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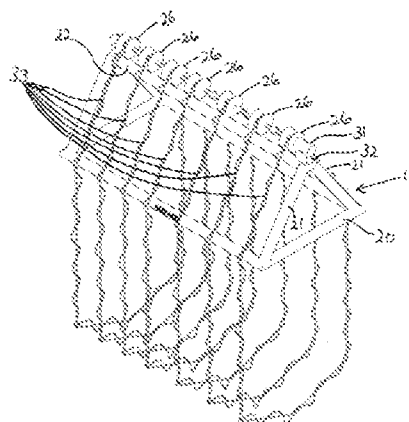
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(54)	Title	A shelter support and a shelter for cleaner fish, and a method for operating a shelter for cleaner fish
(57)	Abstract	

There is disclosed a shelter support (16) for at least one shred unit (33) for cleaner fish, where the shelter support (16) comprises at least one support shaft (25) for support of the at least one shred unit (33) such that a desired length of the at least one shred unit (33) can be moved around the at least one support shaft (25) at regular or irregular intervals. The at least one support shaft (25) is arranged above the surface of the water in which the shelter support (16) is arranged, such that a section of the at least one shred unit (33) that is supported by the at least one support shaft (25), is arranged above the surface of the water. There is also disclosed a shelter (14) comprising a shelter support (16) and at least one shred unit (33), and a method for operating a shelter (14) for cleaner fish comprising a shelter support (16) for stepwise drying of the at least one shred unit (33).



The present invention is related to a shelter support and a shelter for cleaner fish, a method for operating a shelter support or a shelter for cleaner fish and a use of the shelter support or the shelter for drying shred units.

In the industry of fish farming, such as farming of salmon, cleaner fish are used to clean fish which are infected with salmon louse. The cleaner fish can be lumpfish which do not thrive unless they have places where they can hide. The fish pens in which fish such as salmon, is farmed can therefore be provided with artificial shelters for cleaner fish.

Shelters for cleaner fish are well known in the art. The shelters usually comprise a number of shred elements which are submerged in water in the fish pen. The shred elements normally comprise strips of a plastic material creating a seaweed-like forest in which the cleaner fish, such as lump fish, can hide. However, the submerged shred elements are susceptible to fouling and over time the shred elements will get fouled if nothing is done to prevent fouling. Therefore, the shred elements must be removed from the fish pen at certain intervals and dried before the shred elements are reimmersed into the fish pen.

The shred elements are quite long, often around 10 meters long, and to lift such shred elements from a fish pen, a crane is needed. Such a crane is often not available at the fish pen and a service boat with a suitable crane must be used. The whole process of lifting the shelter with the shred elements from the fish pen, drying the shred elements and reimmersing the shelter into the fish pen is very time consuming, requires a number of workers and is therefore also a costly procedure.

In addition, the removal of the shelter from the fish pen causes an extra stress on the cleaner fish that use the shelter to hide and relax. This stress on the cleaner fish can cause increased mortality among the cleaner fish.

Hence, an object of the present invention has been to provide an improved shelter for cleaner fish.

A further object has been to develop a shelter for cleaner fish with improved handling of fouling of the shelter.

A further object has been to reduce the time needed to manage fouling of shelters for cleaner fish.

A further object has been to maintain the welfare of cleaner fish while at the same time avoid fouling of the shred elements of the shred elements of the shelter.

A further object has been to reduce the time needed to manage fouling of shelters for cleaner fish.

A further object has been to reduce the costs involved in managing the fouling of shelters for cleaner fish.

- 5 These objectives are met with a shelter support for cleaner fish as defined in independent claim 1, a shelter according to claim 15, a method for operating a shelter for cleaner fish as defined in independent claim 17 and a use of the shelter support or the shelter as defined in claim 19. Further embodiments of the present invention are defined in the dependent claims.
- 10 The idea behind the present invention was to use strips of plastic which form a loop, i.e. an infinitely long shred unit, where the loop-shaped shred units are arranged on a support shaft such that a portion of the shred units are above the surface of the water. The portion above water will thereby get dried and the fouling removed. When the portion above water has dried, a length of the loop-
- 15 shaped shred elements is moved over the support shaft until substantially the entire dried portion of the shred elements is submerged and a new portion of the loop-shaped shred elements are above water to be dried. This process can be carried out at regular or irregular time intervals, depending on weather, wind, air temperature and other factors that may influence the time it takes to dry the
- 20 portion of the shred elements which are above the water surface at any given time. A portion of the loop-shaped shred elements will therefore always be above the water to dry and all parts or sections of the shred elements will be dried sufficiently often so that fouling of the shred elements is prevented.

- Hence, there is provided a shelter support for at least one shred unit for cleaner
- 25 fish, where the shelter support comprises at least one support shaft for support of the at least one shred unit such that a desired length of the at least one shred unit can be moved around the at least one support shaft at regular or irregular intervals. The at least one support shaft is arranged above the surface of the water in which the shelter support is arranged, such that a section of the at least
- 30 one shred unit that is supported by the at least one support shaft, is arranged above the surface of the water.

The at least one support shaft is preferably provided with at least one shred support element on which the at least one shred unit is supported.

- The at least one shred support element is preferably provided with at least one
- 35 guide element to guide the at least one shred unit as it is moved over the at least one shred support element.

The at least one guide element can take many different shapes such as a groove or flange elements forming a groove in the outer surface of the shred support element, as long as the shred elements supported by the at least one shred support element are safely guided over the at least one support element when a section or a portion of the at least one shred element is moved over the at least one support element.

The at least one support shaft and/or the at least one shred support element is/are preferably rotatable. When the at least one support shaft and/or the at least one shred support element is/are rotatable about the longitudinal axis of the at least one support shaft, the moving of the at least one shred unit supported on the at least one support shaft or the at least one shred support element, is simplified. By rotating the support shaft and/or the at least one shred support element, a desired length of the at least one shred unit supported on the at least one support shaft or the at least one shred support element, can be moved, or rotated, over the at least one support shaft. Preferably, the at least one shred support element is fixedly attached to the at least one support shaft, while the at least one support shaft is rotatably supported about its own longitudinal axis.

Alternatively, the at least one shred support unit is rotatably mounted on the at least one support shaft about the common, longitudinal axis of the at least one shred support unit and the at least one support shaft, while the at least one support shaft is non-rotatably mounted in the shelter support. Alternatively, the at least one support shaft is rotatable about its longitudinal axis and the at least one shred element is rotatably mounted on the at least one support axis about the common longitudinal axis of the at least one shred support element and the at least one support shaft.

The at least one shred support element is preferably a shred support wheel, i.e. the at least one shred support element has a circular shape as seen in a side view in the direction of said common longitudinal axis of the at least one shred support element and the support shaft, but the at least one shred support element may take different shapes. For example, the at least one shred element may have a polygonal shape as seen in a side view in the direction of said common longitudinal axis of the at least one shred support element and the support shaft. Preferably, if the at least one shred element has a polygonal shape, it has a regular polygonal shape, such as a square or a regular pentagon, hexagon, heptagon, octagon etc.

The at least one shred support unit may also be provided with an oval or elliptic shape as seen in a side view in the direction of said common longitudinal axis of the at least one shred support element and the support shaft. This shape will

allow the distance between the two portions of the loop-shaped, at least one shred unit that hang down from either side of the at least one shred support element to be adjusted to a desired distance.

5 The at least one guide element may be a groove formed in a radially outer surface of the at least one shred support element. Alternatively, radial flange elements extending from the at least one shred support element or any other features or devices can be used that is capable of guiding the at least one shred unit over the at least one shred support unit as a desired length of the at least one shred unit is moved over, or rotated over, the at least one shred support
10 element.

The shelter support is preferably semi-submersible in the water or floating on the surface of the water.

The at least one support shaft is preferably provided with a plurality of shred support elements. Furthermore, the shelter support can be provided with a
15 plurality of support shafts. With a plurality of shred support elements arranged on one or more support shafts, the shelter can be made to create a forest-like shelter for the cleaner fish having a desired size, depending on the number of cleaner fishes in the fish pen.

The shelter support is provided with at least one shaft motor to rotate the
20 support shaft or the support shafts. Most preferably, is the shelter support is provided with a plurality of support shafts, each support shaft is provided with its own shaft motor so that the support shafts can be rotated independently of each other.

The shelter support preferably comprises a support unit which supports the
25 support shaft or support shafts.

The support shaft or the support shafts are preferably rotatably mounted to the support unit, preferably supported by suitable bearings.

The support unit is preferably provided with at least one buoyancy and ballast unit. The at least one buoyancy and ballast unit may be one or more tanks which
30 is/are arranged integrally within the support unit and/or one or more tanks which is/are mounted externally on the support unit. The at least one buoyancy and ballast unit helps to keep the shelter support, and the shred units supported by the shelter support, floating and can be used to adjust the draught of the shelter support to a desired level where the shelter is floating on the surface of the
35 water or is submerged to a desired level. Hence, the shelter can be either a floating or a semi-submersibel vessel.

The support unit can obviously be designed in many different ways. For example, the support unit may comprise a support frame and a plurality of support arms which are securely attached to the support frame, wherein the support shaft or support shafts are supported by the support arms.

- 5 The support shaft or support shafts are preferably rotatably mounted to the support arms.

The at least one buoyancy unit is preferably an integral part of the support frame or may alternatively be mounted to the support frame. A combination of one or more buoyancy units integrated in the support frame and one or more external
10 buoyancy units mounted to the frame is also possible.

There is also provided a shelter for cleaner fish comprising a shelter support as described above including none, one, some or all of the additional features described above, and where the shelter further comprises at least one shred unit which forms a loop, and the at least one shred unit is supported by the at least
15 one support shaft.

The at least one support shaft is preferably provided with a plurality of shred support elements, and preferably at least one shred unit is supported from each shred support element.

Shred units are commonly known in the art and readily available commercially.
20 The at least one shred unit, for the present invention, is preferably made of a plastic material.

There is also provided a method for operating a shelter for cleaner fish comprising a shelter support which is provided with at least one support shaft, and at least one shred unit which is formed as a loop and is supported on the at
25 least one support shaft. The at least one support shaft is arranged above the surface of the water such that at any time a section of the at least one shred unit is above the surface of the water for drying of said section of the at least one shred unit.

A part of the at least one shred unit is preferably moved over the at least one
30 support shaft at regular or irregular intervals to change the section of the at least one shred unit which is above the surface of the water for stepwise drying of the at least one shred unit.

The shelter used in the method is preferably a shelter as described above including none, one or all of the additional features mentioned, and the shelter
35 support of the shelter is preferably the shelter support as described above

including none, one, some or all of the additional features related to the shelter support as described above.

There is also provided a use of a shelter support as described above including none, one, some or all of the additional features related to the shelter support as described above, or a shelter as described above including none, one or all of the additional features related to the shelter as described above, for stepwise drying of sections of at least one, loop-shaped shred unit which is supported by the shelter support or the shelter.

The shelter according to the present invention will now be further described in detail with reference to two non-limiting embodiments shown in the attached figures, where:

Figure 1 shows a shelter according to the present invention arranged in a fish pen.

Figure 2 shows a perspective view of a shelter according to the present invention comprising one support shaft and shred units supported on the support shaft such that a section of the shred units is arranged above the surface of the water.

Figure 3 shows two side views of the shelter shown in figure 2.

Figure 4 shows a perspective view of the shelter in figures 2 and 3 without the shred units.

Figure 5 shows a top view of a shelter support according to the present invention comprising two support shafts.

Figure 6 shows a side view of the shelter support in figure 5.

Figure 7 shows a side view of the shelter support in figures 5 and 6.

Figure 8 shows a perspective view of a shelter comprising a shelter support as shown in figures 5-7 and shred units supported by the shelter support.

Figure 9 shows a side view of the shelter shown in figure 8.

Figure 10 shows a side view of the shelter shown in figure 8 and 9.

Figure 11 shows a top view of the shelter shown in figures 8-10.

In figure 1 a typical fish pen 10 is shown which is arranged in a body of water and anchored to the sea bed with anchor lines 12. A support vessel 35 is also shown next to the fish pen.

Inside the fish pen 10, a shelter 14 according to the present invention, is shown. In figure 1 only one shelter 14 is shown, but any number of shelters 14 can be

arranged in the fish pen 10 depending on various factors such as the size of the fish pen 10, the number of fishes being farmed and, obviously, the number of cleaner fish that are present in the fish pen 10.

In figures 2-4 a first embodiment of the shelter 14 is shown. A shelter 14 comprises at least one, but usually a number of shred units 33 which are supported by a shelter support 16.

The shred units 33 according to the present invention, is a formed as a loop as indicated in figures 1-3 and figures 8-11. The shred units 33 comprise strips of a plastic material creating a seaweed-like forest in which the cleaner fish, such as lump fish, can hide.

In figure 4, the shelter support is shown without the shred units 33. The shelter support comprises a support unit 18. The support unit 18 is typically a frame work as shown in the figures. The support unit 18 comprises a support frame 20 at the bottom. The support frame 20 can be provided with one or more buoyancy tanks and/or one or more ballast tanks to provide the desired buoyancy to the shelter 14. Typically, the shelter 14 floats on the surface 38 of the water but may also be semisubmersible.

The support unit 18 of the shelter support 16 further comprises at least one, but preferably a plurality of support arms 21 which are attached to the support frame 20 and extends upwards, either substantially vertically, as shown in figures 5-11, or slanting as shown in figures 2-4. The support unit 18 shown in figures 2-4, is further provided with an upper support member to which the support arms 21 are attached. Together the support frame 20, the support arms 21 and the upper support element 22 form a sturdy frame that is capable of supporting a number of shred units 33.

The shelter support 16 is further provided with a support shaft 25. The support shaft 25 is preferably mounted on top of the support unit 18. The support shaft 25 is further mounted on or to the support unit 18 such that it is situated well above the water surface 38. The distance between the water surface 38 and the support shaft 25 creates a drying zone whereby the part or section of the shred units 33 which are in the drying zone are dried and the fouling of the shred units 33 is

The support shaft could be stationary but is preferably rotatably mounted to the support unit 18. In order to rotate the support shaft 25, a shaft motor 31 can be arranged at one end of the support shaft 25 driving the support shaft 25 directly as indicated in figures 2-11, or indirectly through a drive mechanism such as chain, a drive belt, a system of gears etc. Hence, as clearly shown in figure 4, in one end the support shaft 25 can be rotatably mounted to a shaft support unit 23 which in turn is securely attached to the support unit 18, and in the other end the support shaft 25 can be connected to the shaft motor 31 which is securely supported on a shaft motor support 32 which in turn is securely mounted to the support unit 18. Alternatively, the support shaft 25 could be rotatably supported

by a shaft support unit 23 in both ends of the support shaft 23. That would be especially relevant if the shaft motor 31 rotates the support shaft 25 via a drive mechanism as mentioned above.

5 The support shaft 25 is provided with at least one, but preferably a number of shred support elements 26 for support of respective loop-shaped shred elements 33. The shred support elements 26 are preferably evenly spaced out along the support shaft 25.

10 Alternatively, the shred units 33 could supported directly on the support shaft 25. In this case, the support shaft 25 could be provided with a non-circular cross-sectional shape, such as elliptical, oval, rectangular or any other suitable cross-sectional shape, in order to facilitate the movement of the shred units 33 over the support shaft 25.

15 The shred support elements 26 are preferably provided with a groove 28 formed by two guide elements 27 as clearly shown in figure 4. The groove 28 in the shred support elements 28 helps to keep the shred units 33 in their respective position during operation in windy conditions and, also during rotation of the loop-shaped shred units 33 over their respective shred support elements 26.

20 When the shelter 14, as shown in figures 2-4, and also in the shelter shown in figures 5-11, is in operation, the shred units 33 is supported on their respective shred support elements 26 on the support shaft 25. Since the support shaft 25 is arranged above the water surface 38, the section of the loop-shaped shred units 33 which are situated in the drying zone between the water surface 38 and their respective shred support elements 26, will be drying. After some time, depending on the weather conditions, the sections of the shred units 33 above in the drying zone will have dried and the fouling will have been removed. Then the support shaft 25 is rotated until substantially the whole section of the loop-shaped shred units 33 which have been dried, are submerged and a new section of the loop-shaped shred units 33 have emerged into the drying zone. The rotation of the support shaft 25 is then halted and the new section of the shred units 33 are left to dry and the fouling to be removed. This process can be repeated over and over again and all parts of the loop-shaped shred units 33 are dried sufficiently often to avoid any serious fouling of the shred units 33.

35 In figures 5-11 there is shown a shelter 14 according to the present invention, having a slightly different construction than the shelter shown in figures 2-4, but the principle of how the two embodiments work is the same.

In figures 5-7 the shelter support 16 is shown without the shred units 33. In figures 8-11 the complete shelter 14 with the shelter support 16 shown in figures 5-7 and the shred units 33 supported by the shelter support 16 is shown.

40 The difference between the shelter support 16 shown in figures 2-4 and the shelter support 16 shown in figures 5-11 is mainly that the shelter support 16 in

figures 5-11 is provided with two support shafts 25 instead of one support shaft as shown in figures 2-4.

The shelter support 16 shown in figures 5-11 are provided with a support unit 18 comprising a support frame 20 as explained above, which can be provided with one or more buoyancy tanks and/or one or more ballast tanks for adjustment of the draught of the shelter 14.

The support frame 18 is further provided with a number of support arms 21, for example a pair of support arms 21 as shown in the figures, which extends upwards from the support frame 20, substantially vertically as indicated in the figures or slanting. As indicated in figures 5-11, the two pairs of support arms 21 can be arranged at either end of the support unit 18 where the support shafts 25 are supported. At the top of the two pairs of support arms 21 there is provided a cross member 24 connecting the two support arms 21 of each pair of support arms 21 and thus creating a sturdy support unit 18.

The two support shafts 25 can be provided with separate shaft motors 31 as indicated in the figures, which can rotate the support shafts 25 independently of each other. Alternatively, only a single shaft motor could be provided driving the support shafts 25 via an additional, suitable drive mechanism such as one or more drive belts, chains, etc.

The support shafts 25 are preferably, in the same way as for the shelter 14 shown in figures 2-4, provided with at least one, but preferably a plurality of shred support elements 26. The shred support elements 26 are preferably evenly distributed along the support shafts 25 as indicated in the figures.

In figures 8-11 the shelter 14 is shown with shred units 33 supported from the shred support elements 26, which can be of the same type as shown in figures 2-4, i.e. the shred support units 26 can be wheel-shaped and are preferably provided with respective grooves 28 around the radial periphery of the shred support units 33 which guide the shred units 33 over the shred support units 26 when the support shafts 25 are rotated.

The shelter 14 shown in figures 5-11 works in the same way as the shelter shown in figures 2-4. The section of the shred units 33 which are in the drying zone between the water surface 38 and the support shafts 25 are being dried and the fouling is removed. When the drying and defouling process is completed, the support shafts 25 are rotated until substantially the whole section that has been dried, is submerged and a new section of the shred units 33 have emerged in the drying zone ready for drying and defouling.

CLAIMS

1. A shelter support (16) for at least one shred unit (33) for cleaner fish, the shelter support (16) comprising at least one support shaft (25) for support of the at least one shred unit (33) such that a desired length of the at least one
5 shred unit (33) can be moved around the at least one support shaft (25) at regular or irregular intervals, and wherein the at least one support shaft (25) is arranged above the surface of the water in which the shelter support (16) is arranged such that a section of the at least one shred unit (33) that is supported by the at least one support shaft (25), is arranged above the
10 surface of the water.
2. The shelter support according to claim 1,
wherein the at least one support shaft (25) is provided with at least one shred support element (26) on which the at least one shred unit (33) is supported.
3. The shelter support according to claim 2,
15 wherein the at least one shred support element (26) is provided with at least one guide element (27, 28) to guide the at least one shred unit (33) as it is moved over the at least one shred support element (26).
4. The shelter support according to claim 3,
wherein the at least one guide element (27, 28) is a groove (27) formed in a
20 radially outer surface of the at least one shred support element (26).
5. The shelter support according to one of the claims 2-4,
wherein the at least one support shaft (25) and/or the at least one shred support element (26) is rotatable such that a desired length of the at least one shred unit (33) supported on the at least one shred support element (33),
25 can be moved around the at least one support shaft (25).
6. The shelter support according to one of the claims 2-5,
wherein the at least one shred support element (26) is a shred support wheel.
7. The shelter support according to one of the claims 2-6,
wherein the at least one shred support unit (26) has an oval or elliptic shape.
- 30 8. The shelter support according to one of the claims 1-7,
wherein the shelter support (16) is semi-submersible in the water or floating on the surface of the water.
9. The shelter support according to one of the claims 2-8,
wherein the at least one support shaft (25) is provided with a plurality of
35 shred support elements (26).

10. The shelter support according to one of the claims 1-9,
wherein the shelter support (16) is provided with a plurality of support shafts (25).
- 5 11. The shelter support according to one of the claims 1-10,
wherein the shelter support (16) is provided with at least one shaft motor (31)
to rotate the support shaft (25) or the support shafts (25).
12. The shelter support according to one of the claims 1-11,
wherein the shelter support (16) comprises a support unit (18) which supports
10 the support shaft (25) or support shafts (25).
13. The shelter support according to claim 12,
wherein the support shaft (25) or the support shafts (25) are rotatably
mounted to the support unit (18).
14. The shelter support according to claim 12 or 13,
15 wherein the support unit (18) is provided with at least one buoyancy unit.
15. A shelter (14) for cleaner fish comprising a shelter support (16) according to
any one of the claims 1-14, the shelter (14) further comprising at least one
shred unit (33) which forms a loop, the at least one shred unit (33) being
supported by the at least one support shaft (25).
- 20 16. The shelter according to claim 15,
wherein the at least one support shaft (25) is provided with a plurality of
shred support elements (26), and a shred unit (33) is supported from each
shred support element (26).
- 25 17. A method for operating a shelter (14) for cleaner fish comprising a shelter
support (16) which is provided with at least one support shaft (25), and at
least one shred unit (33) which is formed as a loop and is supported by the at
least one support shaft (25), wherein the at least one support shaft (25) is
arranged above the surface of the water such that at any time a section of the
at least one shred unit (33) is above the surface of the water for drying of the
30 section of the at least one shred unit (33).
18. The method according to claim 17,
wherein a part of the at least one shred unit (33) is moved over the at least
one support shaft (25) at regular or irregular intervals to change the section
of the at least one shred unit (33) which is above the surface of the water for
35 stepwise drying of the at least one shred unit (33).

19. Use of a shelter support (16) according to any one of the claims 1-14 or a shelter (14) according to any one of the claims 15-16, for stepwise drying of sections of at least one, loop-shaped shred unit (33) which is supported by the shelter support (16) or the shelter (14).

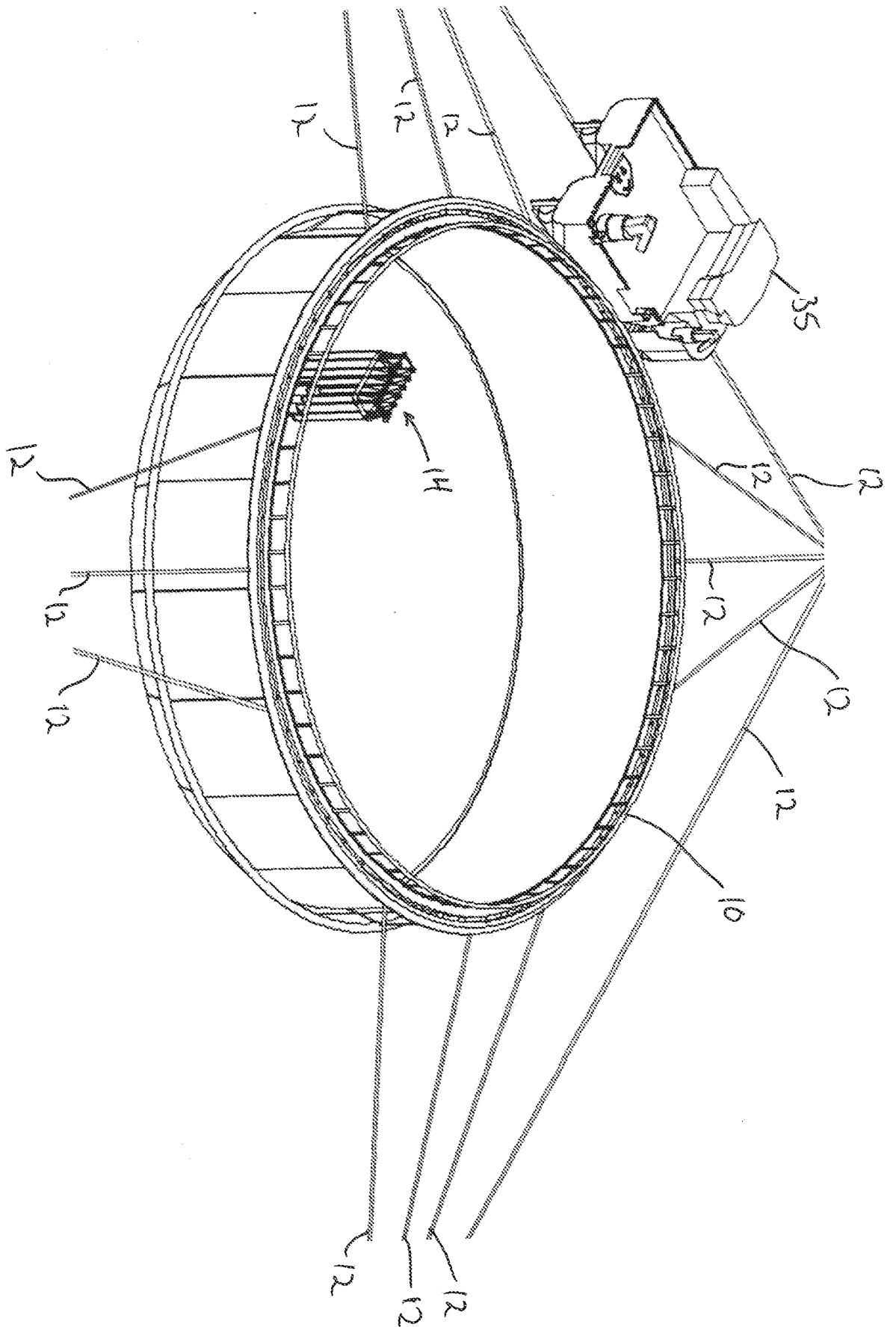


Fig. 1

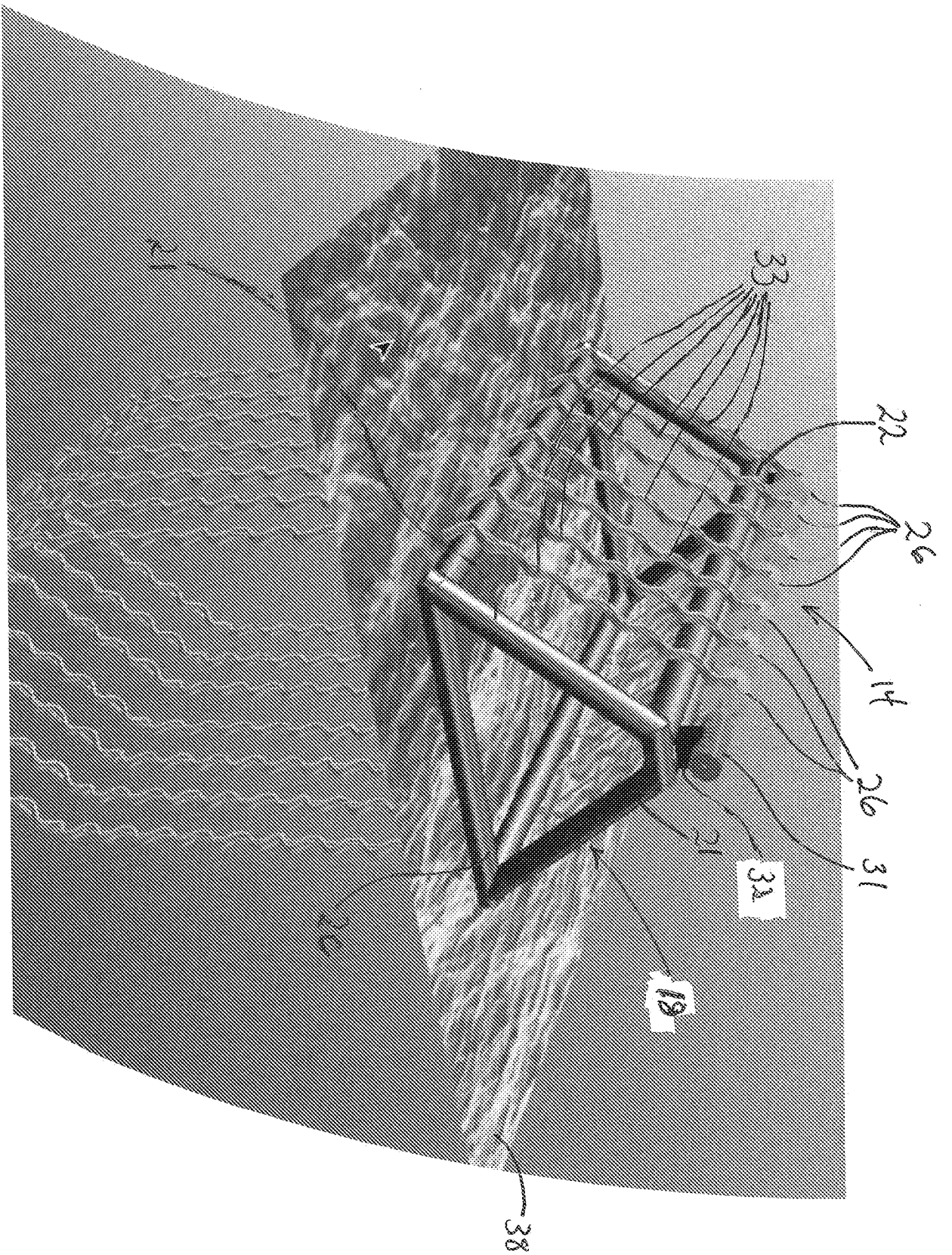


Fig. 2

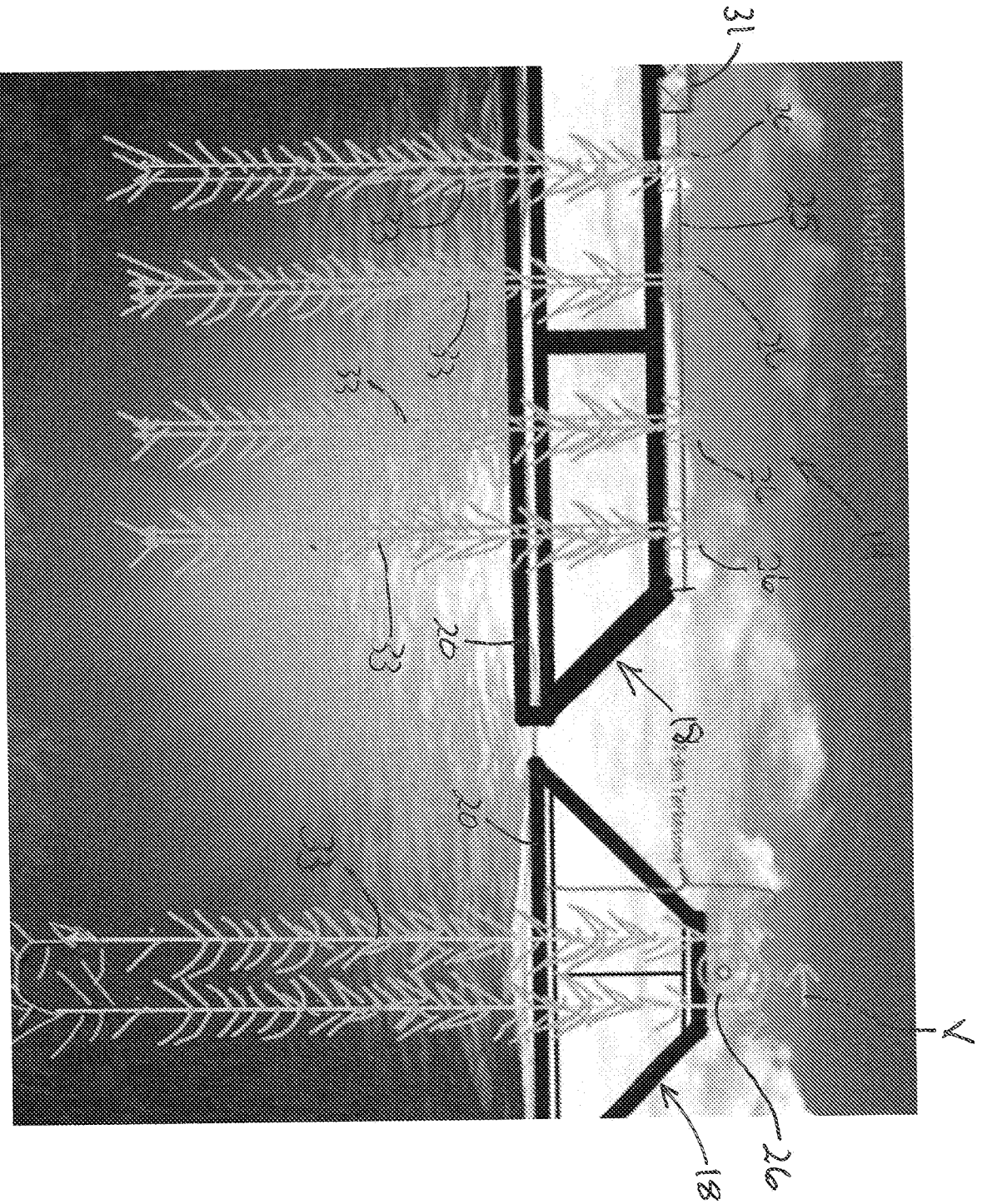
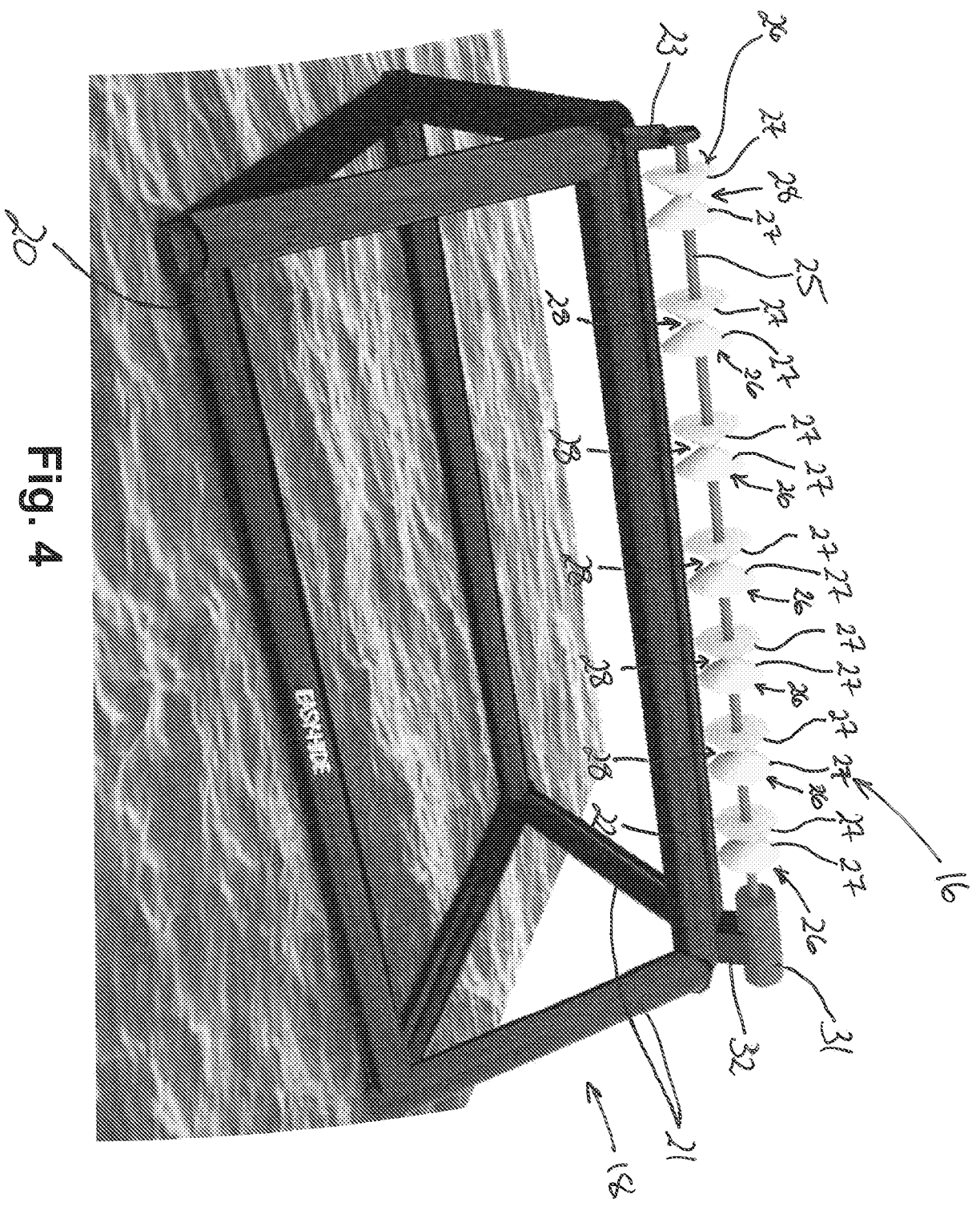


Fig. 3



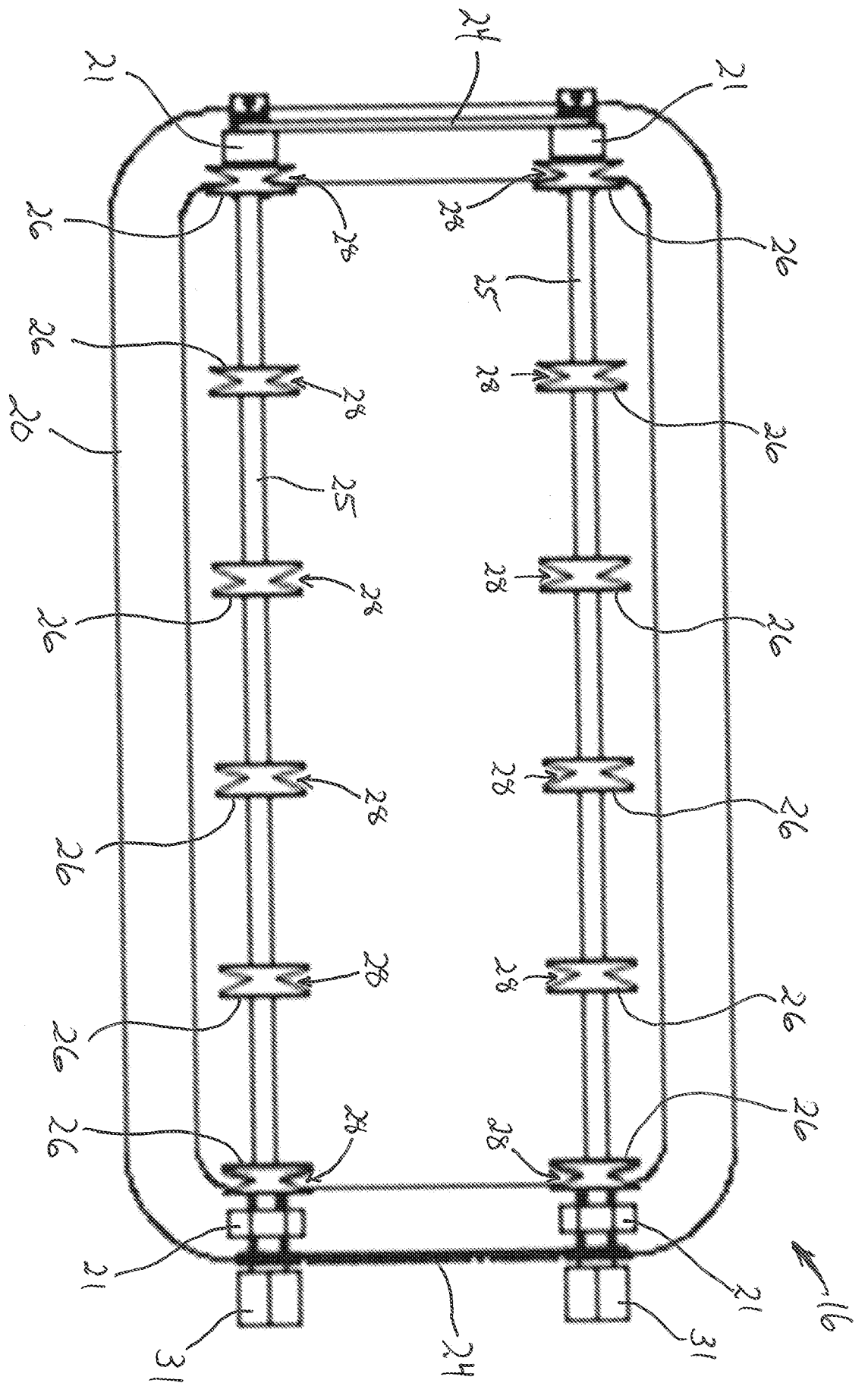


Fig. 5

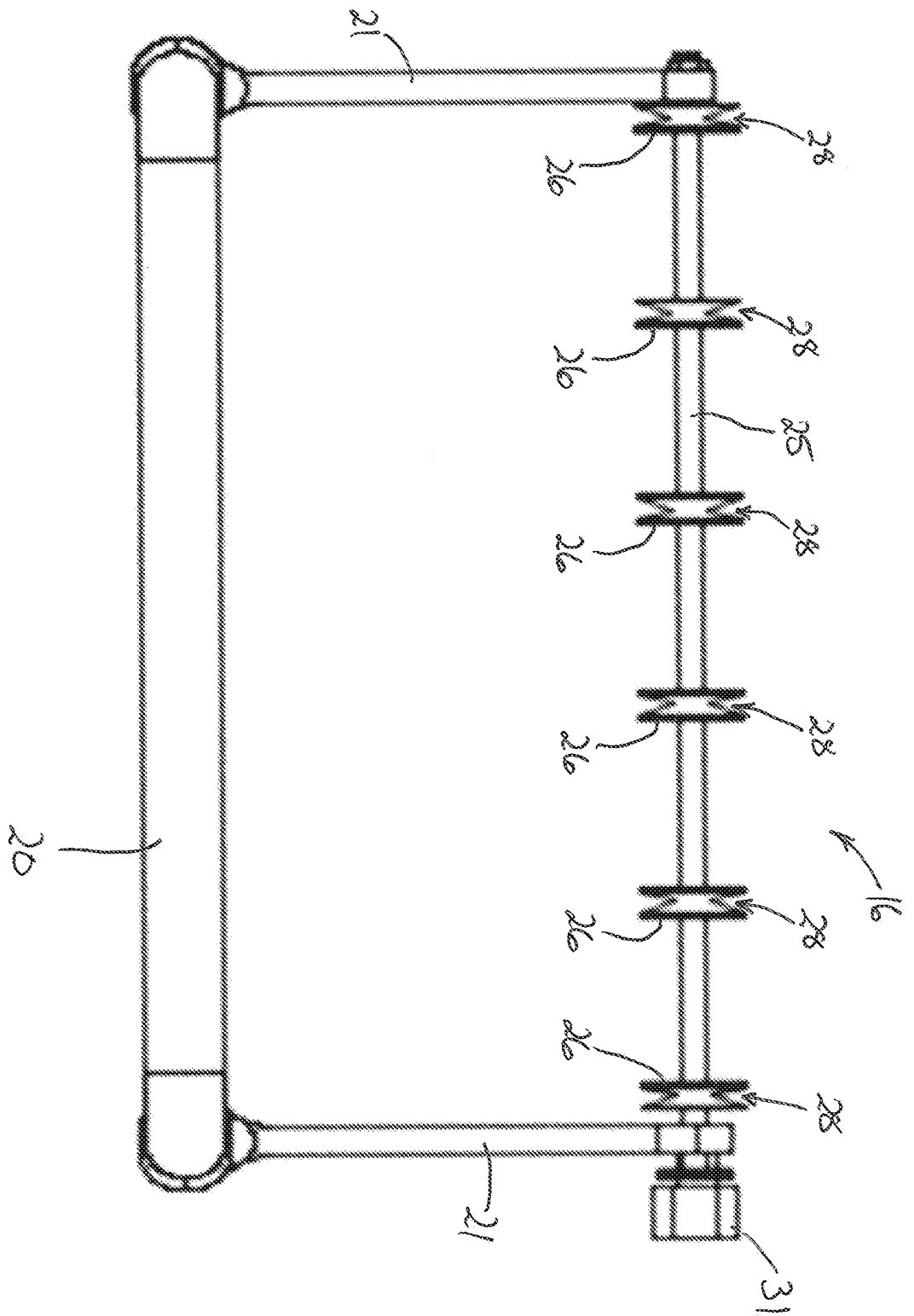


Fig. 6

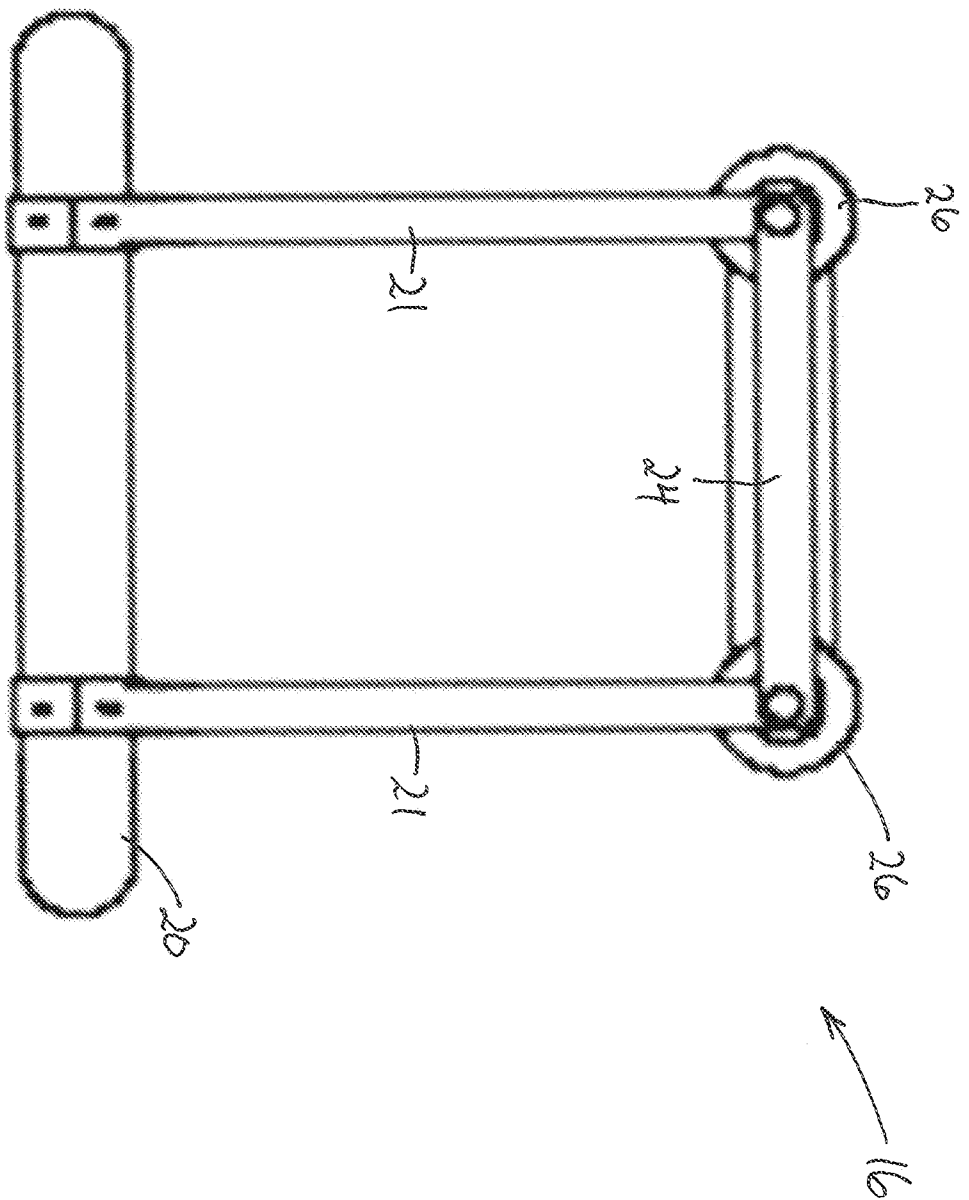
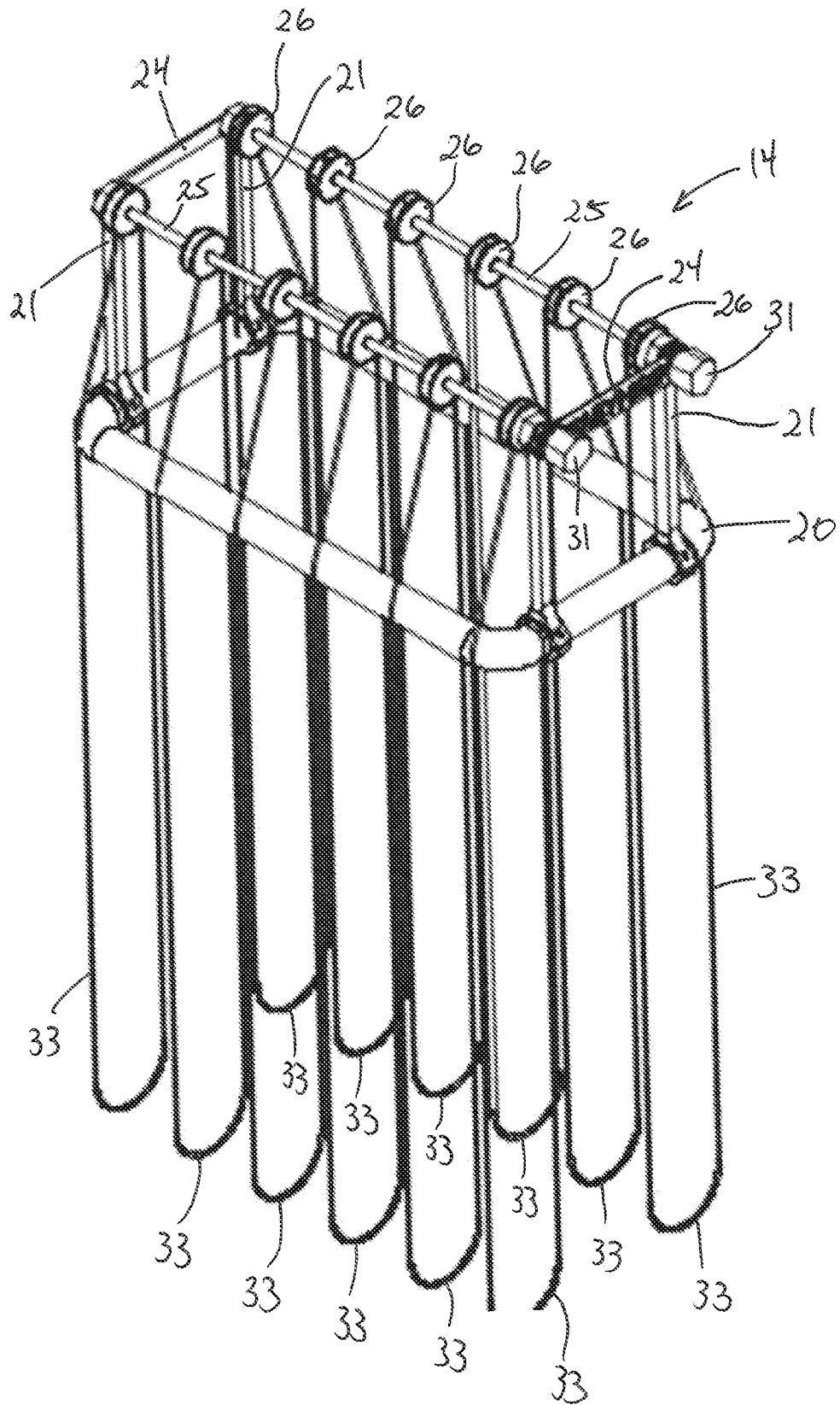
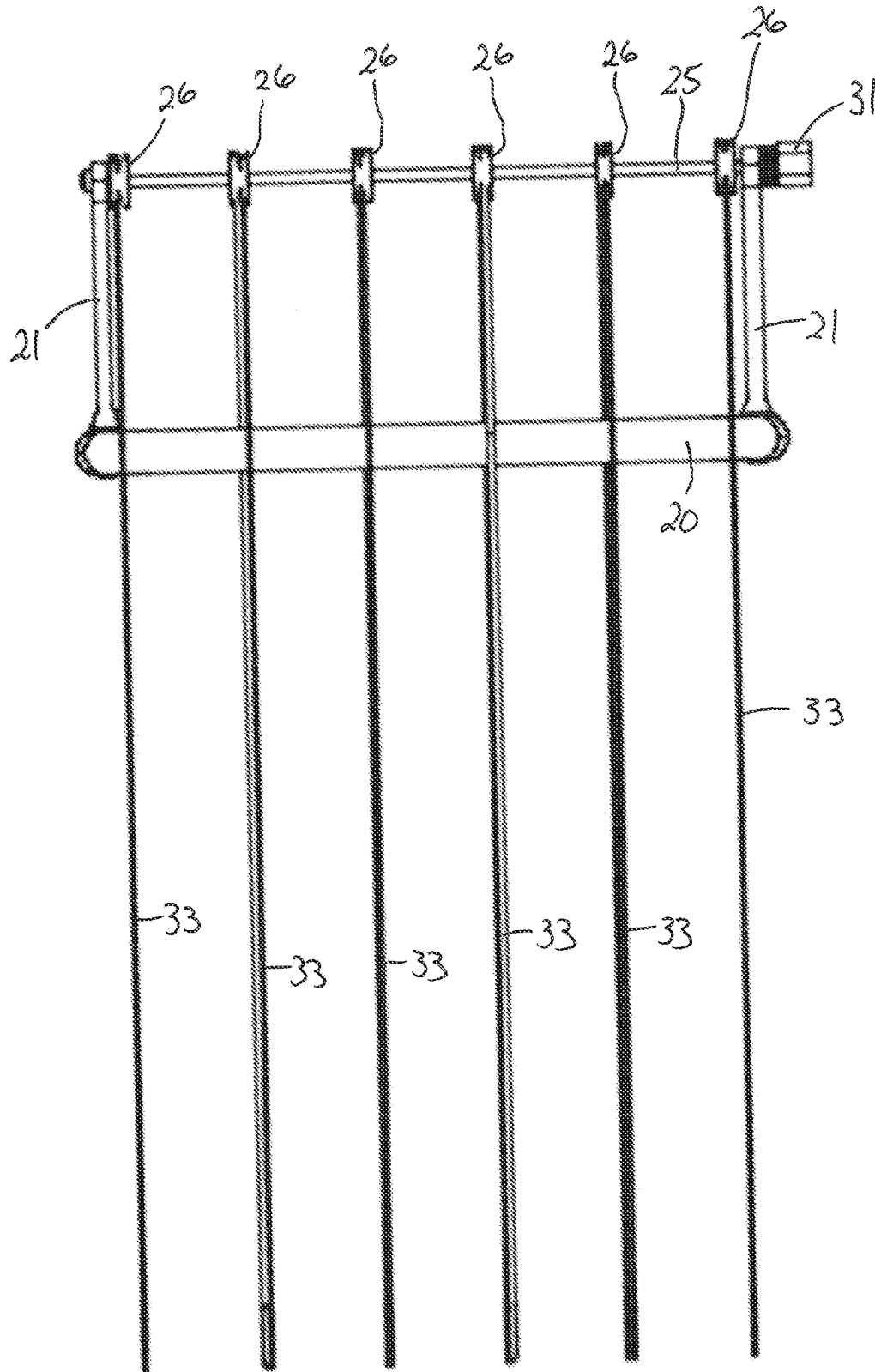
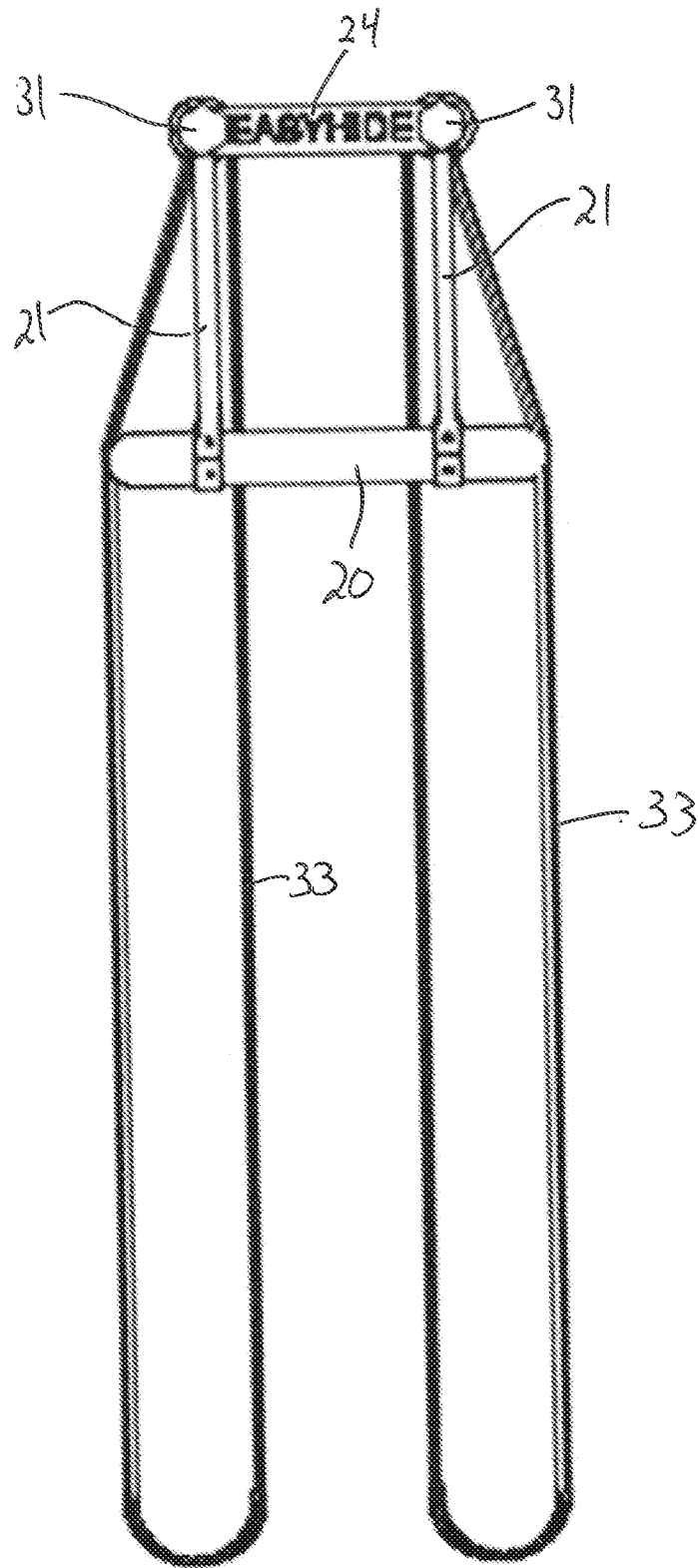


Fig. 7

**Fig. 8**

**Fig. 9**

**Fig. 10**

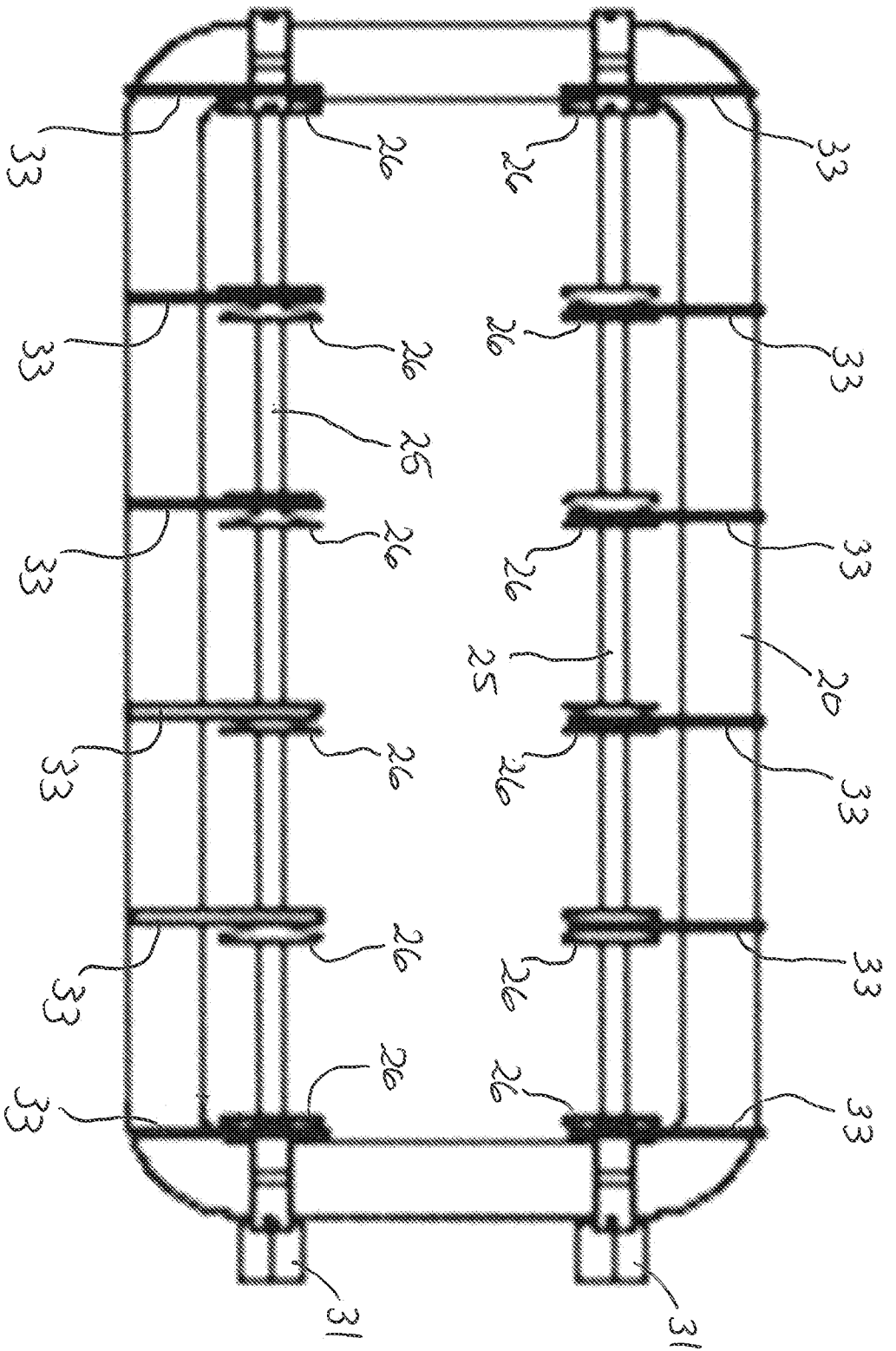


Fig. 11