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(54) Title: SHACKLE BOW AND SHACKLE

(57) Abstract: A shackle bow comprises a generally U-shaped body having a first end, a second end and aligned openings defined in the first and second ends. The body has a load bearing portion positioned between the first and second ends. The load bearing portion has a cross section comprising a bearing surface that curves through more than 180 degrees and an intersecting channel-shaped supporting surface. The channel-shaped supporting surface comprises opposing channel side portions extending from opposite sides of a channel base surface and a series of spaced apart ribs connecting the opposing channel side portions to each other.



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SHACKLE BOW AND SHACKLE

Cross Reference to Related Application

This application claims the benefit of U.S. Provisional Patent Application
5 No. 61/270,087, filed July 1, 2009, which is hereby incorporated by reference.

Field

This application relates to rigging equipment, and in particular, to load-
bearing shackles.

10

Background

Shackles are typically used to couple together rigging components and loads
to allow for lifting and/or moving of the loads. For example, shackles are frequently
used in coupling together load lifting ropes and slings. Conventional shackles may
15 cause unnecessary wear in lifting ropes and slings, and in some cases, cause slings to
become kinked. Particularly as wider slings made of synthetic materials become
more widely used, there is a need for a new shackle design that addresses the
problems with conventional shackles.

20

Summary

Described below is a new shackle bow and shackle that address some of the
problems with conventional shackles.

According to some embodiments, a new shackle bow comprises a generally
U-shaped body having a first end, a second end and aligned openings defined in the
25 first and second ends. The body has a load bearing portion positioned between the
first and second ends. The load bearing portion has a cross section comprising a
bearing surface that curves through more than 180 degrees and an intersecting
channel-shaped supporting surface. The channel-shaped supporting surface
comprises opposing channel side portions extending from opposite sides of a
30 channel base surface and a series of spaced apart ribs connecting the opposing
channel side portions to each other.

In some embodiments, at least a majority of the ribs are dimensioned not to extend beyond the channel side portions. In some embodiments, at least one rib comprises a lifting ear, and the lifting ear may project outward beyond the channel side portions. The series of spaced apart ribs can comprise, as examples, at least
5 five ribs or seven ribs.

In some embodiments, the bearing surface curves continuously through at least 210 degrees. In some embodiments, the bearing surface curves continuously through about 240 degrees.

The generally U-shaped body can be configured to define an opening
10 sufficiently large to accommodate at least two slings. The load bearing portion of the U-shaped body can be spaced from each of the first end and the second end and define a working range having an included angle of about 120 degrees. In the areas adjacent intersections between the bearing surface and the channel shaped supporting surface, the bearing surface can have a partial teardrop shape in cross
15 section to follow closely the contours of an eye of a sling.

According to some embodiments, a shackle comprises a generally U-shaped body having a first end, a second end, aligned openings defined in the first and second ends and a shackle pin connecting the ends. The body has a load bearing portion positioned between the first and second ends. The load bearing portion has a
20 cross section comprising a bearing surface that curves through more than 180 degrees and an intersecting channel-shaped supporting surface. The channel-shaped supporting surface comprises opposing channel side portions extending from opposite sides of a channel base surface and a series of spaced apart ribs connecting the opposing channel side portions to each other.

25 The radius of curvature of the bearing surface can decrease in a direction approaching intersections between the bearing surface and the channel-shaped supporting surface. The shackle can comprise an electronically readable identifier.

The foregoing and additional features and advantages of the disclosed
30 embodiments will become more apparent from the following detailed description, which proceeds with reference to the following drawings.

Brief Description of the Drawings

Fig. 1 is a front elevation view of a conventional shackle connected to a
5 single rope, which could be an in-line pull load-lifting rope or a sling.

Fig. 2 is a side sectional view in elevation of the shackle of Fig. 1, taken
along the line 2-2 of Fig. 1.

Fig. 3 is a front elevation view of a new shackle shown connected to a single
rope.

10 Fig. 4 is a side sectional view in elevation of the shackle of Fig. 3, taken
along the line 4-4.

Fig. 5 is a perspective view of the new shackle connected to a double rope or
sling and having an included angle between the connection points of about 120°.

Fig. 6 is an enlarged view of a portion of Fig. 4 showing how the new
15 shackle cross section has a greater contact area and angular range of contact with the
rope or sling and avoids sharp transitions where the rope or sling and shackle
diverge from each other.

Fig. 7 is an enlarged view comparable to Fig. 6 and showing the
conventional shackle of Figs. 1 and 2 connected to a rope or sling 12 that provides
20 only a lower angular range of contact and sharper transitions.

Fig. 8 is another perspective view of the new shackle showing the shackle
pin. Fig. 9 is another perspective view of the shackle of Fig. 8, but without the
shackle pin 18 shown and showing an RFID tag portion and lifting ears on the
shackle.

25 Fig. 10 is a front elevational view of the new shackle showing the
configuration of the ribs in dashed lines.

Fig. 11 is a side elevation view of the new shackle.

Figs. 12 and 13 are sectional views taken along the sectional lines 12-12 and
13-13, respectively, of Fig. 10.

30 Figs. 14 and 15 are additional perspective views of the new shackle.

Figs. 16, 17 and 18 are side elevation, top plan and top perspective views, respectively, of the new shackle connected to two slings extending from corners of a box load and to a rope or lifting cable for lifting the box load.

Fig. 19 is another perspective view of the new shackle similar to Fig. 18, but from a slightly different perspective.

Detailed Description

Described below are representative embodiments that are not intended to be limiting in any way. Instead, the present disclosure is directed toward novel and non-obvious features, aspects and equivalents of the shackle bow and shackle described below. The disclosed features and aspects of the embodiments can be used alone or in various novel and non-obvious combinations and sub-combinations with one another.

Referring to Figs. 3 and 4, a new shackle 14 has a large sweep angle or load bearing portion 50, as well as a contact area with an eye of a rope 16 that is large and smoothly shaped. As shown Fig. 3, the sweep angle or load bearing portion 50 extends about 120° in some embodiments, which is sufficient to prevent any kinking of the rope or sling in all normal rigging arrangements and allows for at least one second rope 18 to be accommodated with the rope 16 (Fig. 5).

As shown in Figs. 4 and 6, in viewing the cross section of the upper portion of the shackle, there is a smoothly shaped bearing surface 52 providing for contact with a rope or sling over an angle A, e.g., up to 240 degrees in some embodiments. A conventional wide body shackle 10 which is threaded through a rope or sling 12 is shown in Figs. 1 and 2. Comparing Figs. 4 and 6 to the conventional wide body shackle 10 shown in Figs. 2 and 7, it can be seen that that the bearing surface 52 of the new shackle 14 provides much greater contact area and smoother transitions at the ends of the bearing surface 52, which means the ropes and slings tend to wear and/or fray less, particularly in the case of synthetic materials, thus contributing to a longer useful life with greater load capacity than with conventional shackles.

Referring again to Fig. 3, the shackle 14 is comprised of a shackle bow 40 and a shackle pin 24 (described in further detail below). The shackle bow 40 comprises a generally U-shaped body 42 having a first end 44 and an opposed second end 46. Openings 48 (Fig. 9) in the first and second ends 44, 46 are aligned and dimensioned to receive the shackle pin 24. The load bearing portion 50 referred to above is at least a portion of the body 42 between the first and second ends 44, 46. In the illustrated embodiments, the load bearing portion 50 is spaced from the first and second ends 44, 46. The load bearing portion 50 has a cross section comprising the bearing surface 52 that curves through more than 180 degrees and a channel-shaped supporting surface 54 or trough portion that intersects the ends of the bearing surface (see, e.g., Figs. 8-15).

Referring to Figs. 12 and 13, the channel-shaped supporting surface 54 or trough portion comprises opposing channel side portions 56 that extend from opposite sides of a channel base surface 58. As best shown in Figs. 8-15, there are a series of spaced apart ribs 26 positioned generally within the load bearing portion 50 and extending laterally between the opposing channel side portions 56 to connect them to each other. These ribs 26 significantly increase the strength of the shackle structure without needlessly increasing its weight. As shown in Fig. 10, in one embodiment there are seven such ribs 26, with the center rib also being extended to serve as a lifting ear 34. In the illustrated embodiments, the positions of the first and last ribs generally correspond to the outer limits of the recommended working range and provide a user with a quick guide to correct rigging. As also shown in Fig. 10, the ribs 26 can be dimensioned to have a height lower than the adjacent channel side portions 56.

The shackle 14 can include lifting ears or tabs, such as the lifting ears 32 and 34 shown in the figures. For a shackle 14 in a large size, the lifting ears 32 and 34 provide attachment points for other rigging to lift or move the shackle into place. The lifting ears 32 and 34 are preferably smoothly shaped to prevent incidental damage to slings and ropes during use of the shackle 14.

The shackle 14 can include an electronically readable identifier 30, such as an RFID tag. The identifier 30 can provide manufacture date, serial number, use

and service history, usage directions and ratings and/or other types of information. Although not specifically shown, it is course possible to have individual component identifiers, e.g., to have an identifier for the shackle pin 24 as well as for the shackle bow 40.

5 The shackle pin 24 in the illustrated embodiments preferably has an enlarged pin head 22 at one end and a nut 20 at the other end. In some embodiments, an Acme thread is used to provide a stronger threaded connection and greater resistance to damage during use. The enlarged pin head 22 can have a wrenching flat and rounded corners where possible to minimize damage to ropes and slings during use.

10 Figs. 16-19 show various views of the shackle 14 coupled to a lifting rope 60 in the area of the shackle pin 24 and to two slings 16 which are in turn coupled to a box load 36 being lifted. As shown, the shackle 14 defines an opening sufficient to permit its use with at least two ropes.

 Although the shackle bow can be formed of any suitable material, one
15 preferred material is cast steel, such as a 4320 steel alloy. Such a cast steel has good yield and tensile strengths, ductility and toughness, even at low temperatures. The shackle pin can be fabricated from 4340 steel wrought bar steel and subjected to heat treatment. Of course, other suitable materials can be used.

 In view of the many possible embodiments to which the disclosed principles
20 may be applied, it should be recognized that the illustrated embodiments are only preferred examples and should not be taken as limiting in scope. Rather, the scope of protection is defined by the following claims. We therefore claim all that comes within the scope and spirit of these claims.

25

We claim:

1. A shackle bow, comprising:
a generally U-shaped body having a first end, a second end and aligned
5 openings defined in the first and second ends,
the body having a load bearing portion positioned between the first and
second ends, the load bearing portion having a cross section comprising a bearing
surface that curves through more than 180 degrees and an intersecting channel-
shaped supporting surface,
10 the channel-shaped supporting surface comprising opposing channel side
portions extending from opposite sides of a channel base surface, and
a series of spaced apart ribs connecting the opposing channel side portions to
each other.
- 15 2. The shackle bow of claim 1, wherein at least a majority of the ribs are
dimensioned not to extend beyond the channel side portions.
3. The shackle bow of claim 1, wherein at least one rib comprises a
lifting ear, the lifting ear projecting outward of the channel side portions.
20
4. The shackle bow of claim 1, wherein the bearing surface curves
continuously through at least 210 degrees.
5. The shackle bow of claim 1, wherein the bearing surface curves
25 continuously through about 240 degrees.
6. The shackle bow of claim 1, wherein the series of spaced apart ribs
comprises at least five ribs.
- 30 7. The shackle bow of claim 1, wherein the series of spaced apart ribs
comprises seven ribs.

8. The shackle bow of claim 1, wherein the generally U-shaped body is configured to define an opening sufficiently large to accommodate at least two slings.

5 9. The shackle bow of claim 1, wherein the load bearing portion of the U-shaped body is spaced from each of the first end and the second end and defines a working range having an included angle of about 120 degrees.

10 10. The shackle bow of claim 1, wherein adjacent intersections between the bearing surface and the channel shaped supporting surface, the bearing surface has a partial teardrop shape in cross section to follow closely the contours of an eye of a sling.

11. A shackle, comprising:
15 a bow comprising a generally U-shaped body having a first end, a second end and aligned openings defined in the first and second ends,
the body having a load bearing portion positioned between the first and second ends, the load bearing portion having a cross section comprising a bearing surface that curves through more than 180 degrees and an intersecting channel-
20 shaped supporting surface,
the channel-shaped supporting surface comprising opposing channel side portions extending from opposite sides of a channel base surface,
a series of spaced apart ribs connecting the opposing channel side portions to each other, and
25 a shackle pin sized to connect the first and second ends.

12. The shackle of claim 11, wherein at least a majority of the ribs are dimensioned not to extend beyond the channel side portions.

30 13. The shackle of claim 11, wherein at least one rib comprises a lifting ear, the lifting ear projecting outward of the channel side portions.

14. The shackle of claim 11, wherein the bearing surface curves continuously through at least 210 degrees.

5 15. The shackle of claim 11, wherein the bearing surface curves continuously through about 240 degrees.

16. The shackle of claim 11, wherein the series of spaced apart ribs comprises at least five ribs.

10

17. The shackle of claim 11, wherein the generally U-shaped body is configured to define an opening sufficiently large to accommodate at least two slings.

15 18. The shackle of claim 11, wherein the load bearing portion of the U-shaped body is spaced from each of the first end and the second end and defines a working range having an included angle of about 120 degrees.

19. The shackle of claim 11, further comprising an electronically
20 readable identifier.

20. The shackle of claim 11, wherein the radius of curvature of the bearing surface decreases approaching intersections between the bearing surface and the channel-shaped supporting surface.

25

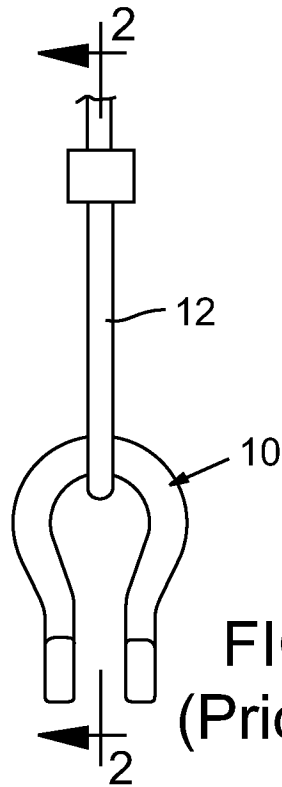


FIG. 1
(Prior Art)

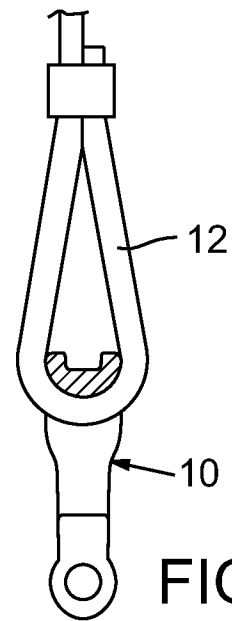


FIG. 2
(Prior Art)

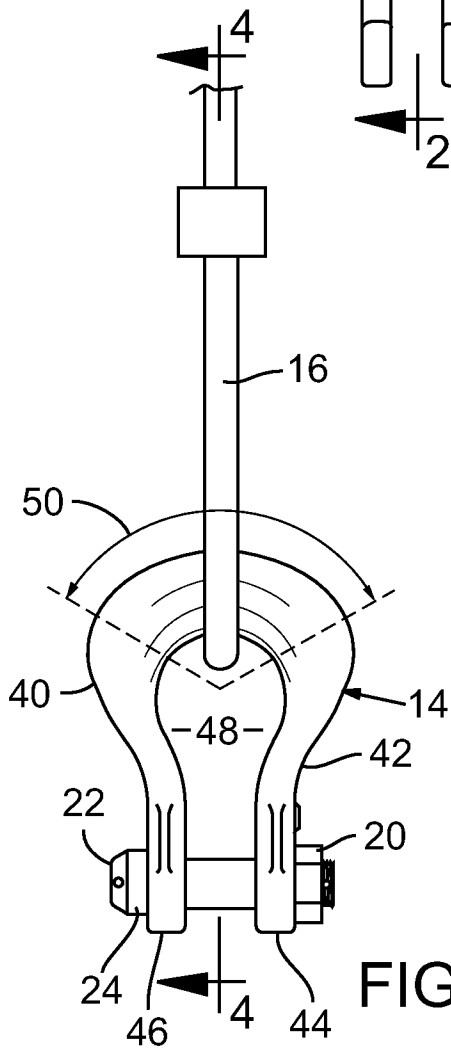


FIG. 3

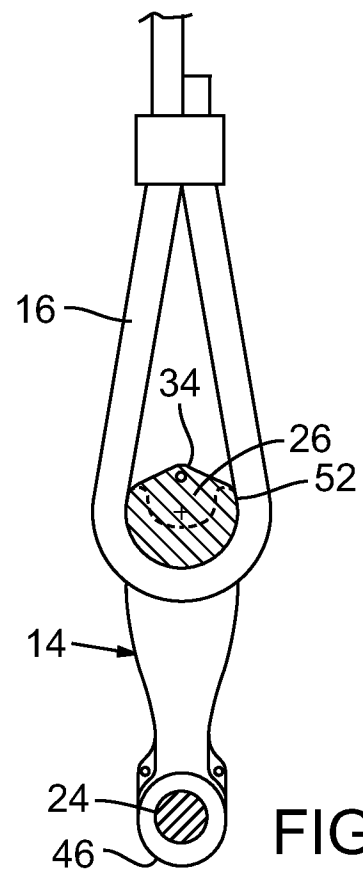


FIG. 4

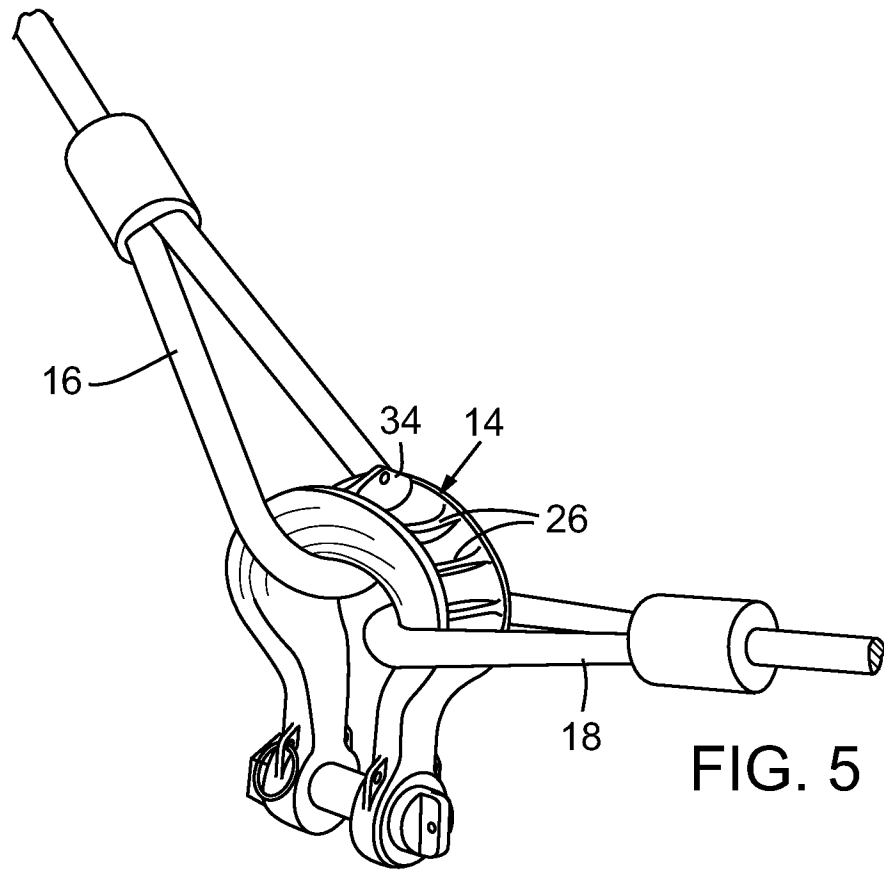


FIG. 5

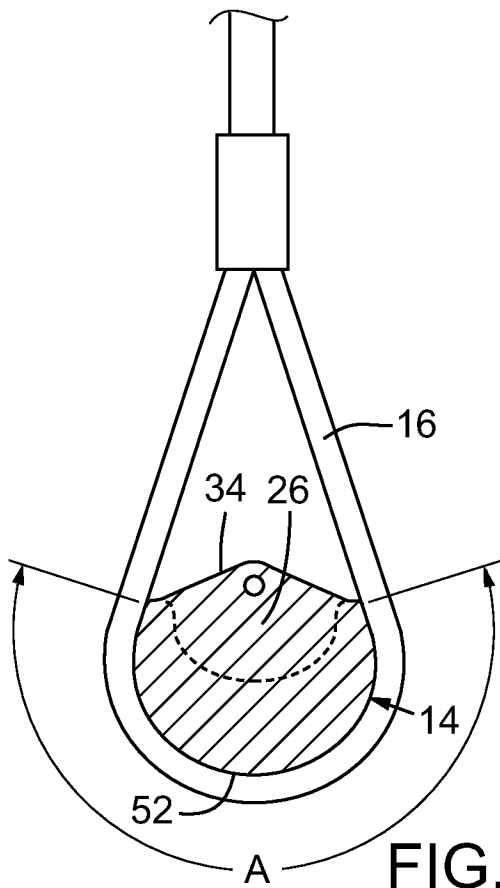


FIG. 6

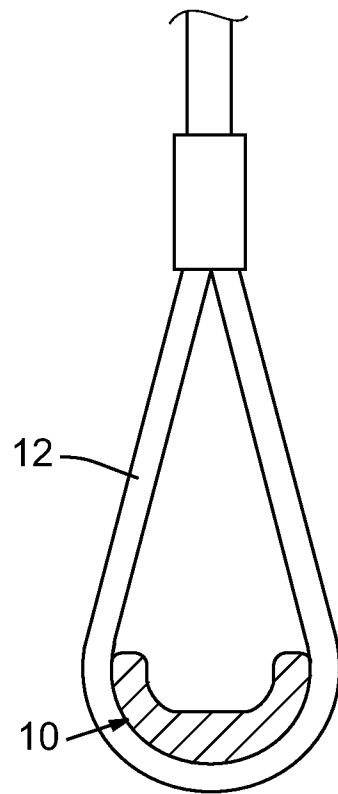


FIG. 7
(Prior Art)

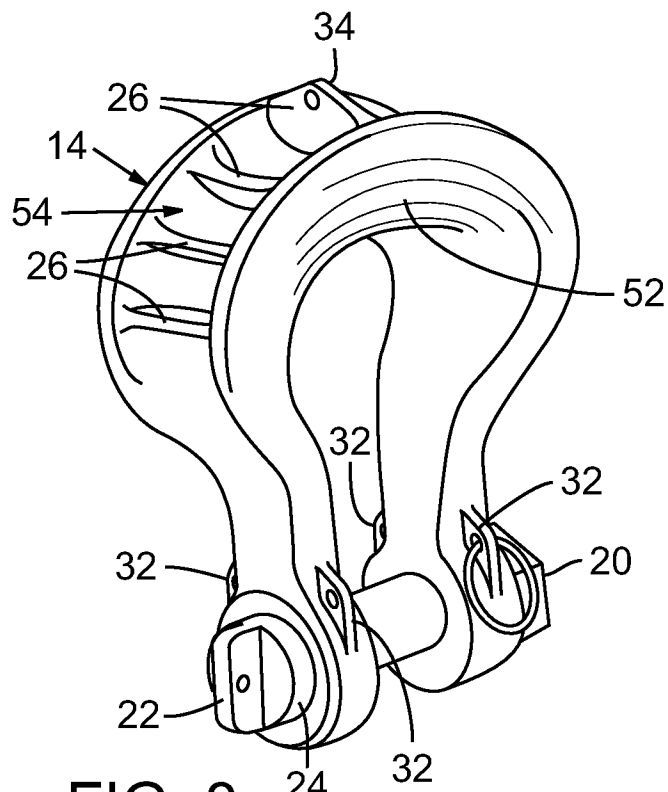


FIG. 8

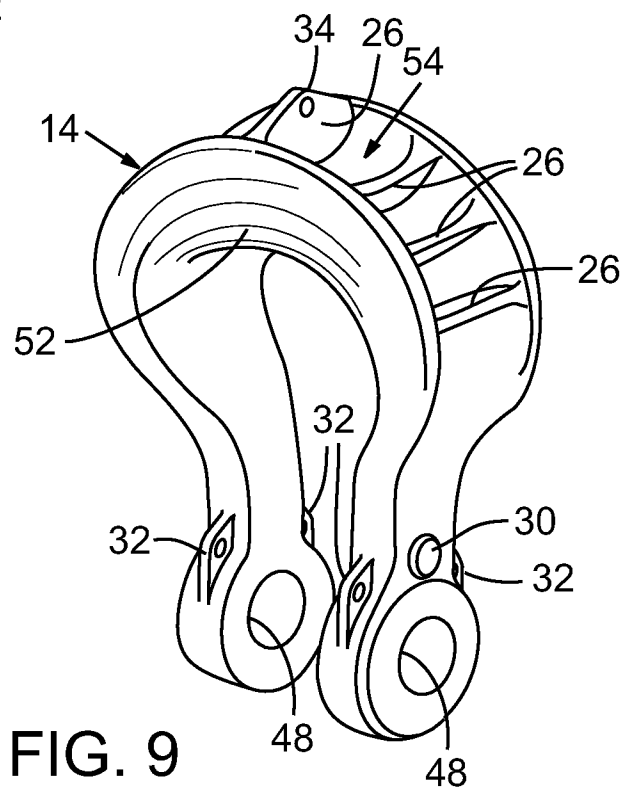
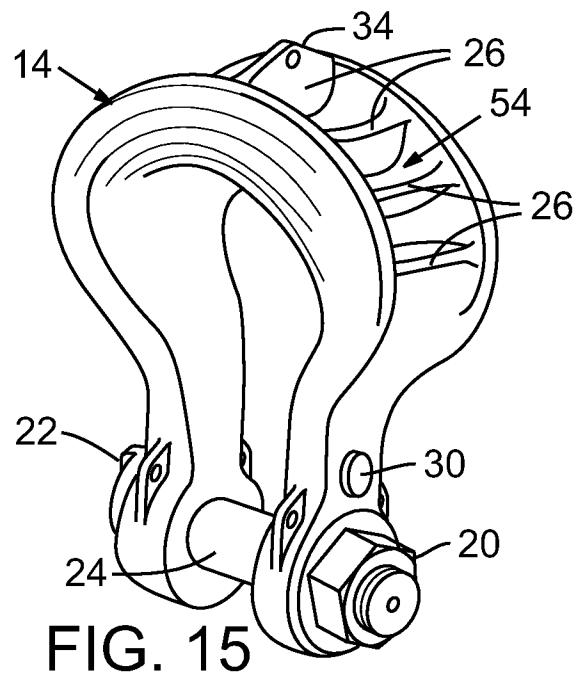
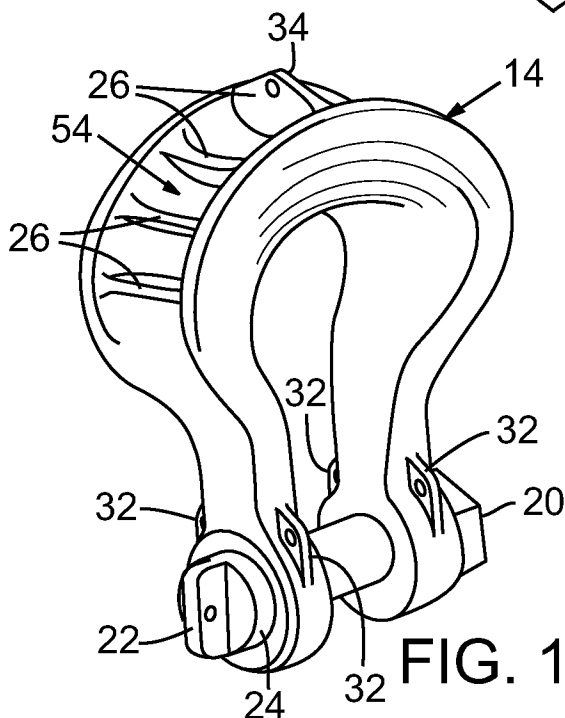
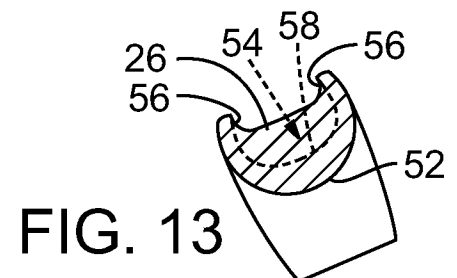
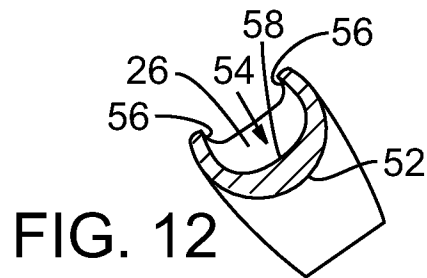
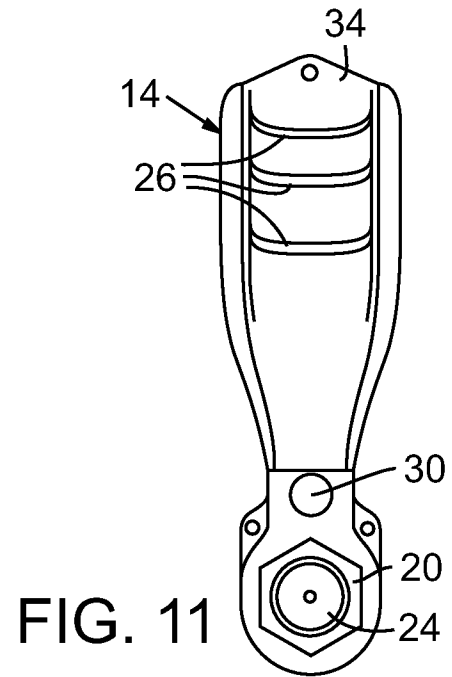
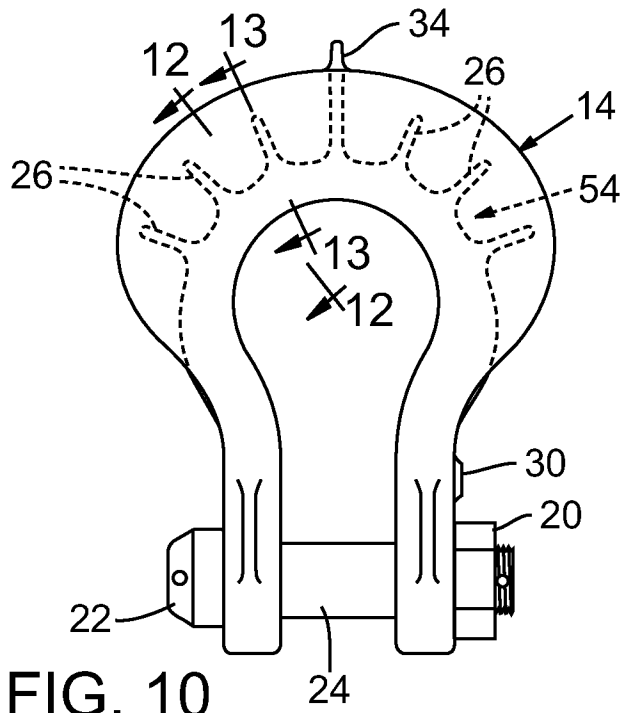


FIG. 9



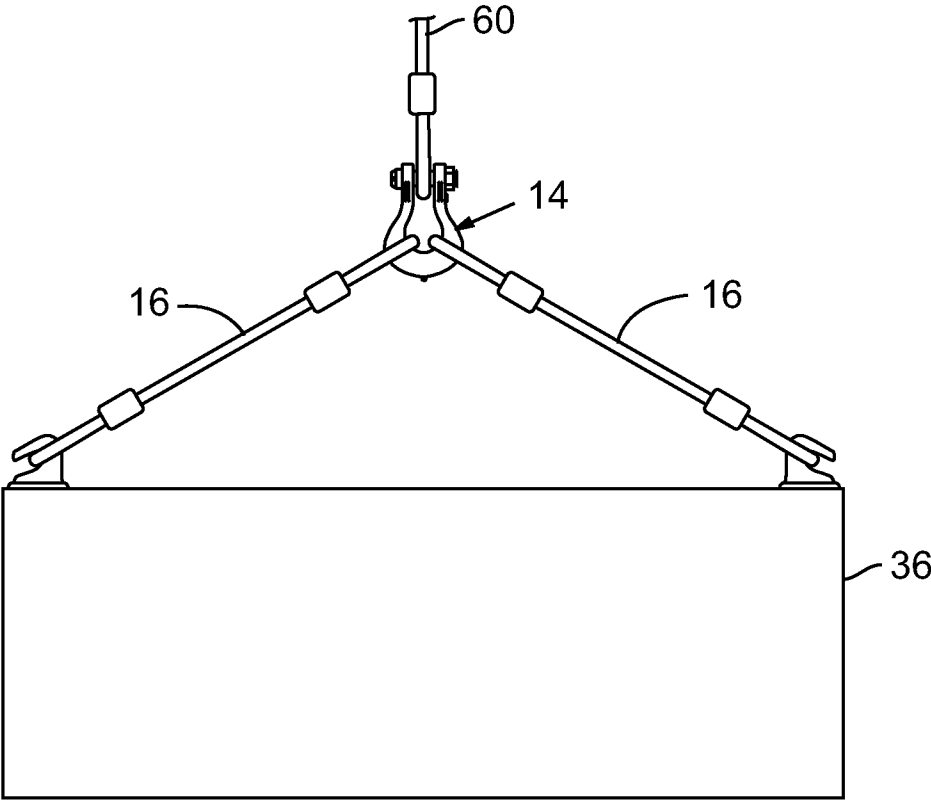


FIG. 16

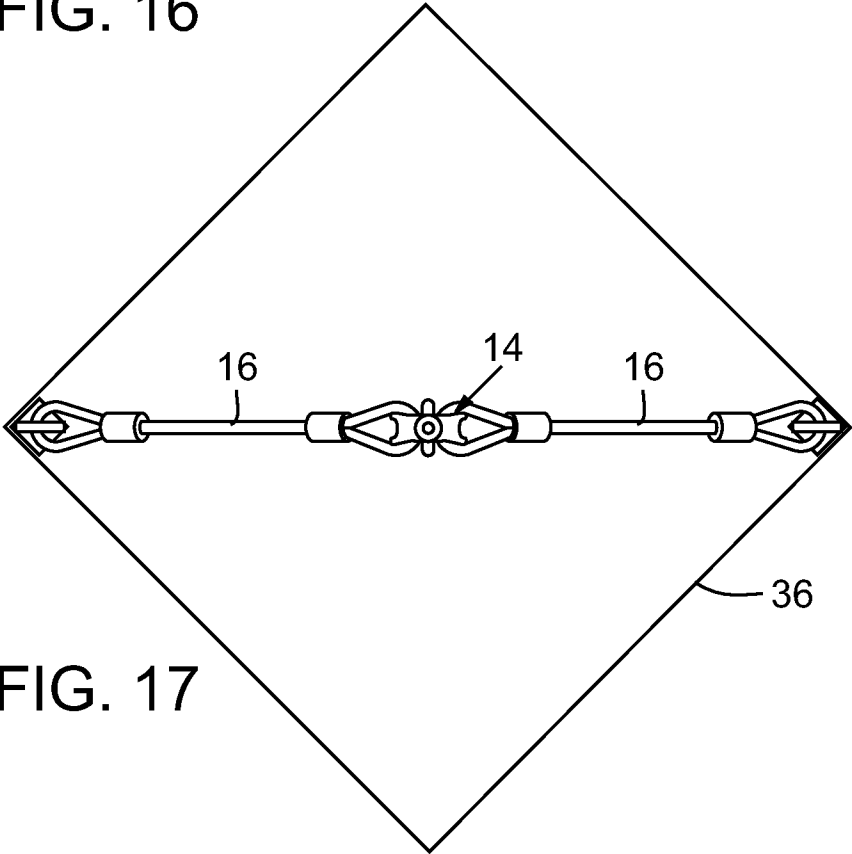


FIG. 17

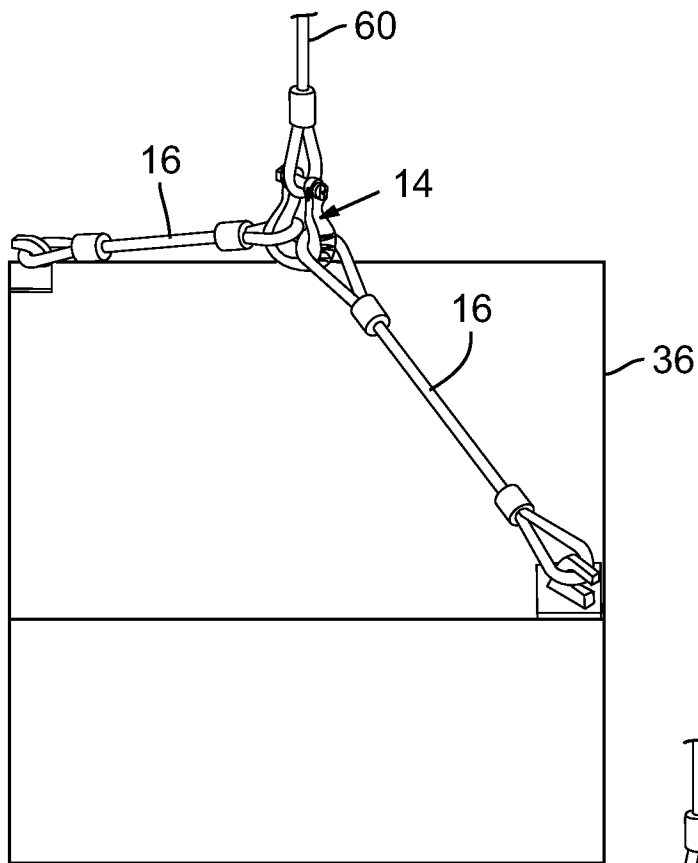


FIG. 18

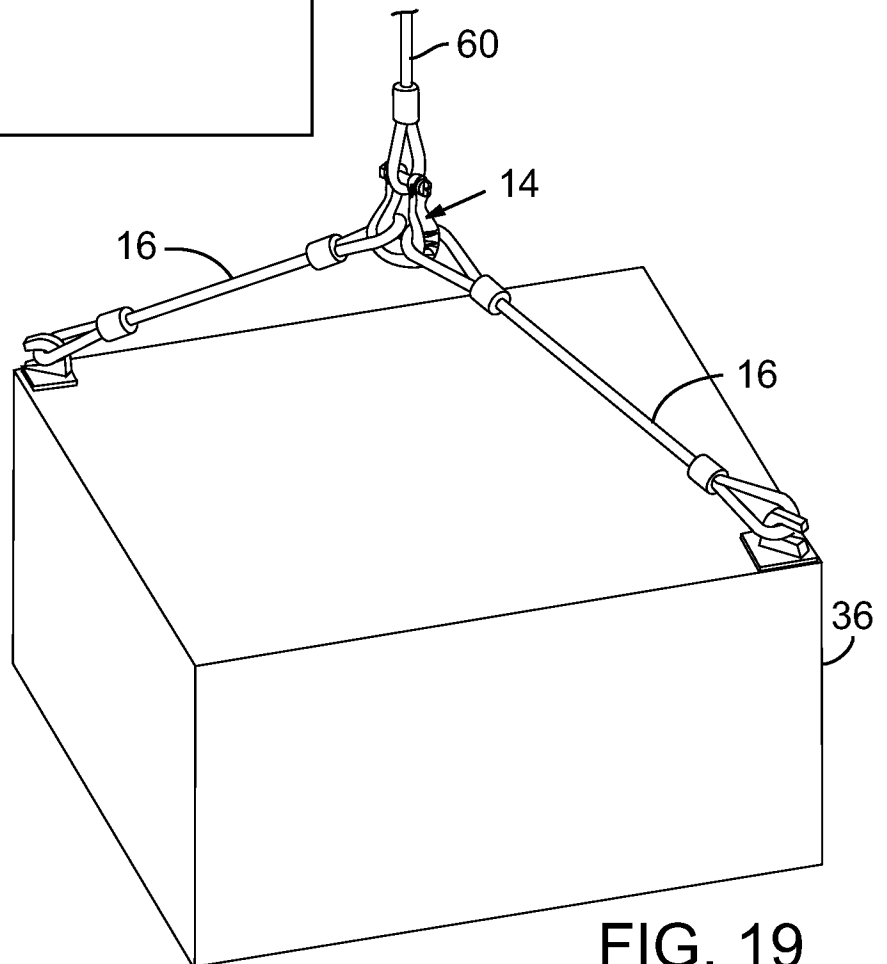


FIG. 19