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(54) Title: OVERHEAD IRRIGATION ASSEMBLY HAVING THREE OR MORE TRUSS RODS

FIG. 1

(57) Abstract: An overhead irrigation assembly having multiple truss rods is disclosed. In an implementation, an overhead irrigation assembly includes a first support, a second support, and a span of pipeline supported between the first support and the second support. The overhead irrigation assembly also includes a first truss rod tensioned between the first support and the second support and a second truss rod tensioned between the first support and the second support. Spreaders are suspended from the span of pipeline that are configured to separate the first truss rod from the second truss rod. The overhead irrigation assembly also includes a third truss rod that is also tensioned between the first support and the second support. The first truss rod, the second truss rod, and the third truss rod are configured to maintain a generally bow shape in the span of pipeline.
Modern day agriculture has become increasingly efficient in the past century and this trend must continue in order to produce a sufficient food supply for the increasing world population. A notable advancement in agricultural production was the introduction of mechanized irrigation systems, such as the center pivot and the linear move irrigation systems. These irrigation systems make it possible to irrigate entire fields, and reduce a crop yield's vulnerability to extreme weather conditions. The ability to monitor and to control the amount of water and/or nutrients (applicants) applied to an agricultural field has increased the amount of farmable acres in the world and increases the likelihood of a profitable crop yield. These irrigation systems typically include a control device configured to furnish a user interface allowing the operator to monitor and control one or more functions or operations of the irrigation system.

SUMMARY

An overhead irrigation assembly having multiple truss rods is disclosed. In an implementation, an overhead irrigation assembly includes a first support, a second support, and a span of pipeline supported between the first support and the second support. The overhead irrigation assembly also includes a first truss rod tensioned between the first support and the second support and a second truss rod tensioned between the first support and the second support. Spreaders are suspended from the span of pipeline that are configured to separate the first truss rod from the second truss rod. The overhead irrigation assembly also includes a third truss rod is also tensioned between the first support and the second support. The first truss rod, the second truss rod, and third truss rod are configured to maintain a generally bow shape in the span of pipeline.

This Summary is provided solely to introduce subject matter that is fully described in the Detailed Description and Drawings. Accordingly, the Summary should not be considered to describe essential features nor be used to determine scope of the claims.
DRAWINGS

[0004] The Detailed Description is described with reference to the accompanying figures. The use of the same reference numbers in different instances in the description and the figures may indicate similar or identical items.

[0005] FIG. 1 is a perspective view illustrating an overhead irrigation assembly having two truss rods in a bow strung truss configuration and a third truss rod extending between wheeled towers supporting a span of pipeline in accordance with an example implementation of the present disclosure.

[0006] FIG. 2 is a partial isometric view illustrating a span of overhead irrigation equipment having four truss rods in accordance with an example implementation of the present disclosure.

[0007] FIG. 3 is a partial isometric view illustrating another span of overhead irrigation equipment having four truss rods in accordance with an example implementation of the present disclosure.

[0008] FIG. 4 is a partial isometric view illustrating a span of overhead irrigation equipment having a third truss rod positioned between two or more truss rods in accordance with an example implementation of the present disclosure.

[0009] FIG. 5 is a partial diagrammatic perspective view illustrating an irrigation system having an overhead irrigation assembly having three or more truss rods in accordance with an example implementation of the present disclosure.

DETAILED DESCRIPTION

Overview

[0010] Overhead irrigation equipment can be used to provide a moveable overhead sprinkler platform for supplying water and chemicals to assist with growing agricultural crops. One type of overhead sprinkler irrigation is center pivot irrigation, where segments of pipe are joined together and supported by trusses, mounted on wheeled towers with sprinklers positioned along the pipe segments. This type of configuration provides movement in a circular pattern and is supplied with water from a pivot point at the center of the circle. Center pivot irrigation systems may be powered using water, hydraulics, and/or electric motors. Another type of sprinkler irrigation is linear/lateral move irrigation, where similar equipment is configured to move in a straight line.
A bow strung trussing design may include a main water pipeline and two sets of truss rods supported by truss angles. The two truss rods are put into tension to create a "bow" in the main water pipeline. However, as spans of overhead irrigation equipment get longer, the tension load required in the truss rod to maintain the proper "bow" can be drastically increased. In some instances, a larger bow can be created to decrease the tension load in the truss rods. However, this may decrease the crop clearance and create a very large distance between the main water pipeline and the truss rods. This distance can make installation, service, and maintenance difficult. Increasing the diameter of the truss rods to accommodate more tension load may also be possible. However, this may increase the associated cost of the equipment.

Accordingly, an overhead irrigation assembly having three or more truss rods is provided. The overhead irrigation assembly can include an additional (third) rod in the bow strung truss design. In some implementations, the third truss rod can be a plurality of truss rod segments in a section of overhead irrigation equipment that allows lengthening of the section while decreasing the corresponding crown depth necessary to support the section. In other implementations, the third truss rod can be "floating" between the trusses, connected to either end of the span. For example, a suspended truss rod can have truss rod segments connected end-to-end. The truss rod segments connected at the end of the span can be threaded to allow adjusting after installation to allow balancing of the tension load in all three truss rods. The balancing can be accomplished by adjusting the tension load in the third truss rod until a desired distance is reached between the main water pipeline and the third truss rod, thereby creating desired "bow" dimensions.

In some instances, a vertical member can be attached to the main water pipeline, extending downward towards the third truss rod with a visual indicator identifying the ideal distance between the main water pipeline and the third truss rod, and therefore a desired tension load in the third truss rod. Further, a proximity switch between the vertical member and the truss rod can be provided, such that if an incorrect adjustment is made, and/or the loads change in the truss rods, and/or the "bow" in the span changes, the proximity switch will open, cutting power to the machine, and eliminating or reducing the likelihood of machine damage.
In some implementations, four or more truss rods can be included with an overhead irrigation assembly. This type of configuration may provide balanced strength and stability on each side of the span. For example, with a four truss rod design, failure of a single rod may result in stretching of the remaining rod, resulting in a "slow motion" failure. It may also be possible to operate the irrigation equipment for some time after a single rod breaks. Further, by increasing the total potential load that can be carried by the truss rods, longer spans with shallower trussing and/or flatter crowns may be possible, resulting in lower product costs (e.g., with fewer truss angles and/or fewer spans per machine), as well as better span stability.

Example Implementations:

FIGS. 1 through 5 illustrate overhead irrigation assemblies in accordance with the present disclosure. As shown, an overhead irrigation assembly 100 includes one or more spans of overhead irrigation equipment 102. Each span of overhead irrigation equipment 102 includes supports at either end of the span, such as wheeled towers 104, for supporting a main water pipeline, such as a span of pipeline 106. The span of pipeline 106 may comprise a number of pipe segments joined together and supported by trusses connected with truss rods to form a bow string truss. In some implementations, the overhead irrigation assembly 100 may comprise central pivot irrigation equipment. In other implementations, the overhead irrigation assembly 100 may comprise linear irrigation equipment. However, these implementations are provided by way of example only and are not meant to be restrictive of the present disclosure. Thus, the overhead irrigation assembly 100 may comprise other types of overhead irrigation equipment.

The overhead irrigation assembly 100 includes three or more truss rods tensioned between the wheeled towers 104. For example, a truss rod 108 and a truss rod 110 may be tensioned between the wheeled towers 104. In implementations, the truss rod 108 and the truss rod 110 comprise a number of truss rod segments 112 extending longitudinally between the wheeled towers 104. The truss rod segments 112 may be arranged end-to-end and separated using a number of spreaders 114 suspended from the span of pipeline 106. For example, spreaders 114 may be used to separate the truss rod 108 from the truss rod 110. The spreaders 114 may be suspended from the span of pipeline 106 using, for example, diagonals 116.
In some implementations, the overhead irrigation assembly 100 may also include a truss rod 118 tensed between the wheeled towers 104. In this type of configuration, the truss rod 108, the truss rod 110, and the truss rod 118 are configured to maintain a bow shape in the span of pipeline 106. In other implementations, the overhead irrigation assembly 100 may include a truss rod 120 in addition to the truss rod 118 tensed between the wheeled towers 104. In this type of configuration, the truss rod 108, the truss rod 110, the truss rod 118, and the truss rod 120 are configured to maintain the bow shape in the span of pipeline 106. In a still further implementation, the overhead irrigation assembly 100 may include a second truss rod 118 in addition to the first truss rod 118.

Referring now to FIG. 1, the truss rod 118 may comprise a suspended truss rod having a series of end-to-end connected truss rod segments extending between the wheeled towers 104. In implementations, the truss rod 118 may be threaded at each end to allow balancing of the tensioning in the truss rod 108, the truss rod 110, and the truss rod 118. Referring to FIGS. 2 through 4, the truss rod 118 and/or the truss rod 120 may comprise a number of truss rod segments 112 extending longitudinally between the wheeled towers 104. The truss rod segments 112 may be arranged end-to-end and separated using the spreaders 114 suspended from the span of pipeline 106 (e.g., as previously described). In the examples illustrated in FIGS. 2 and 3, the truss rod 108, the truss rod 110, the truss rod 118, and the truss rod 120 may be connected together using angle brackets, such as sockets 122, which may be used to couple the spreaders 114 and the diagonals 116 together. In this type of configuration, each truss may include four diagonals 116, two sockets 122, and one spreader 114. The trusses are then connected together using the truss rods 108, 110, 118, and 120.

In some configurations, the truss rod 118 and/or the truss rod 120 may be positioned above the truss rod 108 and the truss rod 110. For example, as shown in FIG. 2, the truss rod segments 112 of the truss rod 118 and the truss rod 120 may be connected to socket 122 proximal to the diagonals 116. In other configurations, the truss rod 118 and/or the truss rod 120 may be positioned generally in the same plane as the truss rod 108 and the truss rod 110. For instance, as shown in FIG. 3, the truss rod segments 112 of the truss rod 118 and the truss rod 120 may be connected to socket 122 proximal to the spreaders 114. As shown in FIG. 4, the truss rod segments 112 of the truss rod 118 and/or the truss rod 120 may be connected end-to-end using the spreaders 114.
Thus, three or more truss rods may be provided. For example, in a configuration having three truss rods, truss rod 118 may be positioned between truss rods 108 and 110. In a still further configuration having five truss rods, truss rods 118 and 120 may be positioned proximal to truss rods 108 and 110 (e.g., as previously described), while a fifth truss rod 118 may be positioned between truss rods 118 and 120. It should be noted that a suspended truss rod (e.g., as described in FIG. 1 may also be included with any of the configurations described in FIGS. 2 through 4). Further, it should be noted that these configurations are provided by way of example only, and are not meant to be restrictive of the present disclosure. Thus, varying numbers of three or more truss rods may be provided in other various configurations in accordance with the present disclosure.

FIG. 5 generally illustrates a self-propelled center pivot irrigation system 200. As shown, the irrigation system 200 includes a center pivot structure 202 having an overhead irrigation assembly 100 as described above. For example, the irrigation system 200 includes one or more spans of overhead irrigation equipment 102. The overhead irrigation assembly 100 of the irrigation system 200 includes three or more truss rods tensioned between the wheeled towers 104. In an implementation, the overhead irrigation assembly 100 of the irrigation system 200 includes a truss rod 108, a truss rod 110, and a truss rod 118 (see FIG. 5). In another implementation, the overhead irrigation assembly 100 of the irrigation system 200 includes a truss rod 108, a truss rod 110, a truss rod 118, and a truss rod 120 (see FIG. 4). However, these implementations are provided by way of example only and are not meant to be restrictive of the present disclosure. Thus, the overhead irrigation assembly 100 of the irrigation system 200 may include various truss rod configurations (e.g., number of truss rods) per the requirements of the irrigation system 200.

Conclusion

Although the subject matter has been described in language specific to structural features and/or process operations, it is to be understood that the subject matter defined in the appended claims is not necessarily limited to the specific features or acts described above. Rather, the specific features and acts described above are disclosed as example forms of implementing the claims.
What is claimed is:

1. An overhead irrigation assembly comprising:
   a first support;
   a second support;
   a span of pipeline supported between the first support and the second support;
   a first truss rod tensioned between the first support and the second support;
   a second truss rod tensioned between the first support and the second support;
   a plurality of spreaders suspended from the span of pipeline for separating the first truss rod
   from the second truss rod; and
   a third truss rod tensioned between the first support and the second support, the first truss rod,
   the second truss rod, and the third truss rod configured to maintain a bow shape in the
   span of pipeline.

2. The overhead irrigation assembly as recited in claim 1, further comprising:
   a fourth truss rod tensioned between the first support and the second support, the fourth truss
   rod configured to maintain the bow shape in the span of pipeline with the first truss
   rod, the second truss rod, and the third truss rod.

3. The overhead irrigation assembly as recited in claim 1, wherein the first truss
   rod and the second truss rod each comprise a plurality of truss rod segments extending
   longitudinally between the first support and the second support.

4. The overhead irrigation assembly as recited in claim 3, wherein the third truss
   rod comprises a plurality of truss rod segments extending longitudinally between the first
   support and the second support.

5. The overhead irrigation assembly as recited in claim 4, further comprising:
   a fourth truss rod tensioned between the first support and the second support, the fourth truss
   rod configured to maintain the bow shape in the span of pipeline with the first truss
   rod, the second truss rod, and the third truss rod.
6. The overhead irrigation assembly as recited in claim 5, wherein the fourth truss rod comprises a plurality of truss rod segments extending longitudinally between the first support and the second support.

7. The overhead irrigation assembly as recited in claim 3, wherein the third truss rod comprises a suspended truss rod extending from the first support to the second support.

8. The overhead irrigation assembly as recited in claim 7, wherein the suspended truss rod is threaded at each span end to allow balancing of the tensioning in the first truss rod, the second truss rod, and the third truss rod.

9. The overhead irrigation assembly as recited in claim 7, further comprising:
a vertical member extending from the span of pipeline downward towards the third truss rod;
and
a visual indicator identifying a desired distance between the span of pipeline and the third truss rod.

10. The overhead irrigation assembly as recited in claim 9, further comprising:
a proximity switch disposed between the vertical member and the third truss rod.

11. The overhead irrigation assembly as recited in claim 1, wherein the plurality of spreaders is suspended by a plurality of diagonals.
12. An irrigation system comprising:
a center pivot structure;
an overhead irrigation assembly coupled to the center pivot structure, the overhead irrigation 
assembly comprising:
a first support;
a second support;
a span of pipeline supported between the first support and the second support;
a first truss rod tensioned between the first support and the second support;
a second truss rod tensioned between the first support and the second support;
a plurality of spreaders suspended from the span of pipeline for separating the first 
truss rod from the second truss rod; and
a third truss rod tensioned between the first support and the second support, the first 
truss rod, the second truss rod, and the third truss rod configured to maintain a 
bow shape in the span of pipeline.

13. The irrigation system as recited in claim 12, further comprising:
a fourth truss rod tensioned between the first support and the second support, the fourth truss 
rod configured to maintain the bow shape in the span of pipeline with the first truss 
rod, the second truss rod, and the third truss rod.

14. The irrigation system as recited in claim 12, wherein the first truss rod and the 
second truss rod each comprise a plurality of truss rod segments extending longitudinally 
between the first support and the second support.

15. The irrigation system as recited in claim 14, wherein the third truss rod 
comprises a plurality of truss rod segments extending longitudinally between the first support 
and the second support.

16. The irrigation system as recited in claim 15, further comprising:
a fourth truss rod tensioned between the first support and the second support, the fourth truss 
rod configured to maintain the bow shape in the span of pipeline with the first truss 
rod, the second truss rod, and the third truss rod.
17. The irrigation system as recited in claim 16, wherein the fourth truss rod comprises a plurality of truss rod segments extending longitudinally between the first support and the second support.

18. The irrigation system as recited in claim 14, wherein the third truss rod comprises a suspended truss rod extending from the first support to the second support.

19. The irrigation system as recited in claim 18, wherein the suspended truss rod is threaded at each span end to allow balancing of the tensioning in the first truss rod, the second truss rod, and the third truss rod.

20. The irrigation system as recited in claim 18, further comprising: a vertical member extending from the span of pipeline downward towards the third truss rod; and a visual indicator identifying a desired distance between the span of pipeline and the third truss rod.
INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER

A01G 25/09(2006.01)i, B05B 3/12(2006.01)i, A01M 7/00(2006.01)i

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)
A01G 25/09; B05B 3/00; A01G 25/02

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

Korean utility models and applications for utility models
Japanese utility models and applications for utility models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
eKOMPASS(KIPO internal) & Keywords: overhead irrigation assembly, support, truss rod, spreader, center pivot

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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<th>Category</th>
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<td>Ün 03946946 A (HANSEN; JAMES E. et al ) 30 March 1976 See abstract ; column 5 , line 58 - column 7 , line 9 ; and figures 2 and 3 .</td>
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☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of citation or other special reason (as specified)
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"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"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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Date of the actual completion of the international search
20 DECEMBER 2012 (20. 12. 2012)

Date of mailing of the international search report

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Form PCT/ISA/210 (second sheet) (July 2009)
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