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(54) **CONNECTED KITE**

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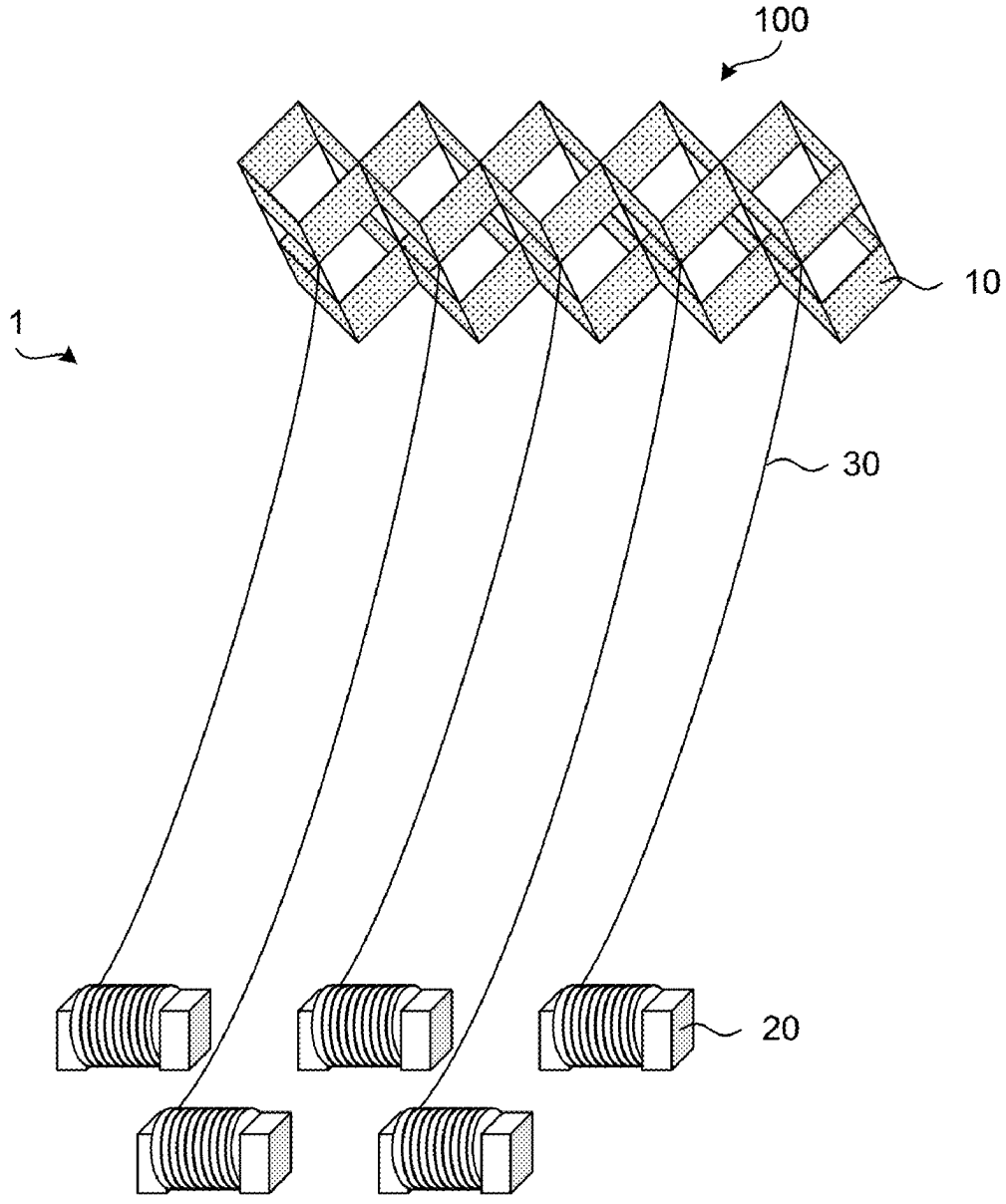
(57) **ABSTRACT**

A connected kite in which a plurality of kites are connected in a separable manner. The connected kite can improve space utilization.



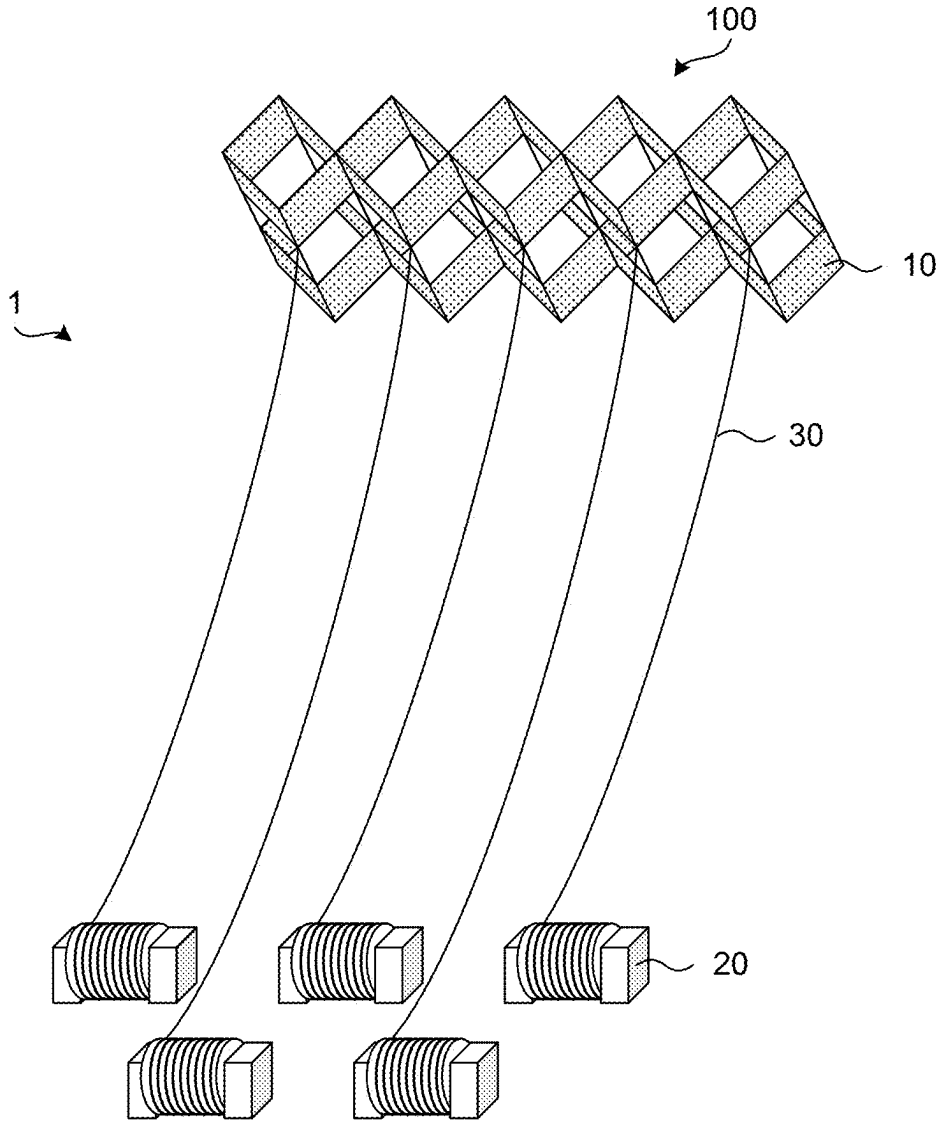


FIG. 1

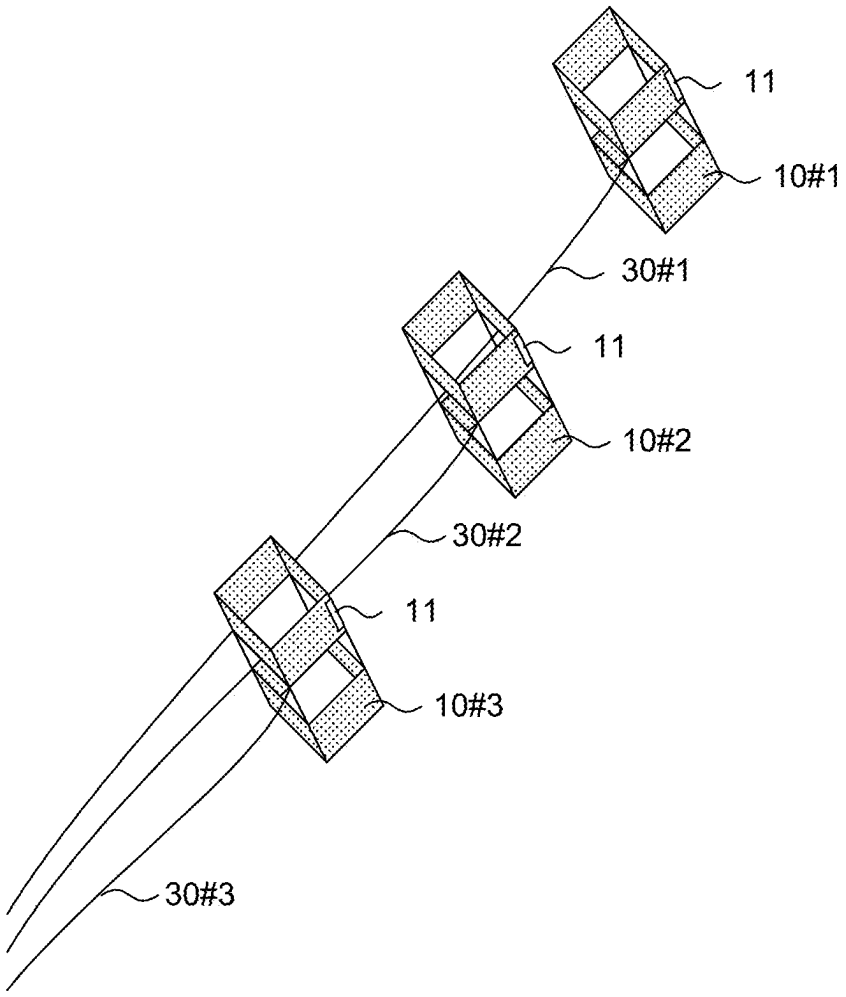


FIG. 2

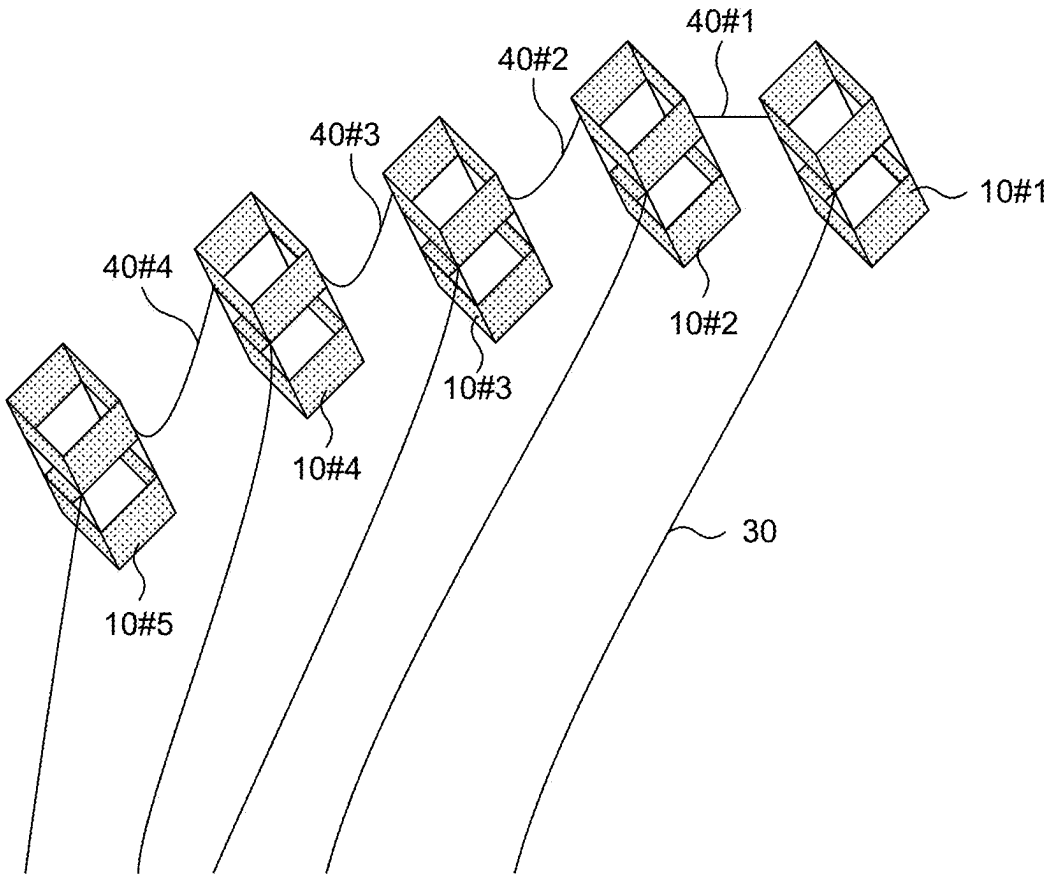


FIG. 3

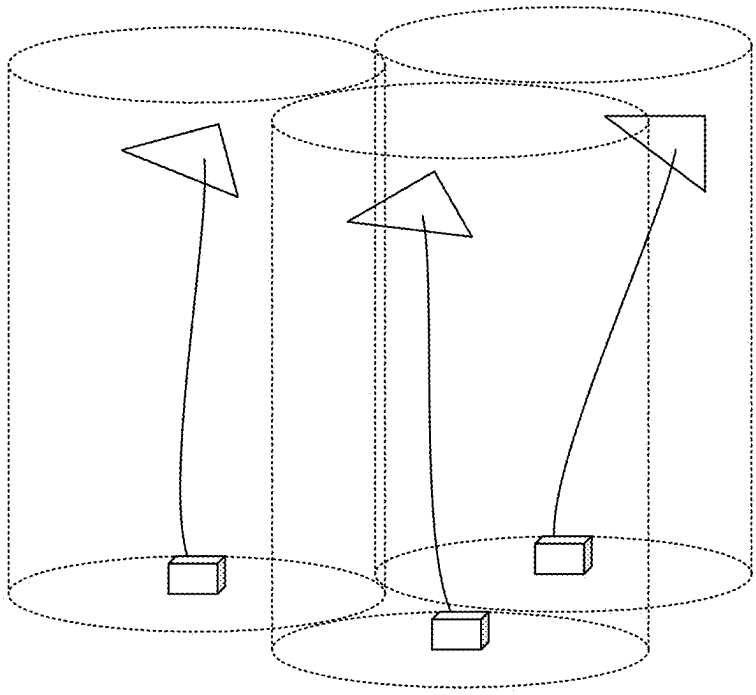


FIG. 4A

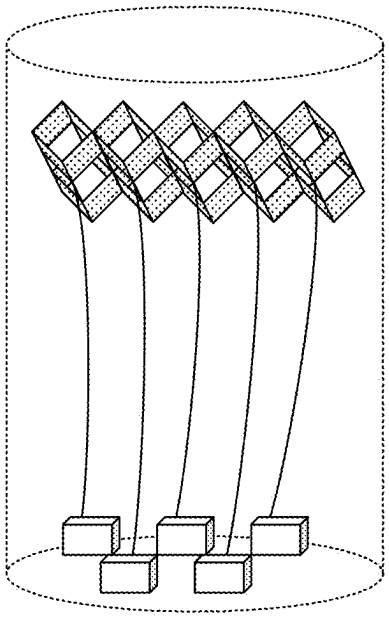


FIG. 4B

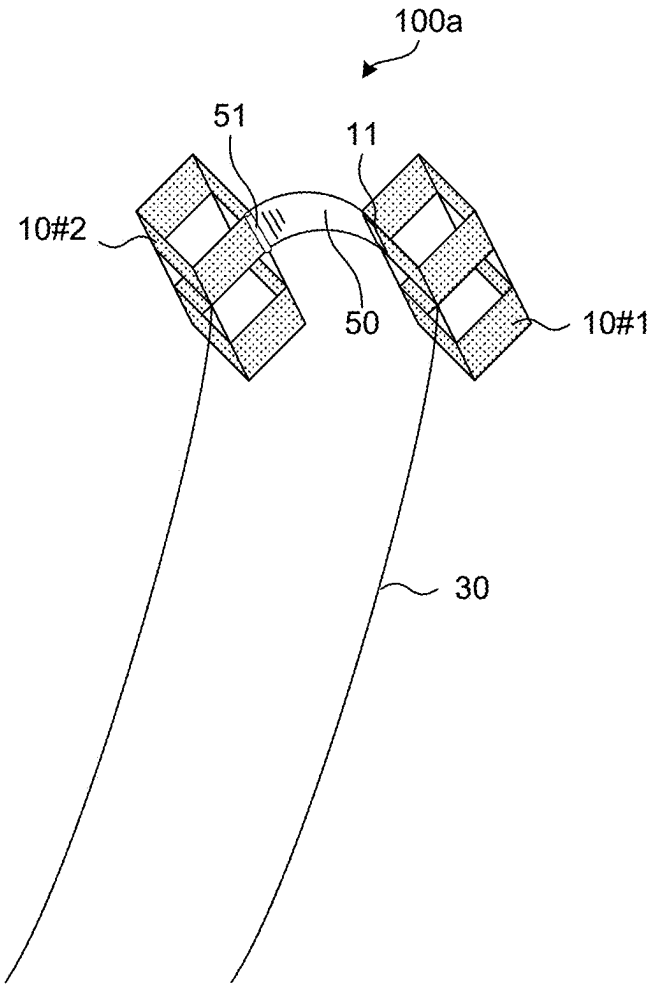


FIG. 5

CONNECTED KITE

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application is based upon and claims the benefit of priority of the prior Japanese Patent Application No. 2024-018583, filed on Feb. 9, 2024, the entire contents of which are incorporated herein by reference.

BACKGROUND

1. Technical Field

[0002] The present invention relates to a connected kite.

2. Description of the Related Art

[0003] This type of kite is sometimes used for wind power generation. For example, a Patent Literature 1 (i.e., Japanese Patent Application Laid Open No. 2016-537233) discloses an aircraft equipped with a wind power generation unit.

[0004] A flying attitude of a kite during flight changes according to at least one of changes in wind direction and wind speed. For this reason, when a plurality of kites are flying, it is necessary to secure a space for each kite to fly without interfering with the other kites to prevent one kite from colliding with the other kites or to prevent the tether that anchors one kite from getting tangled with the tether that anchors the other kites, for example. Moreover, an open area without objects (e.g., buildings, trees) that may be obstacles to flight of a kite is required in order to fly a kite (in other words, to take off a kite). As a result, the space occupied by one kite is significantly larger than the size of the kite. In other words, there is a technical problem that the space utilization rate is relatively low.

SUMMARY

[0005] In view of the problem described above, for example, it is therefore an object of the present invention to provide a connected kite which can improve space utilization.

[0006] A connected kite of one aspect of the present invention is a connected kite in which a plurality of kites are connected in a separable manner.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] FIG. **1** is a diagram illustrating one example of a connected kite according to an embodiment.

[0008] FIG. **2** is a diagram illustrating one example of a connecting method of kites.

[0009] FIG. **3** is a diagram illustrating another example of a connecting method of kites.

[0010] FIGS. **4**A and **4**B are diagrams for explaining effect of a connected kite according to an embodiment.

[0011] FIG. **5** is a diagram illustrating another example of a connected kite according to an embodiment.

DETAILED DESCRIPTION OF THE EMBODIMENT

[0012] An embodiment of a connected kite will be described with reference to FIGS. **1** to **4**B. In FIG. **1**, a connected kite **100** is formed by connecting a plurality of kites **10** to each other in a separable manner (in other words, in a separable aspect). Each of the plurality of kites **10** is moored to a mooring apparatus **20** through a tether **30**. The mooring apparatus **20** may include a drum around which the tether **30** is wrapped. In the present embodiment, the power generation system **1** may be constituted by the connected kite **100** (i.e., the plurality of kite **10**) and the plurality of mooring apparatuses **20**. Incidentally, the configuration of each of the kite **10** and the connected kite **100** shown in FIG. **1** is an example, it is not intended to be limited thereto. Incidentally, the tether **30** may be referred to as a mooring line.

[0013] For example, the mooring apparatus **20** may include a motor for rotating the drum around which the tether **30** is wound and a generator. Wherein the mooring apparatus **20** may have a motor generator that functions as a motor and functions as a generator, instead of the motor and the generator. When the kite **10** (specifically, the connected kite **100**) is raised, the tether **30** is fed out from the drum of the mooring apparatus **20** with raising the kite **10**. The drum rotates due to the unwinding operation of the tether **30**. Generating power may be performed by the generator rotating with the rotation of the drum.

[0014] The tether **30** is unwound to a predetermined length or, after a predetermined amount of time has elapsed, the drum is rotated in a direction to wind the tether **30** by the motor possessed by the mooring apparatus **20**. As a result, the kite **10** (specifically, the connected kite **100**) is lowered due to the winding operation of the tether **30**.

[0015] In the power generation system **1**, power generation may be performed by repeatedly performing the unwinding operation and the winding operation of the tether **30**. In other words, in the power generation system **1**, the tethered wind power generation using the connected kite **100** may be performed.

[0016] For example, at least one kite **10** of the plurality of kite **10** constituting the connected kite **100** may have a solar panel. In this case, in the power generation system **1**, solar photovoltaic power generation using the solar panel mounted on at least one kite **10** may be performed. If at least one mooring apparatus **20** of the plurality of mooring apparatus **20** has a generator, the solar photovoltaic power generation and the tethered wind power generation may be performed in the power generation system **1**.

[0017] Next, a connecting method of the plurality of the kite **10** will be described with reference to FIGS. **2** and **3**. The connecting method described below is an example, not intended to be limited thereto.

[0018] A first aspect of the connecting method will be described with reference to FIG. **2**. In FIG. **2**, first, a kite **10** #**1** is assumed to be raised. After the kite **10** #**1** is raised (in other words, during the flight of the kite **10** #**1**), a kite **10** #**2** is raised. At this time, a tether **30** #**1** may function as a guide of the kite **10** #**2**. As a result, the kite **10** #**2** is raised along the tether **30** #**1** mooring the kite **10** #**1**. If the kite **10** #**2** reaches the vicinity of the kite **10** #**1**, the kite **10** #**1** and the kite **10** #**2** may be connected by couplers **11** provided on the kite **10** #**1** and the kite **10** #**2**. In FIG. **2**, in order to avoid complication of the drawings, it illustrates one coupler **11** to one kite **10**, each kite **10** may have a plurality of couplers **11**.

[0019] After the kite **10** #**2** is raised, a kite **10** #**3** is raised. At this time, the tether **30** #**2** may function as a guide of the kite **10** #**3**. As a result, the kite **10** #**3** is raised along a tether **30** #**2** mooring the kite **10** #**2**. When the kite **10** #**3** reaches the vicinity of the kite **10** #**2**, the kite **10** #**2** and the kite **10** #**3** may be connected by couplers **11** provided on the kite **10**

#2 and the kite **10** #3. Incidentally, a timing, at which the kite **10** #3 is raised, may be a timing after connecting the kite **10** #2 with the kite **10** #2, or a timing before connecting the kite **10** #2 with the kite **10** #1.

[0020] The coupler **11** may be, for example, at least one of an electromagnet, a mechanical coupling and a hook-and-loop fastener. In other words, the coupler **11** may be an electro-magnetic coupling unit or may be a mechanical coupling unit. Here, the electromagnet loses magnetic force by energization is stopped. Therefore, by stopping the energization of the electromagnet, it is possible to separate connected two kites (e.g., the kite **10** #1 and the kite **10** #2). Moreover, the mechanical coupling and the hook-and-loop fasteners are mechanically couplable and mechanically separable. For this reason, two kites, which are connected by at least one of the mechanical coupling and the hook-and-loop fasteners, are separable. Wherein the mechanical coupling and the hook-and-loop fastener may be referred to as a reversible coupling apparatus. Incidentally, the coupler **11** may have the function of both the electro-magnetic coupling unit and the mechanical coupling unit. For example, the coupler **11** may include an electromagnet and a hook-and-loop fastener. In this case, two kites (e.g., kites **10** #1 and **10** #2) may be coupled by both the electromagnet and the hook-and-loop fastener.

[0021] A second aspect of the connecting method will be described with reference to FIG. **3** In FIG. **3**, before the plurality of kites **10** #1, **10** #2, **10** #3, **10** #4, and **10** #5 are raised, for example, the kite **10** #1 and the kite **10** #2 are connected by a tether **40** #1, the kite **10** #2 and the kite **10** #3 are connected by a tether **40** #2, the kite **10** #3 and the kite **10** #4 are connected by a tether **40** #3, and the kite **10** #4 and the kite **10** #5 are connected by a tether **40** #4. Incidentally, the tether **40** #1, **40** #2, **40** #3 and **40** #4 are tethers different from the tethers **30** for mooring the plurality of kites **10** #1, **10** #2, **10** #3, **10** #4 and **10** #5.

[0022] For example, after the kite **10** #1 is raised (in other words, during the flight of the kite **10** #1), the kite **10** #2 may be raised. After the kite **10** #2 is raised, the kite **10** #3 may be raised. After the kite **10** #3 is raised, the kite **10** #4 may be raised. After the kite **10** #4 is raised, the kite **10** #5 may be raised.

[0023] After the kites **10** #1 and **10** #2 are raised (in other words, during the flight of the kites **10** #1 and **10** #2), the tether **40** #1 may be wound, thereby the kite **10** #1 and the kite **10** #2 may be connected. After the kites **10** #2 and **10** #3 are raised (in other words, during the flight of the kites **10** #2 and **10** #3), the tether **40** #2 is wound, thereby the kite **10** #2 and the kite **10** #3 may be connected. After the kites **10** #3 and **10** #4 are raised (in other words, during the flight of the kites **10** #3 and **10** #4), the tether **40** #3 is wound, thereby the kite **10** #3 and the kite **10** #4 may be connected. After the kites **10** #4 and **10** #5 are raised (in other words, during the flight of the kites **10** #4 and **10** #5), the tether **40** #4 is wound, thereby the kite **10** #4 and the kite **10** #5 may be connected.

[0024] Incidentally, the kite **10** (e.g., the kites **10** #1, **10** #2, **10** #3, **10** #4 and **10** #5) may have a winch having a drum wounding the tether **40** (e.g., the tethers **40** #1, **40** #2, **40** #3 and **40** #4). For example, winding of tethers **40** #1, **40** #2, **40** #3 and **40** #4 may be performed by the winches.

[0025] Incidentally, after the connected kite **100** is formed by connecting the plurality of kites **10**, the tether **30** for mooring a part of kite **10** of the plurality of kite **10** may be disconnected from the kite **10** or mooring apparatus **20**. In this case, the number of tethers **30** mooring the connected kite **100** may be less than the number of the plurality of kites **10** constituting the connected kite **100**. The kite **10** is not limited to having the solar panel described above, for example, a camera, a sensor or the like may be mounted. In other words, the kite **10** may have a mounted object.

Technical Effect

[0026] Technical effect of the connected kite **100** according to the embodiment will be described with reference to FIGS. **4**A and **4**B When each of the plurality of kites flies independently, it is necessary to prevent the collision between kites and entanglement of the tether. Therefore, for example, as shown in FIG. **4**A, it is necessary to secure the space each kite can fly safely (see cylindrical dotted line in FIG. **4**A). As a result, the space occupied by a kite becomes significantly larger than the size of the kite. In contrast, in the connected kite **100**, since the plurality of kites **10** flies together, it is possible to prevent the collision between kites **10** constituting the connected kite **100**, it is possible to suppress the occurrence of entanglement of the tether **30**.

[0027] In order to rise the kite (in other words, take off the kite), it is necessary to have open land free of objects (e.g., buildings, wood) that could obstruct the kite's flight. The area of the land required to lift kite is directly proportional to the wing area of a kite. Therefore, when a single kite, which has the same wing area as the connected kite **100**, is raised, a wider land than the land required for raising the kite **10** is required. In this embodiment, for example, as described with reference to FIGS. **2** and **3**, after raising each kite **10**, in the sky (i.e., during the flight of each kite **10**), each kite **10** is coupled. Therefore, in the present embodiment, it is possible to fly the connected kite **100** in a narrower land than is required when the single kite, which has the same wing area as the connected kite **100**, is raised.

[0028] As a result of the above, in the present embodiment, it is possible to fly the connected kite **100** in which the plurality of kites **10** are connected in a space, in which the single kite **10** can fly safely (see cylindrical dotted line in FIG. **4**B). In other words, according to the connected kite **100** of the present embodiment, it is possible to improve the space utilization.

Modification

[0029] A modification of the connected kite of the embodiment will be described with reference to FIG. **5**. As shown in FIG. **5**, the connected kite **100***a* according to the modification is formed by connecting the plurality of kite **10** (e.g., the kites **10** #1 and **10** #2) separably. For example, the kite **10** #2 may have a membrane storage apparatus **51** for storing the membrane **50**. A coupler **11** may be attached to one end of the membrane **50**.

[0030] For example, after the kite **10** #1 and the kite **10** #2 are connected by the coupler **11**, the membrane **50** may be pulled out from the membrane storage apparatus **51** due to the force of the wind received by each of the kites **10** #1 and **10** #2. Alternatively, after the kite **10** #1 and kite **10** #2 are connected by the coupler **11**, the membrane **50** is delivered from the membrane housing apparatus **51** by a motor provided on the membrane housing apparatus **51**, thereby the membrane **50** may be deployed.

[0031] According to the connected kite **100***a* of the modification, it is possible to enlarge the wing area of the connected kite **100***a*.

[0032] Aspects of the invention derived from the embodiments and modifications described above will be described below.

[0033] A connected kite of one aspect of the present invention is a connected kite in which a plurality of kites are connected in a separable manner. Two or more kites of the plurality of kites may be moored to mooring apparatuses. At least one kite of the plurality of kites may have a mounted object. Wherein, examples of the mounted object include the solar panels, cameras and sensors described above. At least a part of the plurality of kites may be mechanically connected. At least a part of the plurality of kites may be electromagnetically connected.

[0034] The present invention is not limited to the above-described embodiments, but can be appropriately modified in range which is not contrary to the gist or the philosophy of the invention which can be read from range and the specification of the patent claim, and the connected kite accompanied by such modifications is also included in the technical range of the present invention.

What is claimed is:

1. A connected kite in which a plurality of kites are connected in a separable manner.

2. The connected kite according to claim **1**, wherein two or more kites of the plurality of kites are moored to mooring apparatuses.

3. The connected kite according to claim **1**, wherein at least one kite of the plurality of kites has a mounted object.

4. The connected kite according to claim **1**, wherein at least a part of the plurality of kites are mechanically connected.

5. The connected kite according to claim **1**, wherein at least a part of the plurality of kites are electromagnetically connected.

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