   au moins un capteur (52) délivrant un signal de sortie représentant un paramètre de fonctionnement associé à une vitesse de déchargement du produit agricole par l’intermédiaire dudit transbordeur au cours d’une opération de déchargement ;
un circuit de traitement électrique (54) couplé à un actionneur de ladite trappe de dosage (50) et audit au moins un capteur (52), ledit circuit de traitement électrique (54) contrôlant une position de ladite trappe de dosage (50) en fonction dudit signal de sortie au moyen dudit actionneur ; ledit paramètre de fonctionnement associé audit au moins un capteur (52) correspond à au moins un paramètre parmi :

- un terrain que traverse la moissonneuse agricole (10),
- une pression de fluide d’un vérin de levage associé au transbordeur, et
- une position d’un ensemble de transfert de second niveau télescopique (34) du dit transbordeur.

2. Moissonneuse (10) selon la revendication 1, dans laquelle ledit circuit de traitement électrique (54) contrôle une position de ladite trappe de dosage (50) pour obtenir un débit prédéterminé du produit agricole à travers ledit transbordeur, en fonction dudit signal de sortie.

3. Moissonneuse (10) selon la revendication 1, dans laquelle ledit transbordeur comprend au moins un dispositif parmi un transporteur de déchargement à courroie (38) et une vis de déchargement.

4. Moissonneuse (10) selon la revendication 1, dans laquelle ledit transbordeur comprend un transporteur de déchargement à courroie (40) extensible.
REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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- EP 09164621 A [0020]