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TWISTING OSCILLATED MECHANICAL POWER TRANSMISSION SYSTEM

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ABSTRACT

Mechanical power transmission applied for distributed floating energy systems must cope with fluctuated/ oscillated motions caused by waves which makes components of the transmission systems displaced complexly while it is rotating. The Twisting Oscillated Mechanical Power Transmission System (TOMPTS) is developed to apply for both linear to rotational and rotational to rotational transmission systems using Drive Ropes. The most significant features are to be able to maintain low transmission efficiency while the systems are working on highly fluctuated/ oscillated water surfaces, causing floating components twisting complexly.

DESCRIPTION

1.1 [0002] Twisting Oscillated Mechanical Power Transmission System (TOMPTS)

[0003] The TOMPTS is applied for both floating and grounding energy systems, including (floating or grounding) solar tracking systems and wave energy systems. The word "rope" here implies rope, belt, cable or others which can bear tensional forces.

[0004] The TOMPTS is based on a compound of a pair of pulleys (#1 and #2) and a Drive Rope (#3) (Figure (a)). The compound is called the Pulley Pair Compound (PPC). Mechanical power from the first pulley (#1) is transmitted to the second pulley (#2) through the Drive Rope (#3) of the Pulley Pair Compound. Diameters of the two pulleys of the Pulley Pair Compound may need to be equal if rotational angles of the two pulleys are required to be the same.

[0005] The TOMPTS is composed of several Pulley Pair Compounds (Figure (b)). Drive Ropes of these Pulley Pair Compound can be separate for each pair of pulleys or continuous on all pairs of pulleys.

[0006] When pulleys of a pair are not in the same plane (their plane vectors are not in the same directions), the transmission is called "twisting". It reflects that the two pulleys of the pair, and the Drive Rope of the pair are being twisted as presented in Figure (a).

[0007] This system is developed for transmitting mechanical power from the first pulley to a number of pulleys, while:

(1) All these pulleys might and might not be in the same plane. In other words, rotational axes of these pulleys might and might not be parallel. These rotational axes are being twisted.
(2) Centres of these pulleys can be quite fluctuated or oscillated in any degree of freedom and within limits.

(3) These pulleys might be floating independently or grounding. However, distances between two centres of every pair of pulleys (of a Pulley Pair Compound) is unchanged over time.

[0008] Figure (a) presents that the pair of pulleys, the pulley (#1) and the pulley (#2), are not in the same plane. In other words, the upper line and the lower line of the Drive Rope (#3) are twisting. It is clear that the pulley (#1) can still transmit mechanical power to the pulley (#2) while their Drive Rope (#3) is being twisted.

[0009] The TOMPTS is able to be applied in the following cases:

(1) For floating transmission systems such as applications for floating solar tracking system or wave energy systems, where the plane vectors of pulleys vary over time and the centres of these pulleys are fluctuated or oscillated. No matter how waves displace the pair of pulleys (the two consecutive pulleys), as the distance between the pair of pulleys is unchanged, mechanical power transmissions between the two pulleys are still maintained. Particularly, the angles of rotations of the pair of pulleys are also maintained if both pulleys have the same diameters. This technical feature is appropriate for floating solar tracking systems: solar panels attached on the torsional beams (#6) of all pairs of pulleys (of the transmission systems) have the same angles of rotations which are required for facing to the sun. Thus, the TOMPTS is beneficial for floating energy systems as listed below:
    (a) Maintaining rotations of solar panels independently from motions of waves (for floating energy systems) and complex terrains (for grounding energy systems) and
    (b) The TOMPTS is considerable to have better transmission efficiencies than other transmissions using drive shafts connected via universal joints when it is oscillated by waves or it is laid on a fluctuated surface.
(2) For grounding solar tracking systems on complex terrains, the benefits are still the same.

[0010] In addition, the TOMPTS can be used to be the second axis of the dual axes solar tracking systems (Figure (b)) as follows:

(1) The First Active Pulley (#1) is connected to the First Drive Motor (#7).

(2) The Pulleys numbered from 2 to (N+1) belong to the Second Rotational Axis of the N solar trackers.

(3) The First Rotational Axis connects through the above N solar trackers via drive shafts (#5) with universal joints integrated. These N solar trackers can be rotated according to the First Rotational Axis.

(4) While the First Rotational Axis (#5) is rotating, the Drive Rope (#3) between the First Active Pulley (#1) and all the remaining Pulleys (#2 and #4) are being twisted consequently. At the same time, the First Drive Motor (#7) of the Second Rotational Axis rotates the First Active Pulley (#1). Then the First Active Pulley pull the Twisted Drive Rope (#3) and then transmit mechanical power to all the Pulleys numbered from 2 to (N+1). Thus, the TOMPTS can be used for the Second Rotational Axis of a dual axes solar tracking system. Both the First Rotational Axis and the Second Rotational Axis can rotate the trackers of solar panels at the same time independently thanks to the capability of the TOMPTS with Twisting Drive Ropes and Twisting Pulleys.

(5) The First Rotational Axis is not required to be strait. In other words, the centres of pulleys are either statically or dynamically fluctuated. The TOMPTS is capable to work with all such cases.

[0011] The TOMPTS can also be used for:

(1) single axis solar tracking systems, and

(2) floating solar tracking systems with either single axis or dual axes.

1.2 [0012] Free Bending Solution of Symmetric Pull (FBSSP)

[0013] The FBSSP is developed to enhance the Twisting Oscillated Mechanical Power Transmission System (TOMPTS). It is applied for both floating and grounding energy systems, including (floating or grounding) solar tracking systems and wave energy systems. It composes of two TOMPTSs which are combined and arranged symmetrically as presented in Figure (c).

[0014] If there is only one Drive Pulley (#7) (powered by a Drive Motor) at one end of the TOMPTS, the Drive Pulley pulls all the Pulleys of the transmission system with Lower Pulling Forces (#15), including tops of the (floating) posts where the Pulleys are secured to. The Lower Pulling Forces cause:

(1) Bending moments in the (floating) posts, and
(2) Capsizing the (floating) posts, and
(3) Pulling all structure of the system to one side which is the side of the Drive Pulley (#7), and
(4) Causing the supporting structure of the Drive Pulley (#7) and the structure of the whole system, including anchoring/ mooring systems as well as structures of the Pulleys/ Bearings, required to be strengthened and anchored further.

[0015] The FBSSP is to add a secondary Drive Pulley (#11) powered by a second Drive Motor. The Second Drive Pulley, which is symmetric with the First Drive Pulley, creates the Upper Pulling Forces (#14). As a result, all matters caused by the First Drive Pulley are eliminated by the Second Drive Pulley, leading to saving costs for structures and improving structural stability of energy systems, particularly floating energy systems.

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CLAIMS

1. a twisting oscillated mechanical power transmission system used for floating solar energy systems or wave energy systems; wherein the transmission system comprising:
   - ⊕ a number of posts being floated;
   - ⊕ a number of pulley pair compounds;
     - wherein each pulley pair compound further comprising:
       - a pair of pulleys, namely a first pulley and a second pulley;
       - a rope circularly connecting the first pulley and the second pulley for transmitting rotations between the pair of pulleys;
       - a beam, with or without a pair of universal joints at its two ends, used to rigidly hold the first pulley and the second pulley together; wherein:
         - the first pulley and the second pulley are rotatably connected to the two ends of the beam;
         - the pair of pulleys and the beam are supported by a pair of posts at the two ends of the beam; wherein the top of each post is allowed to be oscillated by waves within limits in any degrees of freedoms;
     - and wherein the pulley pair compounds are connected together sequentially; wherein:
       - each two adjacent pulley pair compounds share a shared pulley; wherein:
         - the shared pulley belongs to both the two adjacent pulley pair compounds;
         - mechanical power of rotations is transmitted between the two adjacent pulley pair compounds via their shared pulley;
   - ⊕ a primary motor used to drive a first pulley of a first pulley pair compound; wherein the first pulley of the first pulley pair compound rotates remaining pulleys of the pulley pair compounds.

2. a transmission system according to the Claim 1 further comprising a secondary motor; wherein:
   - the secondary motor is arranged symmetrically and oppositely to the primary motor;

- the secondary motor is used to drive a second pulley of a last pulley pair compound; wherein the second pulley of the last pulley pair compound rotates all remaining pulleys of the pulley pair compounds;
- and wherein the primary motor and the secondary motor create symmetrical tensional forces along the ropes; wherein:
    - both the primary motor and the secondary motor rotate the pair of pulleys of each pulley pair compound in the same rotational direction;
    - the symmetrical tensional forces created by the primary motor and the secondary motor are equal in magnitudes and opposite in directions;
    - the symmetrical tensional forces help to eliminate bending moments created by the primary motor and the secondary motor on each post.

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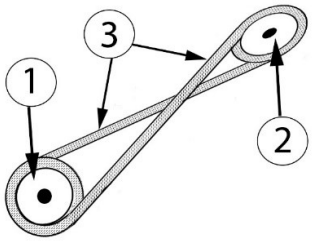
DRAWINGS

(a)



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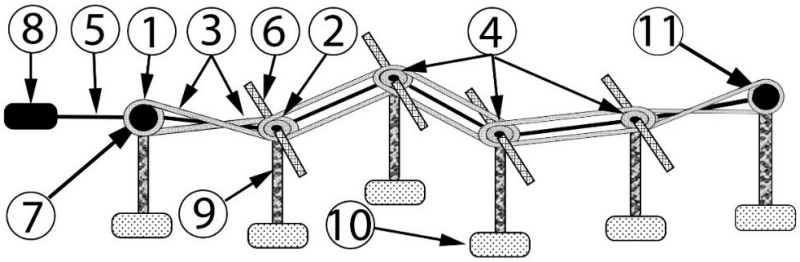

(c)

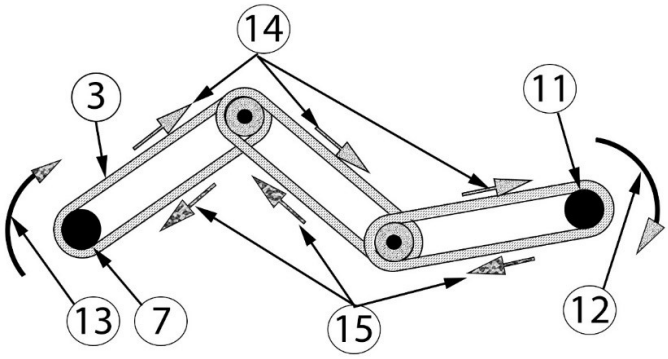

Figure 1