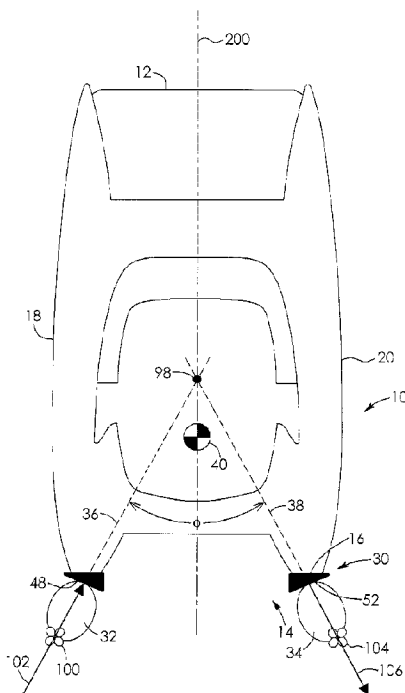




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(54) Titre : ENSEMBLE DE FIXATION POUR POSITIONNER DES UNITES DE PROPULSION MONTEES SUR L'ARRIERE AVEC UNE CONVERGENCE A L'AVANT
(54) Title: MOUNTING ASSEMBLY FOR POSITIONING STERN-MOUNTED PROPULSION UNITS WITH A FORWARD CONVERGENCE



(57) **Abrégé/Abstract:**

There is provided a mounting assembly for a marine vessel having a pair of stern-mounted propulsion units. The assembly includes a pair of angle-setting members which forwardly angle the propulsion units towards a bow of the marine vessel when each propulsion unit is at the center of its total steering range. Each propulsion unit has a line of action of its propulsion force. The lines of action of the propulsion units intersect each other between a center of rotation of the marine vessel and a stern of the marine vessel when the propulsion units are steered forwardly towards each other.

ABSTRACT OF THE DISCLOSURE

There is provided a mounting assembly for a marine vessel having a pair of stern-mounted propulsion units. The assembly includes a pair of angle-setting members which forwardly angle the propulsion units towards a bow of the marine vessel when each propulsion unit is at the center of its total steering range. Each propulsion unit has a line of action of its propulsion force. The lines of action of the propulsion units intersect each other between a center of rotation of the marine vessel and a stern of the marine vessel when the propulsion units are steered forwardly towards each other.

at a point on a centerline of the marine vessel and, when no rotational movement is commanded, at the center of gravity of the marine vessel. Internal combustion engines are provided to drive the marine propulsion devices. The steering axes of the two marine propulsion devices are generally vertical and parallel to each other. The two steering axes
5 extend through a bottom surface of the hull of the marine vessel.

BRIEF SUMMARY OF INVENTION

[0004] There is provided a mounting assembly for a marine vessel having a bow, a stern, a center of rotation and a pair of stern-mounted propulsion units, each propulsion
10 unit having a total steering range. The assembly comprises a pair of angle-setting members which forwardly angle the propulsion units towards the bow of the marine vessel when each propulsion unit is at the center of the total steering range. Each propulsion unit may have a line of action of its propulsion force. The lines of action of the propulsion units may intersect each other between the center of rotation of the marine
15 vessel and the stern of the marine vessel when the propulsion units are steered forwardly towards each other. The marine vessel may be a twin-hulled vessel.

[0005] The marine vessel may have a longitudinal axis. The angle-setting members may angle the propulsion units inwardly and forwardly in the range of greater than 0 degrees and less than 30 degrees relative to the longitudinal axis of the marine vessel.
20 The angle-setting members may angle the propulsion units inwardly and forwardly in the range of 5 to 10 degrees relative to the longitudinal axis of the marine vessel. The angle-setting members may angle the propulsion units inwardly and forwardly by 6 degrees relative to the longitudinal axis of the marine vessel. Each of the angle-setting members may comprise an inwardly biased tiller arm. Propeller axes of the propulsion units may
25 be forwardly convergent relative to the tiller arms when the tiller arms align parallel with the longitudinal axis of the marine vessel.

[0006] The angle-setting members may be wedge-shaped. Each angle-setting member may have a thin end and a thick end. The thick ends of the angle-setting members may be

positioned to face each other. There may be a pair of stern brackets which are operatively connected to respective ones of the propulsion units. The angle-setting members may be connected to the stern brackets. The angle-setting members may be integrally connected to and integrally formed with the stern brackets.

5 **[0007]** The marine vessel may have a transom. There may be a pair of stern brackets operatively connected to respective ones of the propulsion units. The angle-setting members may be connected to the stern brackets. The angle-setting members may be interposed between the stern brackets and the transom. Each angle-setting member may have a pair of spaced-apart apertures. There may be a plurality of fasteners. Each of the fasteners may extend through a
10 respective one of the apertures. The fasteners may connect the stern brackets, the angle-setting members and the transom together. The angle-setting members may comprise angled portions of the transom. Each angle-setting member may comprise an angled stern bracket that connects to the transom.

15 **[0008]** There is also provided a mounting assembly for a marine vessel having a pair of stern-mounted propulsion units with a total steering range. The assembly comprises a pair of stops which allow the propulsion units to steer to a maximum steering range. The maximum steering range is one half of the total steering range plus an angle β on a first side and one half of the total steering range less the angle β on a second side.

20 **[0008a]** There is also provided a mounting assembly for positioning stern-mounted propulsion units for a marine vessel, the marine vessel having a bow, a stern, a longitudinal center line, a center of rotation, a first stern-mounted propulsion unit and a second stern-mounted propulsion unit, the propulsion units each having a steering range with a center and the assembly comprising: a pair of stern brackets, each connected to a respective one of the propulsion units and a pair of angle-setting members, each of the angle-setting members forwardly angles a
25 respective one of the propulsion units towards the bow of the marine vessel and the longitudinal center line when each propulsion unit is at the center of the steering range, wherein each of the propulsion units has a line of action of propulsion force and the lines of action of the propulsion

units intersecting each other between the center of rotation and the stern of the marine vessel when the propulsion units are forwardly steered towards each other, said first propulsion unit having a forwardly directed propulsion force and said second propulsion unit having a rearwardly directed propulsion force.

5 **[0008b]** There is also provided a marine vessel, comprising: a first propulsion unit at a stern of the marine vessel, the first propulsion unit operable to exert on the marine vessel a first propulsion force along a first line of action, the first propulsion unit having a first steering range relative to the marine vessel, wherein when the first propulsion unit is positioned at a center of the first steering range and exerts the first propulsion force on the marine vessel, the first
10 propulsion force has a first lateral component that is lateral relative to the marine vessel; and a second propulsion unit at the stern of the marine vessel, the second propulsion unit operable to exert on the marine vessel a second propulsion force along a second line of action, the second propulsion unit having a second steering range relative to the marine vessel, wherein when the
15 second propulsion unit is positioned at a center of the second steering range and exerts the second propulsion force on the marine vessel, the second propulsion force has a second lateral component that is lateral relative to the marine vessel; wherein the first and second propulsion units are positionable during operation of the marine vessel such that the first line of action intersects the second line of action along a longitudinal centerline of the marine vessel.

BRIEF DESCRIPTION OF DRAWINGS

20 **[0009]** The invention will be more readily understood from the following description of preferred embodiments thereof given, by way of example only, with reference to the accompanying drawings, in which:

25 **[0010]** Figure 1 is a simplified, top plan schematic view of a marine vessel having a pair of outboard engines and a mounting assembly therefor according to one aspect, the engines being positioned in the center of their steering ranges;

[0011] Figure 2 is a simplified, top plan schematic view of the marine vessel of Figure 1, the engines being steered towards each other at a maximum steering angle so that they fully forwardly converge towards each other;

5 [0012] Figure 3 is a front, side perspective view of a stern bracket and a pair of spaced-apart angle-setting members connected thereto, the angle-setting members being part of the mounting assembly of Figure 1;

[0013] Figure 4 is a top plan view of part of the mounting assembly of Figure 1 connected to a transom of the vessel of Figure 1, the transom being shown in fragment, the mounting assembly showing an angle-setting member and a pair of washers;

10 [0014] Figure 5 is a rear, elevational view of a washer of the mounting assembly of Figure 4;

[0015] Figure 6 is a side view of the washer of Figure 5;

15 [0016] Figure 7 is a simplified top plan schematic view of the vessel of Figure 2 showing a port engine generating a forward propulsion force and a starboard engine generating a rearward propulsion force, lines of action of the propulsion forces of the engines intersecting forward of a center of rotation of the vessel;

20 [0017] Figure 8 is a simplified top plan schematic view of the vessel of Figure 2 showing the port engine generating a forward propulsion force and the starboard engine generating a rearward propulsion force, lines of action of the propulsion forces of the engines intersecting at the center of rotation of the vessel;

[0018] Figure 9 is a simplified top plan schematic view of the vessel of Figure 2 showing the port engine generating a forward propulsion force and the starboard engine

generating a rearward propulsion force, lines of action of the propulsion forces of the engines intersecting rearward of the center of rotation of the vessel;

[0019] Figure 10 is a simplified, top plan schematic view of the vessel of Figure 1, with the engines being shown at the centers of their steering ranges and each engine
5 generating a forward propulsion force;

[0020] Figure 11 is a simplified, top plan schematic view of the vessel of Figure 1 showing the vessel performing a turning operation;

[0021] Figure 12 is a front, side perspective view of a mounting assembly for a marine vessel according to a second aspect, the assembly having angle-setting members
10 integrally connected to and integrally formed with the stern bracket;

[0022] Figure 13 is a simplified, top plan schematic view of a marine vessel and mounting assembly according to a third aspect, the mounting assembly having angle-setting members in the form of outwardly angled portions of a transom;

[0023] Figure 14 is a simplified, top plan schematic view of a marine vessel having a pair of outboard engines, the vessel being shown in fragment, and a mounting assembly
15 therefor according to a fourth aspect, the assembly having inwardly-biased tillers;

[0024] Figure 15 is a simplified, top plan schematic view of the marine vessel and mounting assembly of Figure 14, the engines being steered towards each other at a maximum steering angle so that they fully forwardly converge towards each other;

[0025] Figure 16 is a simplified, top plan view of an outboard engine together with a mounting assembly according to a fifth aspect, the assembly having a pair of angle-setting members in the form of spaced-apart engine stops; and
20

[0026] Figure 17 is a simplified, top plan view of the engine and assembly of Figure 16, the engine being fully turned in a hard over direction.

DESCRIPTIONS OF THE PREFERRED EMBODIMENTS

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[0027] Referring to the drawings and first to Figure 1, there is shown a mounting assembly 30 for a marine vessel 10. The vessel 10 has a bow 12, a stern 14 which is spaced-apart from the bow, a transom 16 located at the stern, a port side 18 and a starboard side 20 which is spaced-apart from the port side. The sides 18 and 20 of the vessel 10 extend from the stern 14 to the bow 12. The sides 18 and 20 of the vessel 10 are further spaced-apart in this example compared to a more conventional, narrower beamed vessel. Alternatively, the vessel 10 may be stern heavy compared to a conventional vessel. The vessel 10 has a longitudinal axis or centerline 200 which extends from the stern 14 to the bow 12 and which is situated between the sides 18 and 20 of the vessel. The vessel 10 has a lateral axis 210 that extends perpendicular to the centerline 200 from the side 18 to the side 20.

[0028] The vessel 10 has a plurality of engines, in this example a pair of engines in the form of a port engine 32 located adjacent to the port side 18 and a starboard engine 34 located adjacent to the starboard side 20. The engines 32 and 34 have propeller axes 36 and 38, respectively, as seen in Figure 1, which correspond to the lines of action of their propulsion forces. As seen in Figures 7 to 9, the vessel 10 has a center of rotation 40, which may correspond to the center of gravity of the vessel in its static state. It is possible to apply the improvement to vessels that have three engines, where the outer two engines are far apart from each other. Angling the outer engines in a manner similar to the two engine embodiment illustrated herein can achieve a similar result. This description focuses on illustrating the improvement with two engines.

[0029] Referring back to Figure 1, the mounting assembly 30 has a pair of stern brackets 42 and 44 which are operatively connected to the outboard engines 32 and 34,

respectively. One of the stern brackets 42 is shown in greater detail in Figure 3. The stern bracket 42 has a connector portion 46 facing the transom 16 of the vessel 10, shown in Figure 1. The outboard engines and stern brackets in this embodiment are conventional, with parts and functionings well known to those skilled in the art, and therefore will not be described in further detail.

[0030] The mounting assembly 30 includes a plurality of angle-setting members, in this example a pair of spaced-apart members for each engine, as shown by members 48 and 50 for the engine 32 in Figure 3. Only upper members 48 and 52 for the respective engines 32 and 34 are seen in Figure 1. The angle-setting members are configured to position the engines 32 and 34 with a slight forward convergence that is angled towards the centerline 200 when the engines are at the center of their steering ranges, thus altering the steering angles of the engines relative to the centerline of the vessel.

[0031] Each angle-setting member is wedge-shaped in this example, with a thin end and a thick end that is thicker than the thin end. This is shown in Figure 1 by thin ends 54 and 56 and thick ends 58 and 60 for the members 48 and 52, respectively. The thin ends 54 and 56 of the angle-setting members are positioned adjacent to respective sides 18 or 20 of the vessel 10. The thick ends 58 and 60 of the angle-setting members are positioned to face each other.

[0032] As seen in Figure 4, the angle-setting member 48 has a pair of spaced-apart apertures 62 and 64, in this example, extending therethrough adjacent to its ends 54 and 58, respectively. The angle-setting member 48 in this example has an outer face 66, which extends between and is perpendicular to the ends 54 and 58, and an inner face 68 which is spaced-apart from the outer face. The inner face 68 extends between the ends 54 and 58 at a non-perpendicular angle with respect to the ends in this example although this is not essential. As seen in Figure 1, the angle-setting members 48 and 52 are interposed between the stern brackets 42 and 44 and the transom 16 in this example, with the inner face 68 of the angle-setting member 48 abutting an outer surface 70 of the transom as

seen in Figure 4. The outer face 66 of the angle-setting member 48 abuts the connector portion 46 of the bracket 42 as shown in Figure 3.

[0033] As seen in Figures 4 to 6, the angle-setting member 48 includes a pair of wedge-shaped washers 74 and 76. Each washer has a thin end, a thick end which is thicker than the thin end, and a central aperture extending therethrough, as shown by thin end 78, thick end 80 and aperture 82 for the washer 76 in Figure 4. The aperture 82 of the washer 76 aligns with the aperture 64 of the angle-setting member 48 and an aperture 84 of the washer 74 aligns with the aperture 62 of the angle-setting member 48. The washer 76 in this example has a first face 86, which extends between and is perpendicular to the ends 78 and 80, and a second face 88 which is spaced-apart from the first face. The face 88 extends between the ends 54 and 58 of the angle-setting member 48 at a non-perpendicular angle with respect to the ends in this example and abuts an inner surface 72 of the transom 16. The transom has a pair of spaced-apart apertures 90 and 92 extending therethrough for the angle-setting member 48 in this example. The washer 76 and the angle-setting member 48 are shaped such that the face 66 of the member 88 and the face 86 of the washer 76 extend substantially parallel to each other when the washer and the angle-setting member abut the transom 16. However, the exact shape of the washer is not essential. The washer 74 is similar in structure and function to the washer 76 and is accordingly not described in detail herein.

[0034] As seen in Figure 3, the mounting assembly 30 includes a plurality of fasteners, in this example a pair of bolts 94 and 96 for the angle-setting member 48. The bolts extend through the bracket 42, the apertures 62 and 64 of the angle-setting member 48, the apertures 90 and 92 of the transom 16 and the apertures 84 and 82 of the washers 74 and 76, and connect the bracket 42 to the transom 16. As seen in Figure 1, the angle-setting members 48 and 52 thus connect to the stern brackets 42 and 44.

[0035] Referring to Figure 1, the angle-setting member 48 causes the propeller axis 36 of the port engine 32 to angle towards the starboard side 20 of the vessel 10 when the port engine 32 is at the center of its steering range as illustrated. Likewise, the angle-setting member 52 causes the

propeller axis 38 of the starboard engine 34 to angle towards the port side 18 when the starboard engine 34 is at the center of its steering range. According to one embodiment, each propeller axis is inwardly and forwardly angled towards the centerline 200 at an angle β relative to the centerline when the engines 32 and 34 are positioned to the midpoint or center of their steering ranges. As a result, when the engine 32 (a first propulsion unit at the stern 14 of the marine vessel 10) is positioned at the center of its steering range as shown in Figure 1, the port engine 32 is positioned to exert, on the marine vessel 10, a first propulsion force 33 having a first lateral component 35 that is lateral relative to the marine vessel 10 and a first longitudinal component 37 that is longitudinal and forward relative to the marine vessel 10, and when the starboard engine 34 (a second propulsion unit at the stern 14 of the marine vessel 10) is positioned at the center of its steering range as shown in Figure 1, the starboard engine 34 is positioned to exert, on the marine vessel 10, a second propulsion force 39 having a second lateral component 41 that is lateral relative to the marine vessel 10 and a second longitudinal component 43 that is longitudinal and forward relative to the marine vessel 10. The first lateral component 35 is towards the starboard side 20, and the second lateral component 41 is towards the port side 18. In this case and referring to Figure 4, the outer face 66 of the angle-setting member 48 is also angularly spaced-apart from the lateral axis 210 of the vessel 10 and the inner face 68 of the angle-setting member 48 by angle β . It is practical to arrange both port and starboard angle β to be the same or symmetrical with respect to the centerline. The faces 86 and 88 of the washer 76 are also at angle β with respect to each other in this example.

[0036] According to one aspect, angle β is an angle within the range of 1 to 30 degrees. According to another aspect, angle β is an angle within the range of 5 to 15 degrees. According to a further aspect seen in Figures 1 and 2, angle β is substantially equal to 6 degrees, although other angles are possible. In this case and as seen in Figure 2, when the engines 32 and 34 are steered to fully forwardly converge towards each other at the ends of their steering ranges, the angle of separation ϕ between the axes 36 and 38 is equal to 72 degrees. This is in contrast to a conventional engine arrangement where the angle of separation would typically only be 60 degrees. Due to physical limitations, each engine has a total steering range. The embodiments described above allow the total steering range to be maintained while having a biased steering

range for the port side versus the starboard side. In general, one side has a steering range from center of $(total_steering_range/2+\beta)$. The opposite side has a steering range from center of $(total_steering_range/2-\beta)$.

5 **[0037]** Other angles may be used depending on the geometry of the vessel. For example, angle β may be equal to 12 degrees in another example. In this example, the steering range of the port engine extends within the range of 42 degrees to port and 18 degrees to starboard. The steering range of the starboard engine in this example extends within the range of 18 degrees to port and 42 degrees to starboard.

10 **[0038]** The propeller axes 36 and 38 of the engines 32 and 34 intersect at a point of intersection 98 along the centerline 200 of the vessel 10, as seen in Figure 9, when the engines are fully steered towards the centerline. The angle-setting members 48 and 52 enable the point of intersection 98 to be further rearward towards the stern 14 of the vessel 10 compared to a conventional, wide-berthed or stern-heavy vessel. According to one aspect, the angle-setting members 48 and 52 are configured so that the point of intersection 98 is at or aft of the center of rotation 40. Thus, the angle-setting members 48 and 52 allow the point of intersection 98 to be
15 aft of the center of gravity (or rotation) of the vessel 10. Positioning the point of intersection 98 rearward of the center of rotation 40 allows the vessel 10 to have counter-clockwise rotational adjustment while moving sideways, pure sideways movement and clockwise rotational adjustment while moving sideways.

20 **[0039]** In order to achieve pure sideways movement, a forward-moving propeller 100 of a first one of the engines, in this example port engine 32, has a line of action 102 with a forward (or first) propulsion force as seen in Figure 8. The forward (or first) propulsion force along the line of action 102 has a first lateral component 101 that is lateral relative to the marine vessel 10 and a forward (or first) longitudinal component 103 that is longitudinal and forward relative to
25 the marine vessel 10. A reverse-moving propeller 104 of a second one of the engines, in this example starboard engine 34, has a line of action 106 with a rearward (or second) propulsion force. The rearward (or second) propulsion force along the line of action 106 has a second lateral

component 105 that is lateral relative to the marine vessel 10 and a rearward (or second) longitudinal component 107 that is longitudinal and rearward relative to the marine vessel 10. Since the longitudinal components 103 and 107 of the two propulsion vectors, in this example the forward longitudinal component 103 of the forward propulsion force and the rearward longitudinal component 107 of the rearward propulsion force, are equal and opposite, the longitudinal components 103 and 107 cancel each other. The biased steering range created by the angle-setting members 48 and 52 allows the engine propellers 100 and 104 to be steered further towards each other. The angle-setting members 48 and 52 thus enable alignment of the point of intersection 98 with the center of rotation 40 as shown in Figure 8. When the point of intersection 98 is at the center of rotation 40, the propulsion force 102 of the port engine 32 will not create a rotational moment on the vessel 10. Likewise, the propulsion force 106 of the starboard engine 34 will not create a rotational moment on the vessel 10. Since the longitudinal components 103 and 107 of the two propulsion vectors cancel each other, the lateral components 101 and 105 of the two propulsion vectors are summed to provide a pure sideways movement towards starboard from the point of view of Figure 8. Thus,

with the balanced values of steering angles, propulsion forces and moments, the vessel 10 may move purely sideways.

[0040] The biased steering range created by the angle-setting members 48 and 52 alternatively or additionally allows heading corrections during sideways movement. For example, as shown in Figure 9, when the engine propellers 100 and 104 are steered fully towards each other so the point of intersection 98 is rearward of the center of rotation 40, the propulsion forces create a counter-clockwise rotation to the vessel 10 while moving sideways to starboard. Conversely, when the engine propellers 100 and 104 are steered towards each other so that the point of intersection 98 is forward of the center of rotation 40, as shown in Figure 7, the propulsion forces create a clockwise rotation to the vessel while moving sideways to starboard. The biased steering range created by the angle-setting members 48 and 52 accordingly allows the vessel to have clockwise rotational adjustment and counter-clockwise rotational adjustment while moving sideways to starboard. Similarly, the biased steering range also allows the vessel to have clockwise rotational adjustment, counter-clockwise rotational adjustment and pure sideways movement while moving sideways to port.

[0041] Both clockwise rotational adjustment and counter-clockwise rotational adjustment while moving sideways are important in practice. External forces such as wind and current may cause the vessel to rotate unintentionally. Allowing the steering angles to be adjusted slightly provides a smooth maneuver as opposed to shifting gears and steering rudders with large angles. For vessel command functionality, it is desirable that the engines point towards the center of rotation 40, or what is generally referred to as the vessel's center of gravity. It is also desirable that the engine angle should not be at its maximum while pointing towards this center and the angle-setting members as herein described facilitate this objective.

[0042] As seen in Figure 10, when it is desired to move the vessel 10 in a straight ahead forward direction, the angle-setting members 48 and 52 cause propulsion forces 108 and 110 to be "toed in" with respect to the engine mounts. The propeller axes 36 and

38 represent the centers of the steering ranges. This amount of toe in towards the centerline 200 for movement in a straight or steered direction can be dynamically adjusted by an electronic power steering system so that the engines can be parallel when desired.

5 [0043] Referring to Figure 11, the biased steering range is also useful for turning as it can incorporate Ackerman steering geometry. The arcs 112 and 114 represent the turning arcs that show the turning radii. The dot 116 represents the turning center of both engines 32 and 34. Especially when the vessel is moving slowly, this allows smoother steering with less slip. The amount of Ackerman geometry can be dynamically changed due to vessel speed, steering load, and aggressiveness settings by a user. The turning center of each engine can either coincide or be 10 different. The angle-setting members 48 and 52 are not required to incorporate Ackerman steering geometry, but enable the maximum amount of Ackerman steering geometry to be greater.

15 [0044] Figure 12 shows a mounting assembly 30.1 according to a second aspect. Like parts have like numbers and functions are the same as for the assembly 30 shown in Figures 1 to 11 with the addition of “.1”. However angle-setting members 48.1 and 50.1 are integrally connected to and are integrally formed with a stern bracket 42.1 in this example. In this case each angle-setting member comprises an angled stern bracket.

20 [0045] Figure 13 shows a mounting assembly 30.2 and vessel 10.2 according to a third aspect. Like parts have like numbers and functions as the assembly 30 and vessel 10 shown in Figures 1 to 11 with the addition of “.2”. However angle-setting members 48.2 and 52.2 comprise outwardly angled portions 118 and 120 of a transom 16.2. The angled portions are each located adjacent to a respective one of sides 18.2 and 20.2.

25 [0046] Figures 14 and 15 show a mounting assembly 30.3 and vessel 10.3 according to a fourth aspect. Like parts have like numbers and functions as the assembly 30 and vessel 10 shown in Figures 1 to 11 with the addition of “.3”. However angle-setting members 48.3 and 52.3 comprise biased tillers (or tiller arms) 122 and 124. In this configuration,

engines 32.3 and 34.3 are configured such that when the tillers 122 and 124 are held parallel with a centerline 200.3 of the vessel 10.3, propeller axes 36.3 and 38.3 of the engines are forwardly convergent towards the centerline at angles β , each of which is equal to 6 degrees in this example.

5 [0047] In a further alternative, the tillers may be configured in an unbiased conventional manner and the outboard engines may have engine stops which are further spaced-apart to allow for a greater than ± 30 degrees steering range. In this variation, the engine stops may be configured to allow steering in the range of an angle of $30 - \beta$ degrees in the steering direction 126 towards the centerline and $30 + \beta$ degrees in the
10 opposite steering direction 128. In this case, the center point for steering is adjusted, making the steering asymmetrical.

[0048] Figures 16 and 17 show a mounting assembly 30.4 and vessel 10.4 according to a fifth aspect. Like parts have like numbers and functions as the assembly 30 and vessel 10 shown in Figures 1 to 11 with the addition of “.4”. Typically engine stops are
15 spaced-apart to allow an engine to have a steering range of ± 30 degrees. An outboard engine 32.4 in this example has a pair of engine stops 130 and 132. The engine stops in this example are protrusions operatively connected to a transom and stern bracket (not shown). The engine 32.4 has a rotating part 134 with a protrusion 136 that selectively abuts the engine stops 130 and 132 at the outer steering ranges of the engine 32.4. In this
20 variation, the angle-setting members are in the form of engine stops that are further spaced-apart, with the engine stops being altered when designing the engine to allow for a steering range of $\pm (30 + \beta)$ degrees, which in this example equals to ± 36 degrees. The embodiment of Figures 16 and 17 can be modified to provide a total steering range of 60 degrees. One side has $(60/2+12) = 42$ degrees and the other side has $(60/2-12) = 18$
25 degrees.

[0049] The forms of the angle-setting members as described herein may be referred to as means for positioning the outboard engines with a slight forward convergence.

[0050] The assembly 30 is shown in Figure 3 with an upper angle-setting member 48 and a lower angle-setting member 50 in the form of wedges. However, it will be appreciated by a person skilled in the art that many further variations are possible within the scope of the invention described herein. For example, one angle-setting member may
5 be used for each stern bracket instead of two spaced-apart members for each bracket. Alternatively, any number of wedge-shaped pieces may be used. For example, the two wedges could be made of one solid piece or four separate pieces in other embodiments.

[0051] The angle-setting members 48 and 52 may also be built into a jack plate mechanism. While the assembly 30 as described herein refers to two engines, the
10 assembly as described herein may be used in conjunction with more than two engines in other embodiments. Alternatively, such an assembly 30 can be the engine mount which mates to the outboard engine midsection. For example, a metal engine mount is commonly used in pontoon or catamaran vessels.

[0052] It will be understood by a person skilled in the art that the mounting assembly
15 is described herein with reference to outboard engines but that the mounting assembly may also be used with stern drive or inboard-outboard propulsion systems as well.

[0053] It will also be understood by a person skilled in the art that many of the details provided above are by way of example only and are not intended to limit the scope of the invention which is to be determined with reference to at least the following claims.

What is claimed is:

1. A mounting assembly for positioning stern-mounted propulsion units for a marine vessel, the marine vessel having a bow, a stern, a longitudinal center line, a center of rotation, a first stern-mounted propulsion unit and a second stern-mounted propulsion unit, the propulsion units each having a steering range with a center and the assembly comprising:
5 a pair of stern brackets, each connected to a respective one of the propulsion units and a pair of angle-setting members, each of the angle-setting members forwardly angles a respective one of the propulsion units towards the bow of the marine vessel and the longitudinal center line when each propulsion unit is at the center of the steering range, wherein each of the propulsion units has a line of action of propulsion force and the lines of action of the propulsion units intersecting each other between the center of rotation and the stern of the marine vessel when the propulsion units are forwardly steered towards each other, said first propulsion unit having a forwardly directed propulsion force and said second propulsion unit having a rearwardly directed propulsion force.
10
2. The mounting assembly as claimed in claim 1, wherein the marine vessel has a longitudinal axis and wherein the angle-setting members angle the propulsion units inwardly and forwardly in the range of greater than 0 degrees and less than 30 degrees relative to the longitudinal axis of the marine vessel.
15
3. The mounting assembly as claimed in claim 1, wherein the marine vessel has a longitudinal axis and wherein the angle-setting members angle the propulsion units inwardly and forwardly in the range of 5 to 10 degrees relative to the longitudinal axis of the marine vessel.
20
4. The mounting assembly as claimed in claim 1, wherein the marine vessel has a longitudinal axis and wherein the angle-setting members angle the propulsion units inwardly and forwardly by 6 degrees relative to the longitudinal axis of the marine vessel.
- 25 5. The mounting assembly as claimed in claim 1, 2, 3, or 4, wherein the angle-setting members are wedge-shaped.

6. The mounting assembly as claimed in claim 1, 2, 3, or 4, wherein the angle-setting members are integrally connected to and are integrally formed with the stern brackets.

7. The mounting assembly as claimed in claim 1, 2, 3, or 4, wherein the marine vessel has a transom and the angle-setting members are interposed between the stern brackets and the transom.

8. The mounting assembly as claimed in claim 1, 2, 3, or 4, wherein the marine vessel has a transom and wherein each angle-setting member comprises an angled stern bracket that connects to the transom.

9. The mounting assembly as claimed in claim 1, 2, 3, or 4, wherein the marine vessel has a longitudinal axis and wherein each of the angle-setting members comprises an inwardly biased tiller, whereby when the tillers align parallel with the longitudinal axis of the marine vessel, propeller axes of the propulsion units are forwardly convergent relative to the tillers.

10. The mounting assembly as claimed in any one of claims 1 to 9, wherein the marine vessel is a twin-hulled vessel.

11. A marine vessel, comprising:

a first propulsion unit at a stern of the marine vessel, the first propulsion unit operable to exert on the marine vessel a first propulsion force along a first line of action, the first propulsion unit having a first steering range relative to the marine vessel, wherein when the first propulsion unit is positioned at a center of the first steering range and exerts the first propulsion force on the marine vessel, the first propulsion force has a first lateral component that is lateral relative to the marine vessel; and

a second propulsion unit at the stern of the marine vessel, the second propulsion unit operable to exert on the marine vessel a second propulsion force along a second line of action, the second propulsion unit having a second steering range relative to the marine vessel, wherein when the second propulsion unit is positioned at a center of the second steering range and exerts the second propulsion force on the marine vessel, the second propulsion force has a second lateral component that is lateral relative to the marine vessel;

wherein the first and second propulsion units are positionable during operation of the marine vessel such that the first line of action intersects the second line of action along a longitudinal centerline of the marine vessel.

12. The marine vessel of claim 11, wherein:

5 the marine vessel has a longitudinal axis; and

when the first propulsion unit is positioned at the center of the first steering range, and when the second propulsion unit is positioned at the center of the second steering range, the first and second lines of action are greater than 0 degrees and less than 30 degrees relative to the longitudinal axis of the marine vessel.

10 13. The marine vessel of claim 11, wherein:

the marine vessel has a longitudinal axis; and

15 when the first propulsion unit is positioned at the center of the first steering range, and when the second propulsion unit is positioned at the center of the second steering range, the first and second lines of action are between 5 and 10 degrees relative to the longitudinal axis of the marine vessel.

14. The marine vessel of claim 11, wherein:

the marine vessel has a longitudinal axis; and

20 when the first propulsion unit is positioned at the center of the first steering range, and when the second propulsion unit is positioned at the center of the second steering range, the first and second lines of action are 6 degrees relative to the longitudinal axis of the marine vessel.

15. The marine vessel of claim 11, 12, 13, or 14, wherein the first and second propulsion units are positionable during operation of the marine vessel such that the first line of action intersects the second line of action at a point of intersection forward of the first and second propulsion units and aft of a center of gravity of the marine vessel.

25 16. The marine vessel of any one of claims 11 to 15, further comprising means for positioning the first and second propulsion units with a forward convergence.

17. The marine vessel of any one of claims 11 to 15, further comprising:
a transom; and
at least one first angle-setting member between the first propulsion unit and the transom,
the at least one first angle-setting member biasing the first steering range laterally relative to the
5 marine vessel.
18. The marine vessel of claim 17, further comprising at least one second angle-setting
member between the second propulsion unit and the transom, the at least one second angle-
setting member biasing the second steering range laterally relative to the marine vessel.
19. The marine vessel of claim 17 or 18, wherein the at least one first angle-setting member
10 is wedge-shaped.
20. The marine vessel of any one of claims 11 to 15, further comprising:
a transom; and
a first stern bracket mounting the first propulsion unit to the transom, the first stern
bracket biasing the first steering range laterally relative to the marine vessel.
21. The marine vessel of claim 20, further comprising a second stern bracket mounting the
15 second propulsion unit to the transom, the second stern bracket biasing the second steering range
laterally relative to the marine vessel.
22. The marine vessel of any one of claims 11 to 15, further comprising a transom
20 comprising a first angled portion, wherein the first propulsion unit is mounted to the first angled
portion, and wherein the first angled portion biases the first steering range laterally relative to the
marine vessel.
23. The marine vessel of claim 22, wherein the transom further comprises a second angled
portion, wherein the second propulsion unit is mounted to the second angled portion, and
wherein the second angled portion biases the second steering range laterally relative to the
25 marine vessel.

24. The marine vessel of any one of claims 11 to 15, wherein the marine vessel has a longitudinal axis and further comprises a first biased tiller arm operable to steer the first propulsion unit, and wherein, when the first biased tiller arm is parallel to the longitudinal axis, the first propulsion unit is positioned to exert on the marine vessel the first propulsion force having the first lateral component that is lateral relative to the marine vessel.

25. The marine vessel of claim 24, further comprising a second biased tiller arm operable to steer the second propulsion unit, wherein, when the second biased tiller arm is parallel to the longitudinal axis, the second propulsion unit is positioned to exert, on the marine vessel, the second propulsion force having the second lateral component that is lateral relative to the marine vessel.

26. The marine vessel of any one of claims 11 to 15, further comprising first and second engine stops constraining steering of the first propulsion unit to the first steering range.

27. The marine vessel of claim 26, further comprising third and fourth engine stops constraining steering of the second propulsion unit to the second steering range.

28. The marine vessel of any one of claims 11 to 27, wherein:

the first propulsion unit is operable to exert on the marine vessel the first propulsion force, the first propulsion force having (i) a first longitudinal component that is forward relative to the marine vessel and (ii) the first lateral component that is lateral relative to the marine vessel and towards a first side of the marine vessel; and

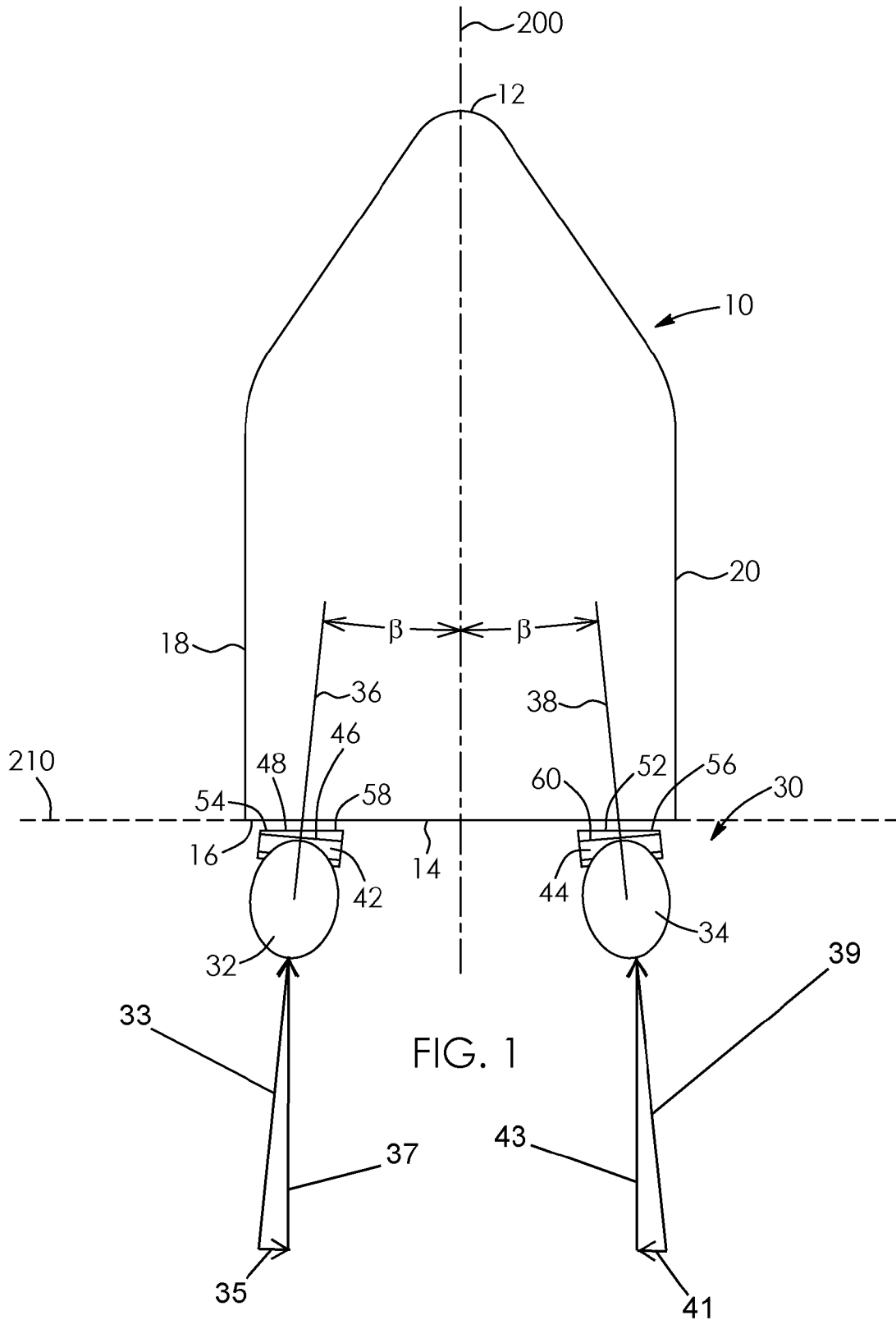
the second propulsion unit is operable, while the first propulsion unit exerts on the marine vessel the first propulsion force having the first longitudinal component that is forward relative to the marine vessel and the first lateral component that is lateral relative to the marine vessel and towards the first side of the marine vessel, to exert on the marine vessel the second propulsion force, the second propulsion force having (i) a second longitudinal component that is rearward relative to the marine vessel and (ii) the second lateral component that is lateral relative to the marine vessel and towards the first side of the marine vessel.

29. A method of operating the marine vessel of any one of claims 11 to 28, the method comprising:

causing the first propulsion unit to exert on the marine vessel the first propulsion force, the first propulsion force having (i) a first longitudinal component that is forward relative to the marine vessel and (ii) the first lateral component that is lateral relative to the marine vessel and towards a first side of the marine vessel; and

causing the second propulsion unit to exert on the marine vessel the second propulsion force while the first propulsion unit exerts on the marine vessel the first propulsion force having the first longitudinal component that is forward relative to the marine vessel and the first lateral component that is lateral relative to the marine vessel and towards the first side of the marine vessel, the second propulsion force having (i) a second longitudinal component that is rearward relative to the marine vessel and (ii) the second lateral component that is lateral relative to the marine vessel and towards the first side of the marine vessel.

30. The method of claim 29, wherein the first line of action intersects the second line of action at a point of intersection forward of the first and second propulsion units and aft of a center of rotation of the marine vessel.



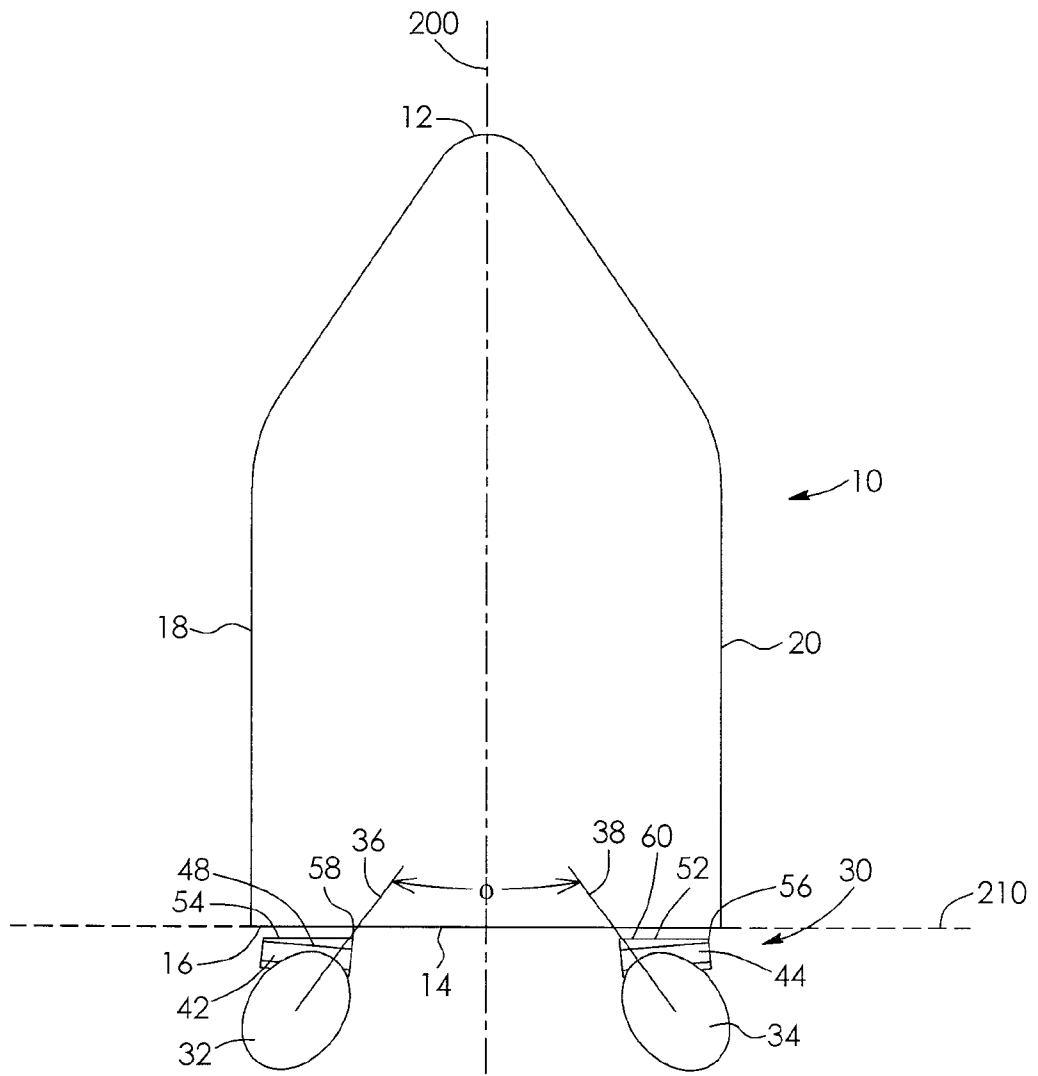


FIG. 2

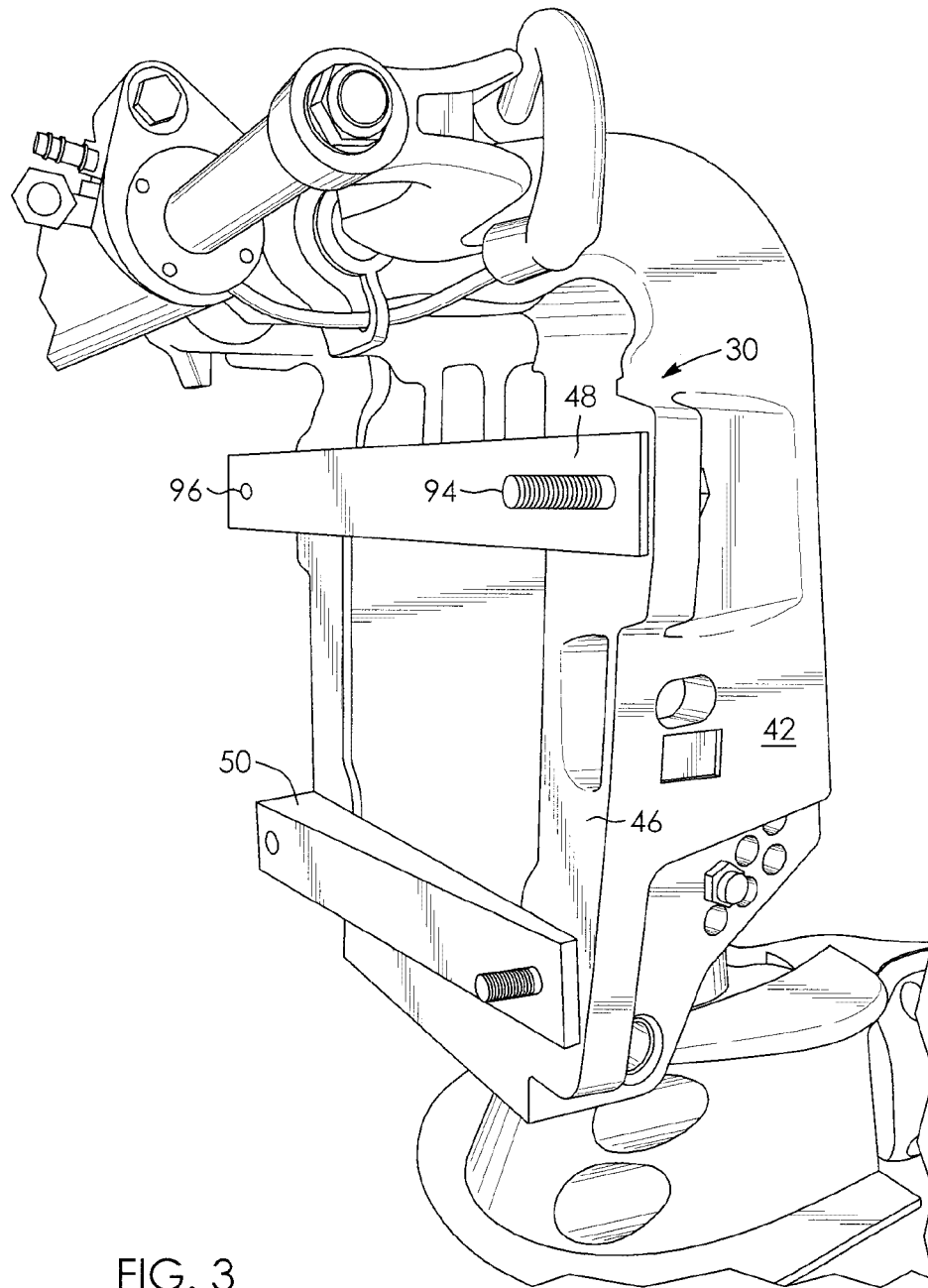


FIG. 3

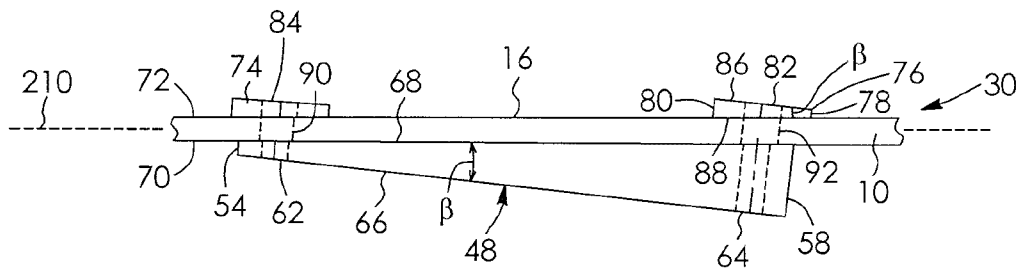


FIG. 4

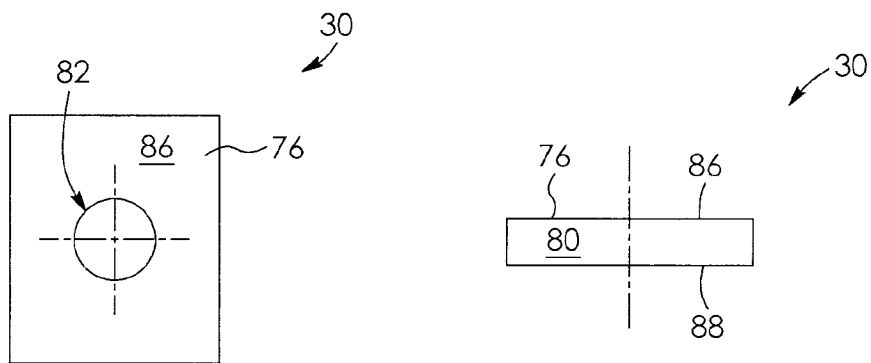
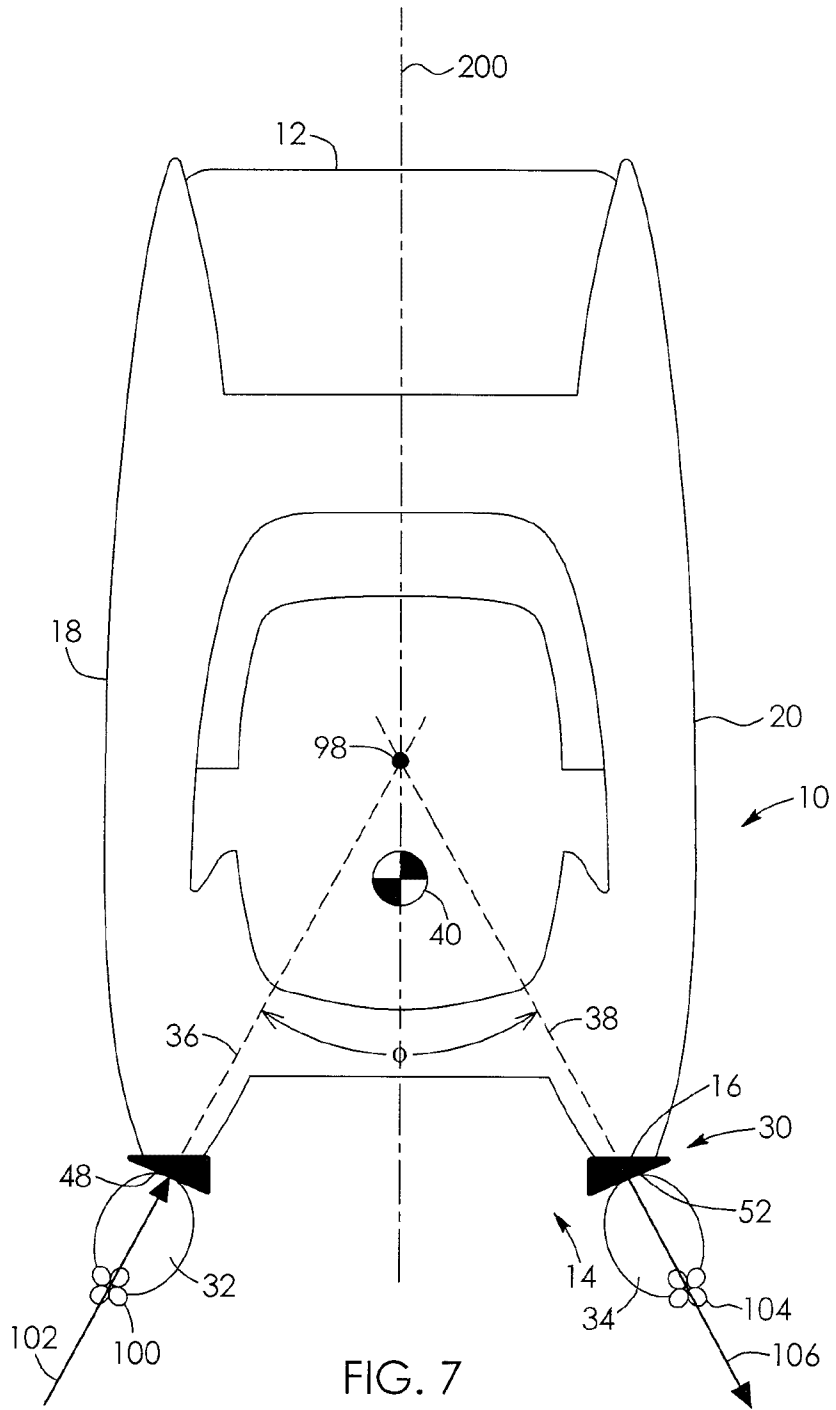
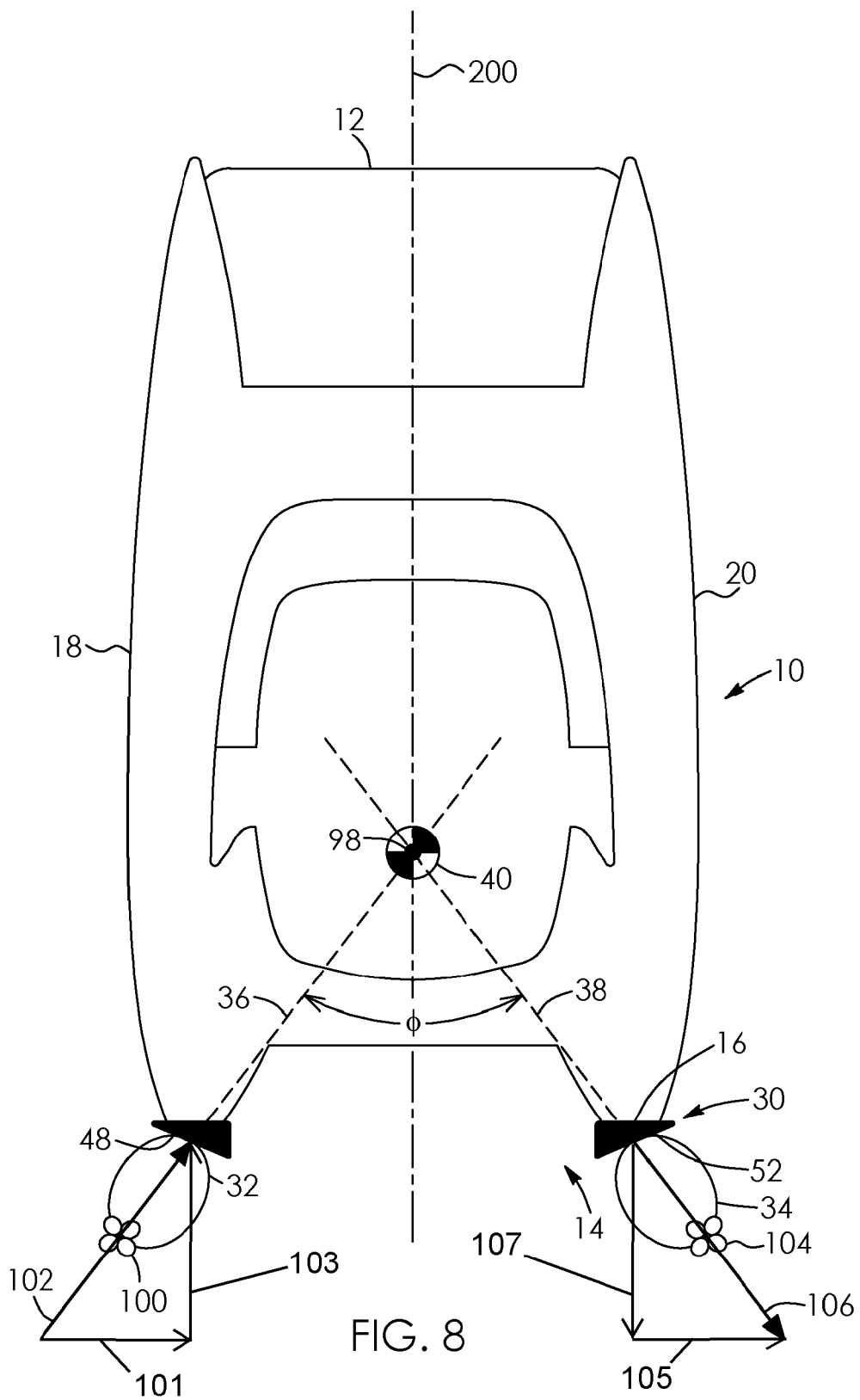


FIG. 5

FIG. 6





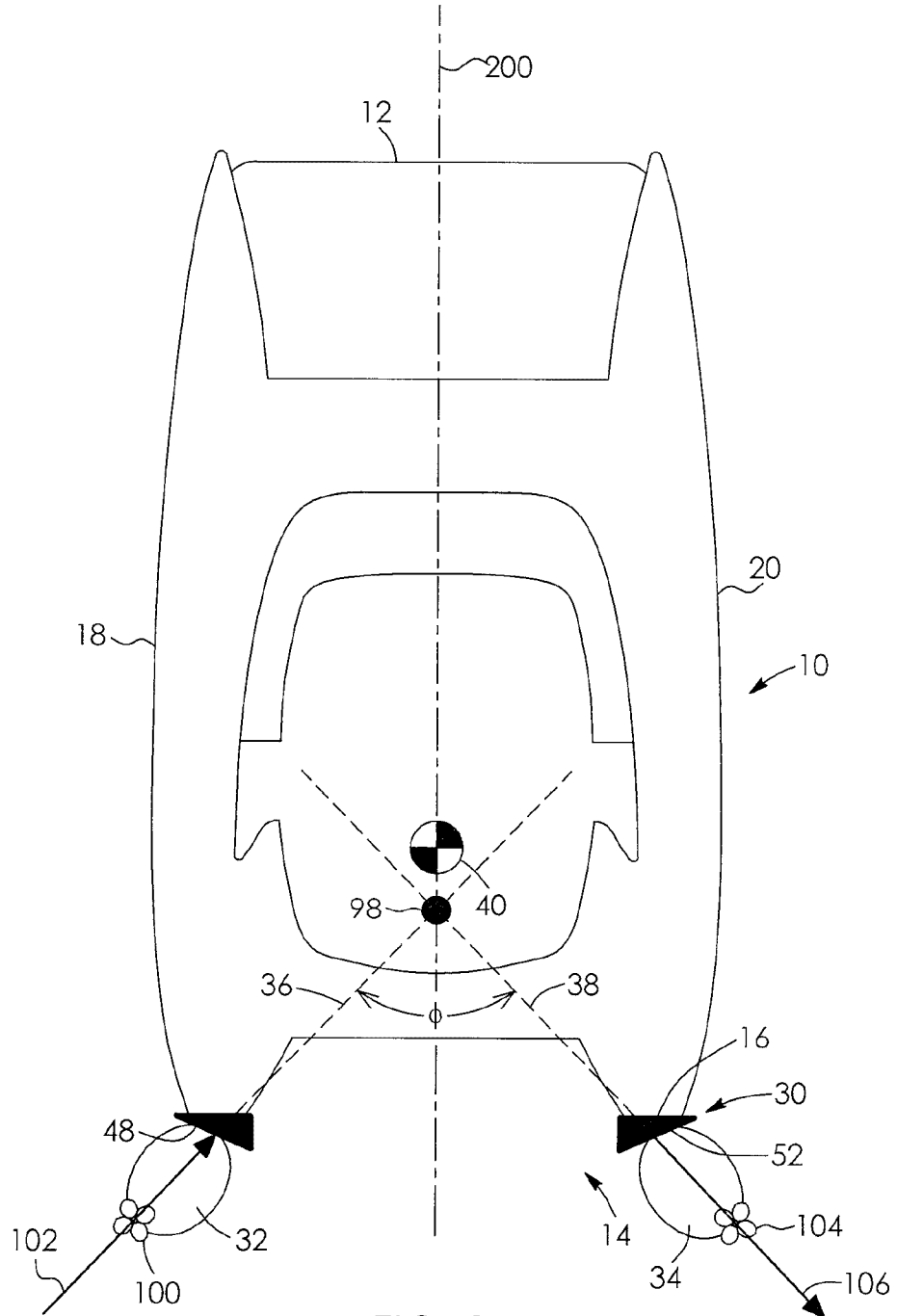


FIG. 9

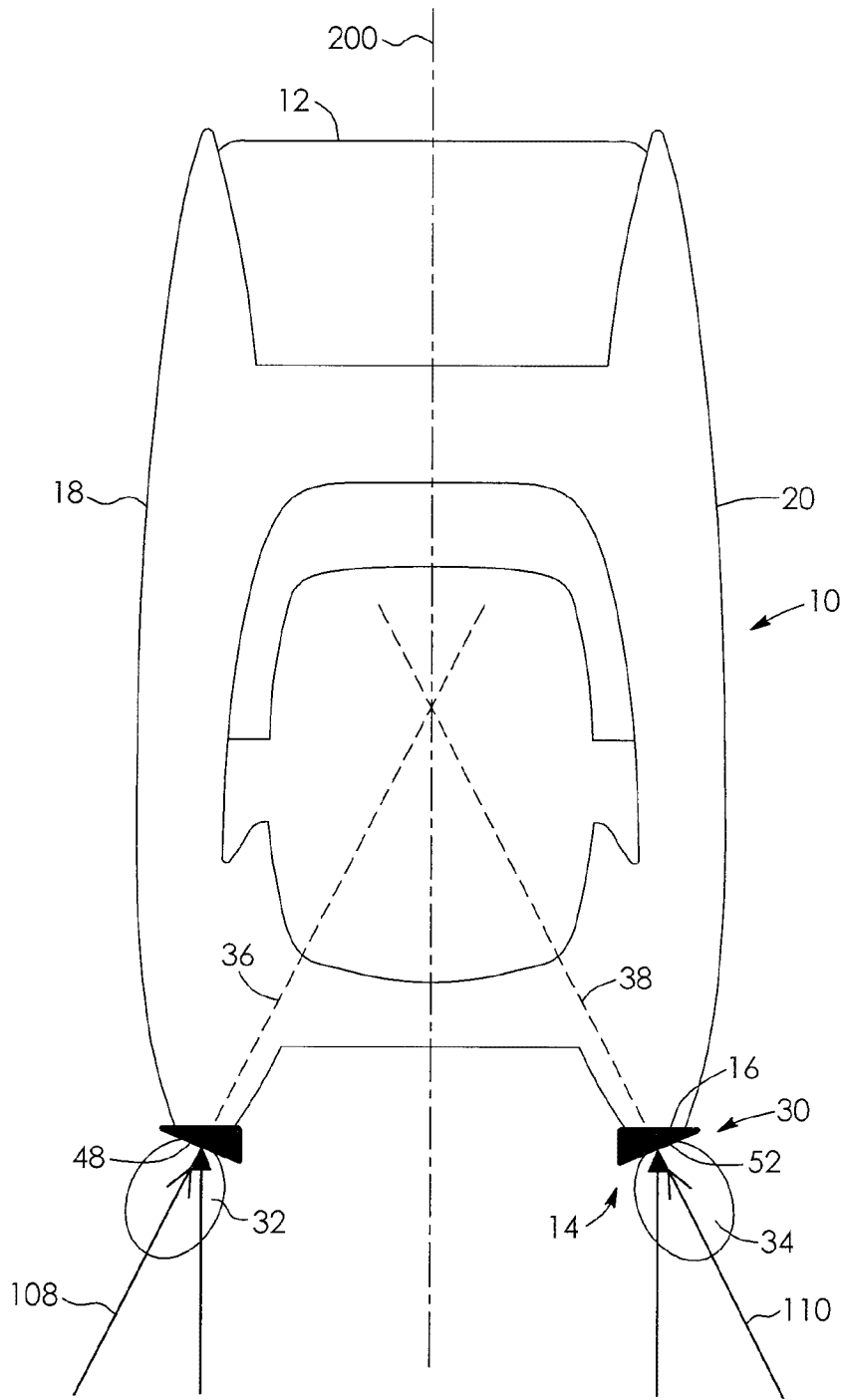


FIG. 10

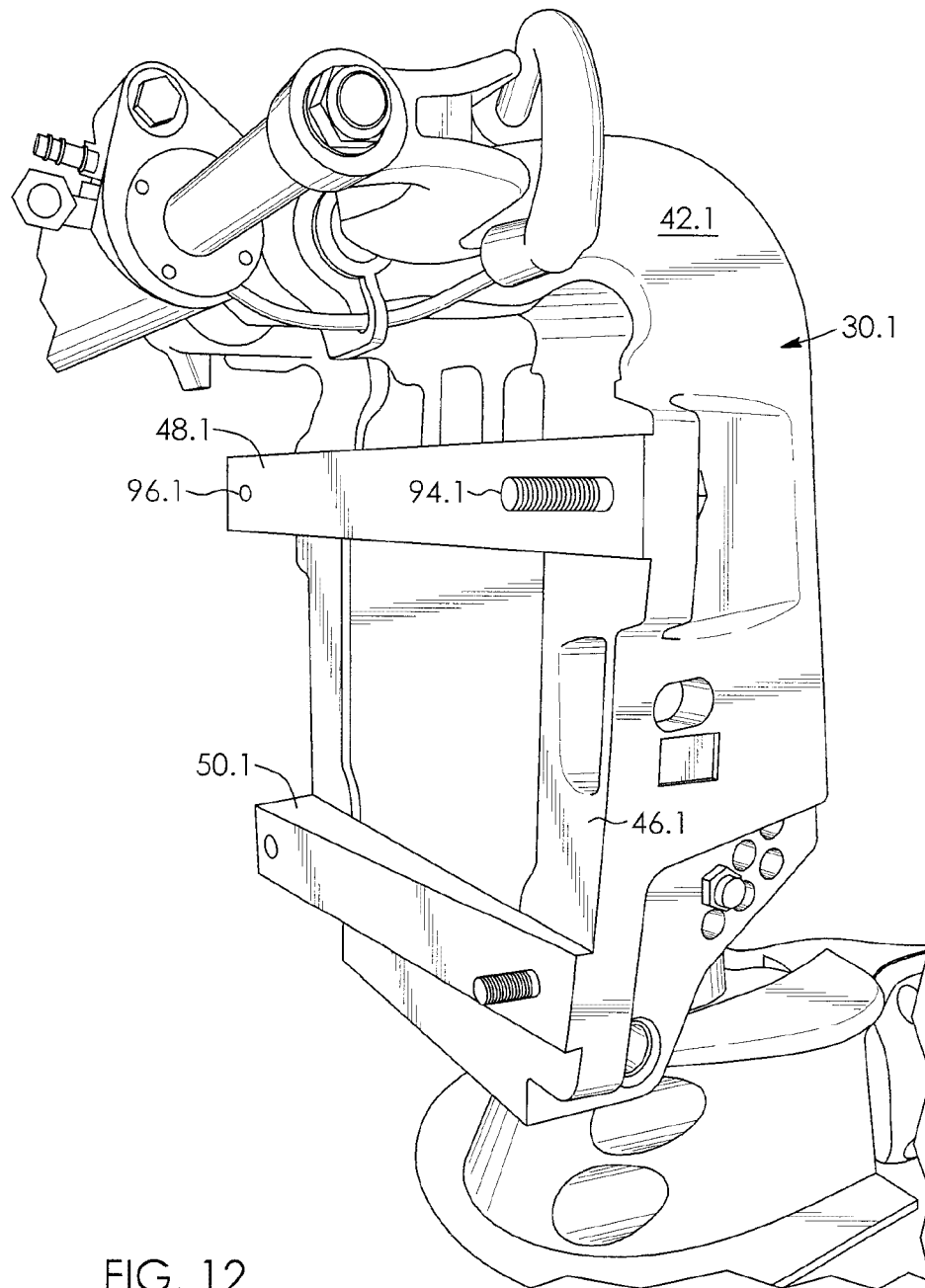


FIG. 12

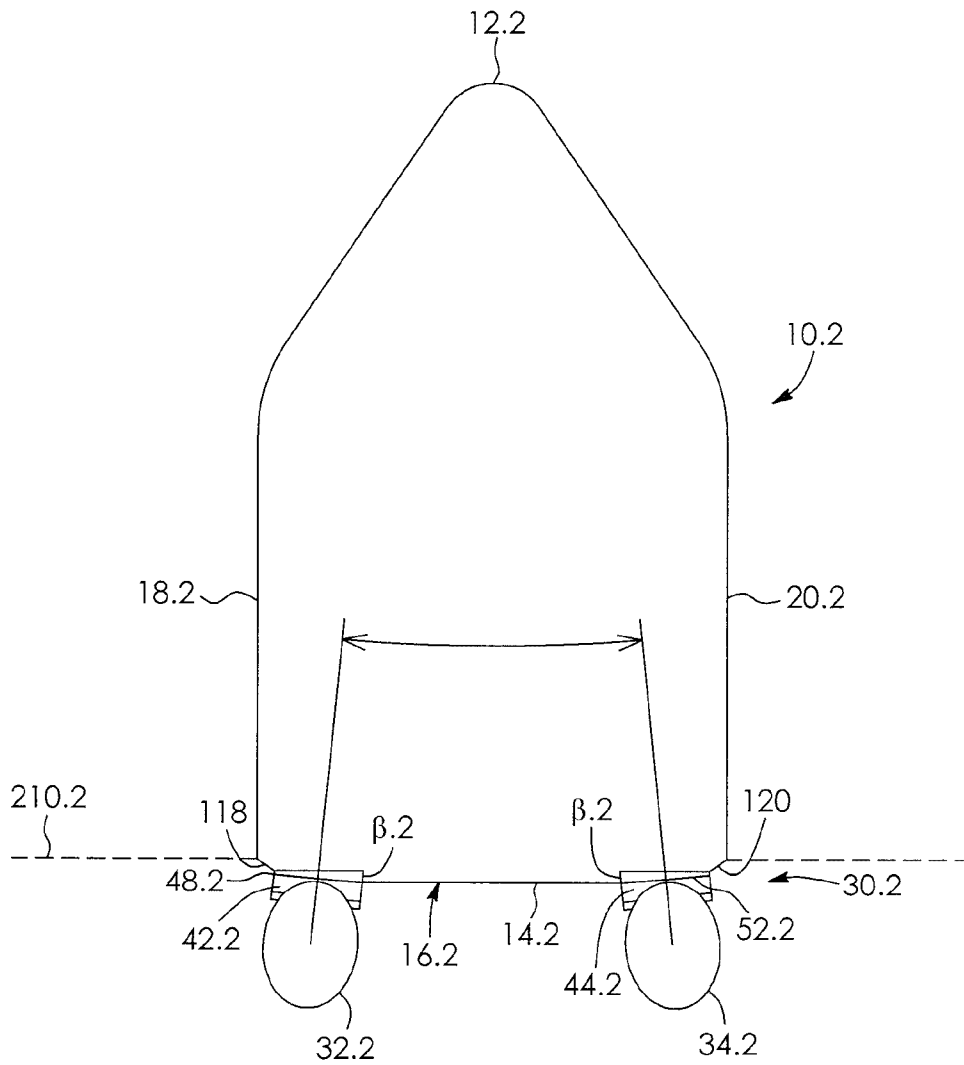


FIG. 13

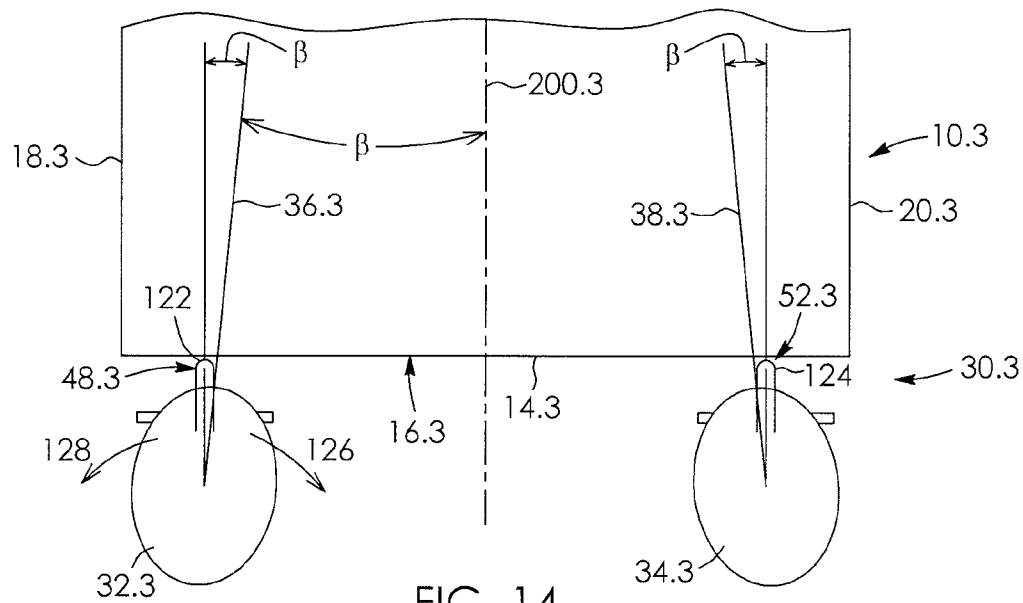


FIG. 14

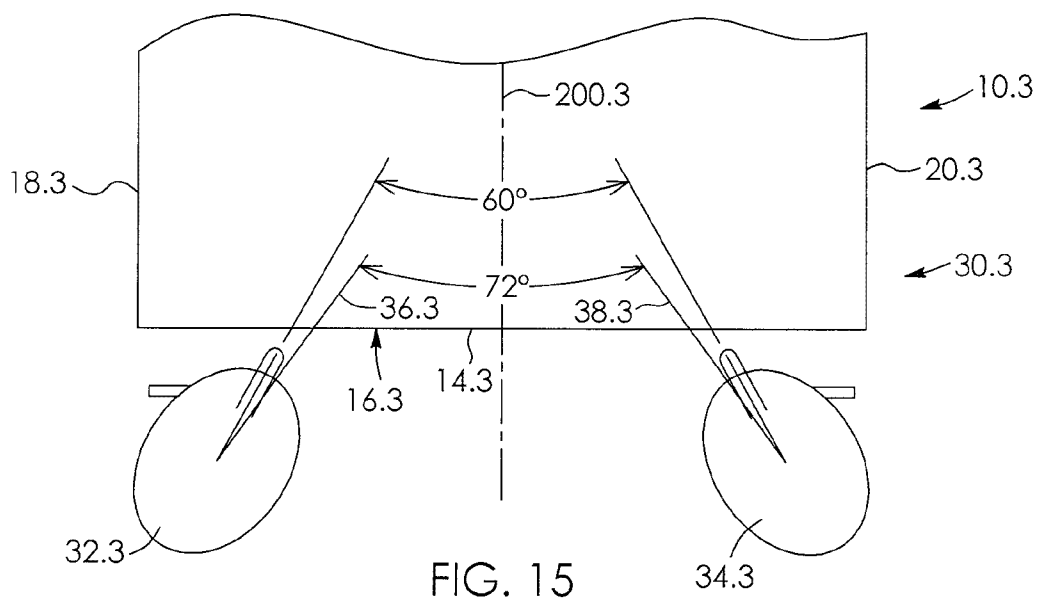


FIG. 15

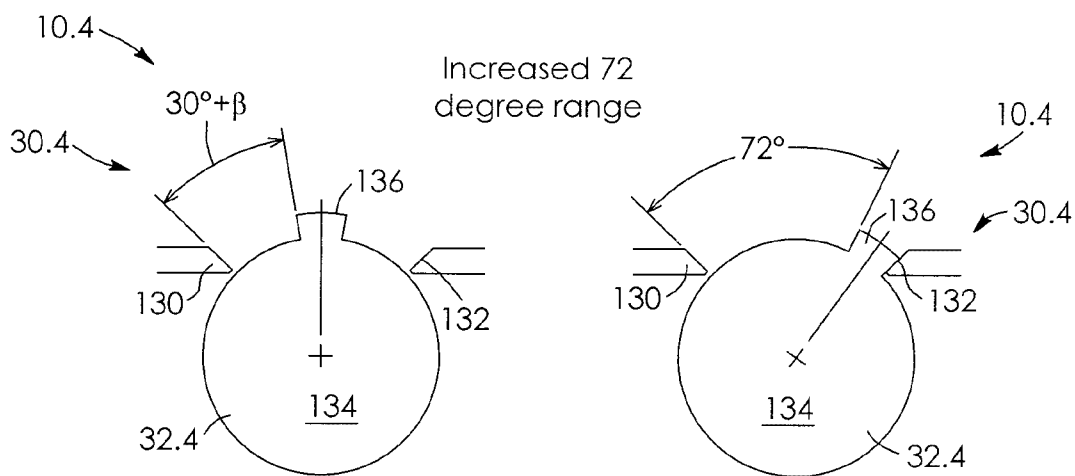


FIG. 16

FIG. 17

