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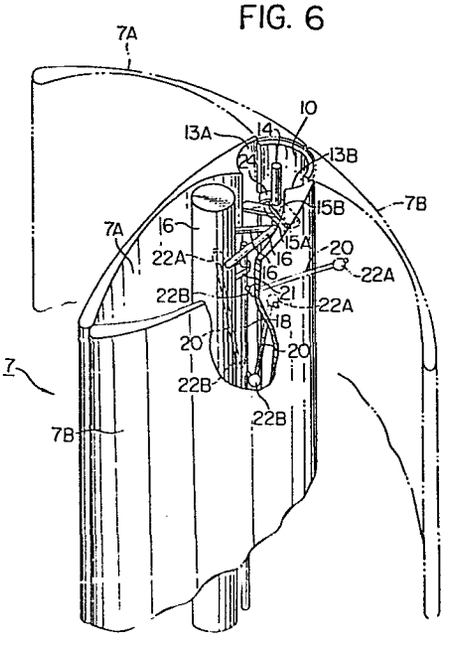
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(54) Rigid marine sail and method of folding said sail.

(57) A marine sail comprising a right-hand and left-hand sail portion (7A, 7B) pivoted to a common vertical axle (14) spaced forward of a mast (6) of a ship. The sail portions are arranged to substantially surround the mast to present a substantially streamlined cross-sectional shape when in the folded position, whereby to reduce wind resistance when the sail is not deployed. The mast can be allowed to rotate freely and is nearer the leading than the trailing edge of the folded sail, whereby the folded streamlined sail tends to align itself with the wind direction.

FIG. 6



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RIGID MARINE SAIL AND METHOD OF FOLDING SAID SAIL

The present invention relates to rigid marine sails and to methods for folding said sails. These sails may be fitted to a ship for selective deployment effectively to utilize wind force on a voyage of the ship.

It has recently been proposed to mount one or more sails on an engine-driven ship for effectively utilizing wind force on a voyage of the ship with a view to saving energy. A conceivable sail to be mounted on a ship is the conventional sail made of canvas fitted to the mast. Such a sail requires however much time and labour for setting and furling the sail.

To avoid this inconvenience, a generally rigid sail comprising thin metal plates or synthetic resin plates applied to reinforced rib members was invented to take the place of the above-mentioned canvas sail. Since this rigid sail can automatically be opened and closed, it permits solving the above-mentioned problem.

As shown in Fig. 1, the present inventors have previously proposed the following sail as one of the above-mentioned rigid sails:

A rigid sail, disclosed in Japanese Patent Provisional Publication No. 47,994/80 dated April 5, 1980, which comprises:

a mast 2 vertically fitted through a mast support (not shown) onto the deck of a ship 1; said vertical mast 2 being rotatable around the axis thereof;

a rigid sail 4 fitted to said mast 2 parallel with the axis thereof; said rigid sail 4 comprising a central sail portion 4A fixed through a fixture 3 to said mast 2, and a left sail portion 4B and a right sail portion 4C both fixed to the respective side edges of said sail portion 4A so as to permit the opening and closing motions of the rigid sail portions 4B and 4C;

cylinders 5A and 5B for opening and closing said

left sail portion 4B and said right sail portion 4C;

whereby said sail portions 4B and 4C are opened and closed relative to said mast by actuating said cylinders 5A and 5B (hereinafter referred to as the "prior art").

However, since the rigid sail in the above-mentioned prior art is folded to form a triangular cross-sectional shape, the rigid sail develops high wind resistance on a voyage against the wind and in calm weather.

A principal object of the present invention is therefore to provide a marine sail and a method for folding said sail, which is fitted to a ship for effectively utilizing wind force on a voyage of the ship, so that the rigid sail may be folded into a shape permitting minimization of such wind resistance.

According to the present invention there is provided a generally rigid marine sail comprising a left-hand sail portion and a right-hand sail portion movable between deployed and folded positions relative to a mast of a ship, characterised in that said sail portions (7A,7B) are arranged so as to substantially surround said mast (6) to present a substantially streamlined cross-sectional shape when in said folded position.

In another aspect the invention provides a method of folding a generally rigid marine sail comprising a left-hand sail portion and a right-hand sail portion movable between deployed and folded positions relative to a mast of a ship, characterised by folding said sail portions so as to substantially surround said mast to present a substantially streamlined cross-sectional shape.

An embodiment of the invention will now be described, by way of example, with reference to the accompanying drawings, in which:-

Fig. 1 is a plan view illustrating the opened and closed states of a rigid marine sail of the prior art;

Fig. 2 is a partially cutaway perspective view illustrating a rigid marine sail in the deployed state in accordance with an embodiment of the present invention;

Fig. 3 is a plan view illustrating the sail in the deployed state;

Fig. 4 is a partially cutaway perspective view illustrating the fitting construction of the sail and a universal bearing therefor;

Fig. 5 is a partially cutaway plan view illustrating the fitting construction of a movable rod of the sail and the universal bearing;

Fig. 6 is a partially cutaway perspective view illustrating the deployed and folded states of the sail;

Fig. 7 is a plan view illustrating the sail in the folded state;

Fig. 8 is a partially cutaway side view of the sail and mast mounting assembly; and

Fig. 9 is a partial sectional front view illustrating the mast fixing mechanism of the sail.

With a view to solving the above-mentioned problem involved in the prior art, i.e., the rigid sail still exposed to a high wind resistance even in the folded state, we carried out extensive studies. As a result, we obtained a finding that the above-mentioned problem could be solved by folding the rigid sail so as to give a streamlined cross-sectional shape. Thus a rigid sail and a method for folding a rigid sail was developed, which comprises:

folding a rigid sail comprising a left sail portion and a right sail portion, fitted to the mast of a ship, so as to surround said mast, whereby said rigid sail has a streamlined cross-sectional shape after folding.

Now, the rigid marine sail in an embodiment of the present invention is described with reference to the drawings.

In Figs. 2 and 3, 6 is a mast fitted vertically to the deck of a ship through a mast support described later; 7 is a rigid sail comprising two sail portions 7A and 7B which are fitted to the mast 6 symmetrically so as to permit

the opening and closing motions of the rigid sail 7, and one side edge of each of the sail portions 7A and 7B is adjacent to each other; 8 is a fitting mechanism for supporting the sail portions 7A and 7B at the above-mentioned one side edge of each of the sail portions 7A and 7B so as to permit the opening and closing motions of the rigid sail 7 relative to the mast 6; 9 is an opening/closing mechanism for opening and closing the sail portions 7A and 7B symmetrically relative to the mast 6; and 10 is a shrouding plate.

The sail portions 7A and 7B are symmetrical in shape with each other, which form respective curved portions, and consist of thin plates 11 made of a metal or a synthetic resin and ribs 12 assembled in lattice shape for reinforcing the thin plate 11. The said portions 7A and 7B are provided with inwardly curved arcuate surfaces 13A and 13B meeting the shrouding plate 10 in the longitudinal direction of the above-mentioned one side edge of the sail portions 7A and 7B.

The fitting mechanism 8 comprises a fitting axle 14 and a plurality of brackets 15A and 15B. The fitting axle 14 is fixed to the mast 6 through a plurality of fixtures 16 in parallel with the mast 6, and has a length substantially equal to the longitudinal length of the rigid sail 7. The

brackets 15A and 15B are fixed at an end thereof to the respective curved surfaces 13A and 13B of the sail portions 7A and 7B at predetermined intervals in a vertical direction. At the other ends of the brackets 15A and 15B, holes 17A and 17B for passing the fitting axle 14 are provided. Thus the sail portions 7A and 7B are supported by the brackets 15A, 15B and the fitting axle 14 passing through the holes 17A and 17B of the brackets 15A and 15B so as to permit the opening and closing motions of the sail portions 7A and 7B relative to the mast 6.

The opening/closing mechanism 9 comprises a movable rod 18, a lift means 19 and connecting rods 20. The movable rod 18 is fitted to the mast 6 through a plurality of guide members 21 so as to be vertically movable in parallel with the mast 6. The lift means 19 is to cause vertical movement of the movable rod 18, comprises a cylinder, and is fixed to the lower part of the mast 6. The connecting rods 20 are provided at predetermined intervals in a vertical direction near the curved surfaces 13A and 13B of the sail portions 7A and 7B. Ends of one side of the rods 20 are connected to the portions near the curved surfaces 13A and 13B of the sail portions 7A and 7B through respective universal bearings 22A at predetermined intervals in a vertical direction (see Fig. 4). The ends of the other side of the rods 20 are connected to the rod 18 through the other respective universal

bearings 22B at predetermined intervals in a vertical direction (see Fig. 5). Thus, the movable rod 18 is vertically driven by actuating said lift means 19, whereby the sail portions 7A and 7B are opened and closed around the fitting axle 14 through the actions of the movable rod 18 and the plurality of connecting rods 20, and the opening and closing motions of the sail portions 7A and 7B are symmetrical relative to the mast 6 (see Figs. 6 and 7).

The shrouding plate 10 is fixed to the fitting axle 14 through a plurality of fixing rods 23 in parallel with the fitting axle 14 in front of the same relative to the mast 6. The shrouding plate 10 has the same length as the longitudinal length of the sail portions 7A and 7B, and has a semi-cylindrical shape. On the both side edges of the shrouding plate 10, a plurality of notches 24 are provided at predetermined intervals in the vertical direction, and the plurality of brackets 15A and 15B are fixed at ends thereof to one side edges of the curved surfaces 13A and 13B after passing through the respective notches 24. Thus, the shrouding plate 10 covers the gap between the side edges of the respective curved surfaces 13A and 13B of the sail portions 7A and 7B, which gap is produced when the sail portions 7A and 7B are closed relative to the mast 6.

The shrouding plate 10 is not always necessary, but it is possible, by providing the shrouding plate 10, to keep a more perfectly streamlined cross-sectional shape of the rigid sail 7 in a state where the sail portions 7A and 7B are closed.

Now, the above-mentioned mast support is described in the following paragraphs.

As shown in Figs. 8 and 9, the mast support 25 comprises: a rotating base 29 fitted through bearings 28A and 28B onto a fixed base 27 which is fixed onto the deck 26; a mast supporting cylinder 30 fixed through bearings 42A and 42B vertically onto the rotating base 29 for supporting the lower end of the mast 6; a rotation control means 31 for controlling rotation of the rotating base 29; and, a mast fixing mechanism 32 fitted to the upper end of the mast supporting cylinder 30.

The rotation control means 31 comprises: a fixed gear 33 fixed horizontally in the rotating base 29; a rotating gear 34 meshing with the fixed gear 33; and, a motor 35 provided on the rotating base 29 for rotating the rotating gear 34. Thus, by actuating the motor 35, the rotating base 29 is rotatively and horizontally driven relative to the fixed base 27 through the gearing of the

gears 33 and 34, and this causes the mast 6 to rotate integrally with the mast supporting cylinder 30.

The mast fixing mechanism 32 comprises: a pair of annular fixed friction plates 36A and 36B; and, a rotating friction plate 37. The fixed friction plates 36A and 36B and the rotating friction plate 37 are provided in an enlarged portion 38 provided on the top of the mast supporting cylinder 30. The fixed friction plates 36A and 36B are provided with a plurality of through-holes 39A and 39B at predetermined intervals in the circumferential direction thereof, and are horizontally fixed to the inner surface of the enlarged portion 38 by a plurality of through-bolts 40 passing through these holes 39A and 39B. The rotating friction plate 37 is horizontally fixed to the outer surface of the mast 6, and is sandwitched between the fixed friction plates 36A and 36B. The fixed friction plates 36A and 36B are mutually fixed by tightening a plurality of pressure bolts 41 screwed into the upper wall of the enlarged portion 38, and are mutually released by loosening the plurality of pressure bolts 41. Thus, the mast 6 is fixed to the mast supporting cylinder 30 by tightening the plurality of pressure bolts 41, and is released relative to the mast supporting cylinder 30 by loosening

the plurality of pressure bolts 41. Therefore, when the rigid sail 7 is exposed to wind resistance in a closed state where the sail portions 7A and 7B are closed, the rigid said 7 rotates around the mast 6 depending upon the wind direction toward the direction in which the shrouding plate 10 becomes opposite to the wind direction. This is because the mast 6 locates eccentrically near the shrouding plate 10 side of the rigid sail 7 in the closed state where the sail portions 7A and 7B are closed. As a result, it is possible to minimize always the wind resistance to which the rigid sail 7 is exposed, irrespective of the wind direction.

According to the method of the present invention, as described above in detail, it is possible to fold a rigid sail so as to give a streamlined cross-sectional shape, and thus to minimize the wind resistance to which the rigid sail is exposed on a voyage under calm, thus providing industrially useful effects.

CLAIMS:

1. A generally rigid marine sail comprising a left-hand sail portion and a right-hand sail portion movable between deployed and folded positions relative to a mast of a ship, characterised in that said sail portions (7A,7B) are arranged so as to substantially surround said mast (6) to present a substantially streamlined cross-sectional shape when in said folded position.

2. A sail according to claim 1 characterised in that said sail portions are pivotably movable between said positions about a common vertical axis (14) spaced forward of said mast (6).

3. A sail according to claim 1 or claim 2 characterised by means (41) permitting substantially free rotation of said mast and folded sail about the axis of said mast, and in that said mast is nearer the leading than the trailing edge of said folded sail, whereby the folded streamlined sail tends to align itself with the wind direction.

4. A sail according to any one of claims 1 to 3 characterised by a substantially semi-cylindrical vertical shroud plate (10) positioned forward of said mast to form the leading edge of said streamlined cross-section when the sail is folded.

5. A method of folding a generally rigid marine sail comprising a left-hand sail portion and a right-hand sail portion movable between deployed and folded positions relative to a mast of a ship, characterised by folding said sail portions so as to substantially surround said mast to present a substantially streamlined cross-sectional shape.

6. A method according to claim 5 characterised by pivotally folding said sail portions about a common vertical axis spaced forward of said mast.

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FIG. 1

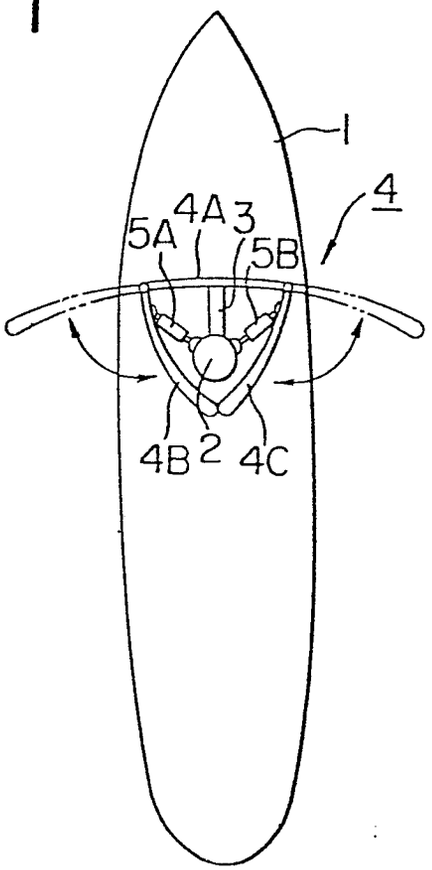


FIG. 3

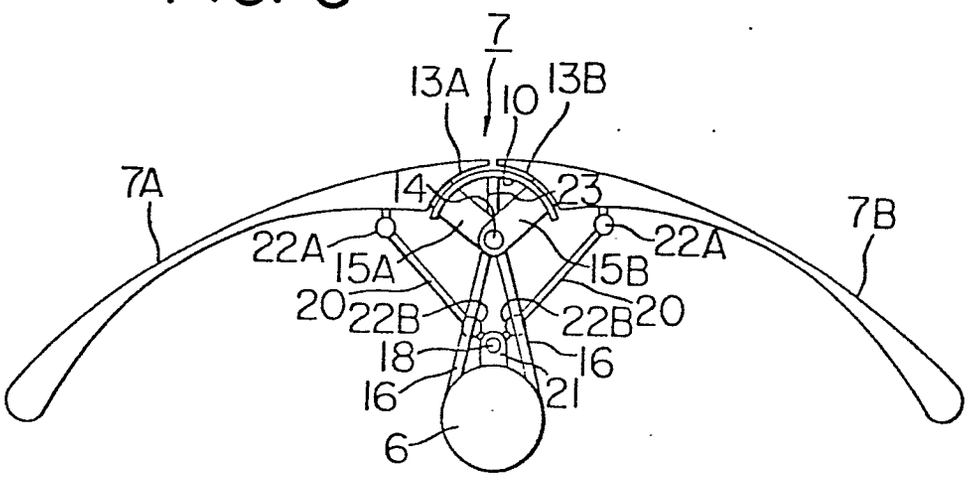


FIG. 2

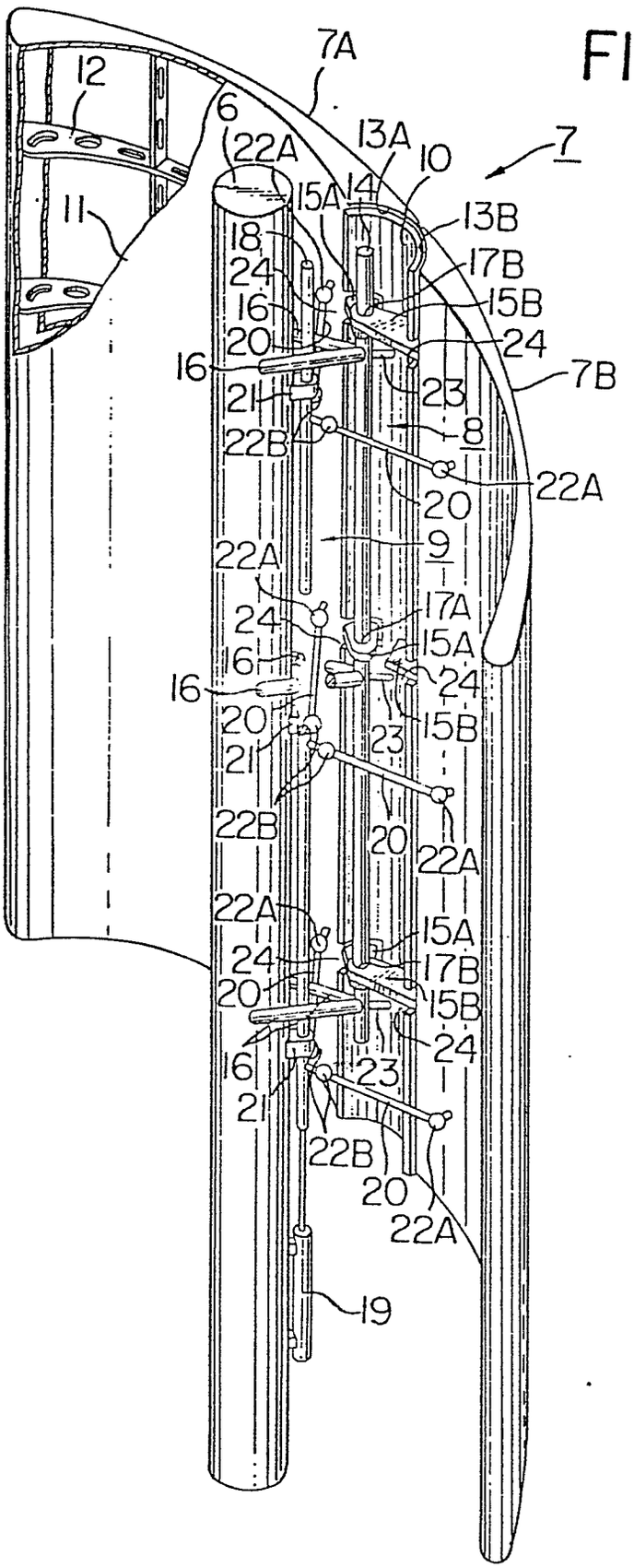

7A
12
6
22A
13A
10
7
15A
14
11
13B
18
17B
24
15B
16
20
24
16
7B
21
23
22B
8
22A
20
9
22A
17A
24
15A
16
24
16
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15B
23
21
22B
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15B
24
16
23
21
22B
20
22A
19

FIG. 4

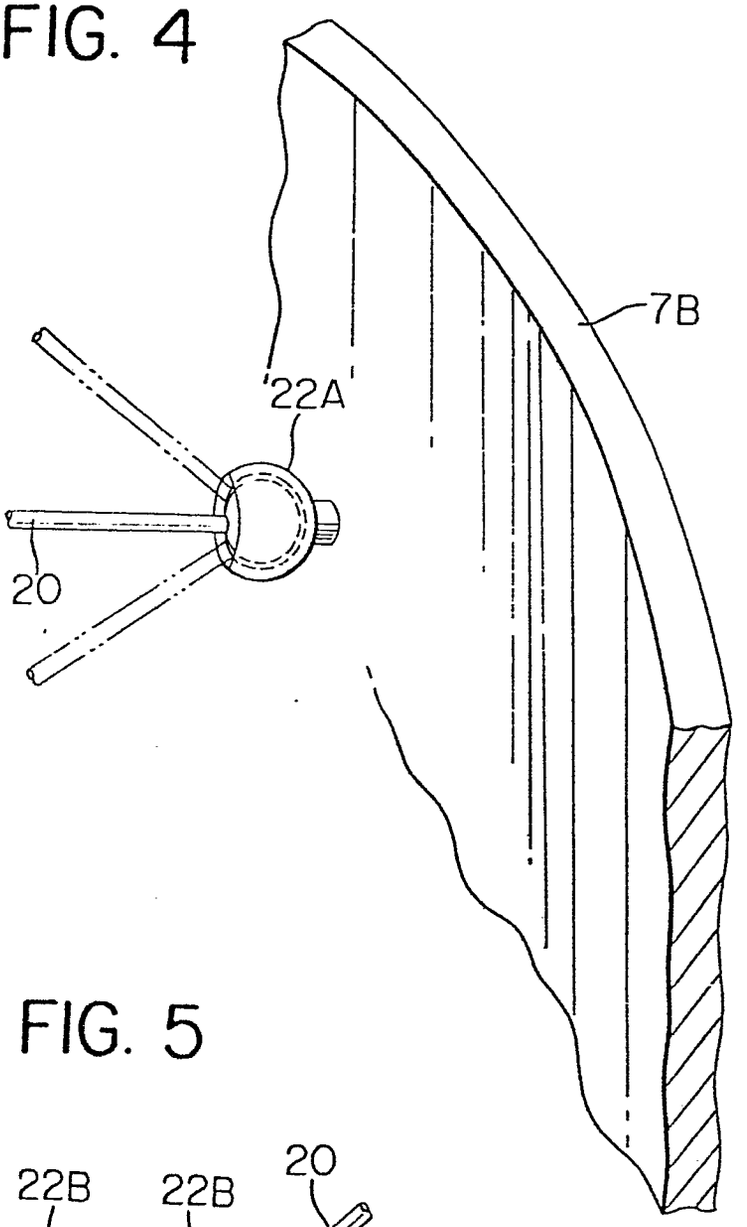


FIG. 5

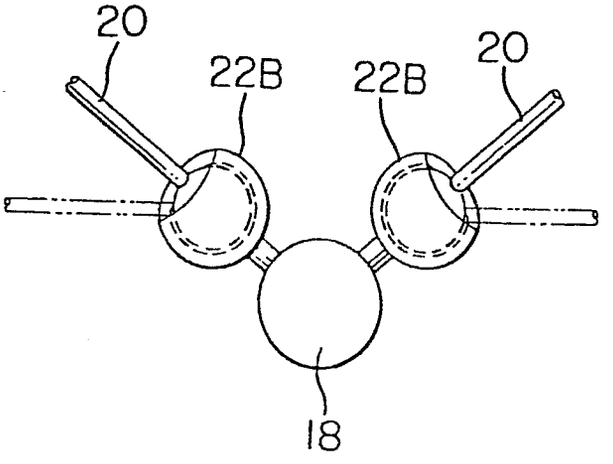


FIG. 6

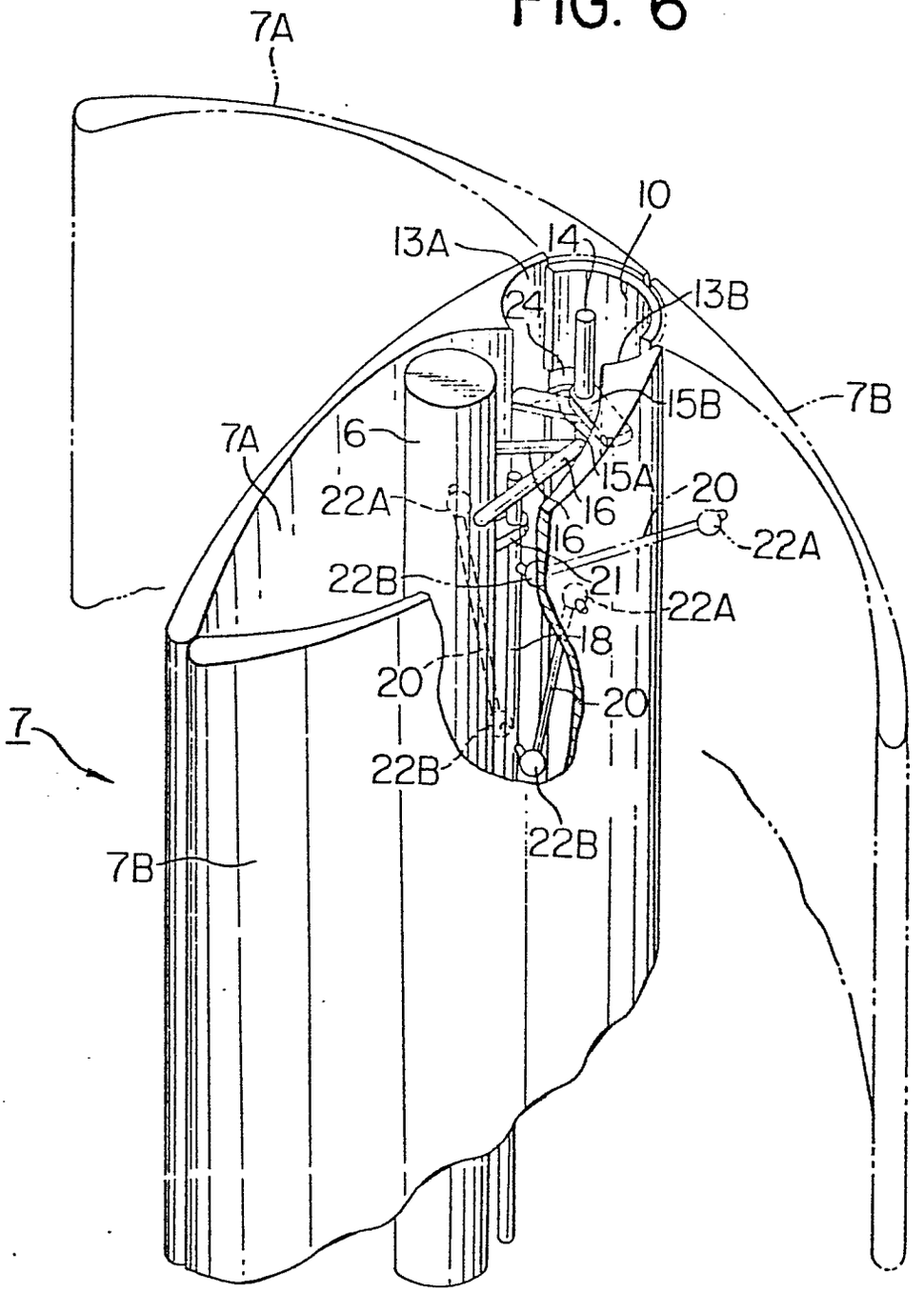

7A
10
13A
14
24
13B
7B
15B
7A
6
15A
20
22A
16
6
22A
22B
21
22A
18
20
20
7
22B
22B
7B

FIG. 8

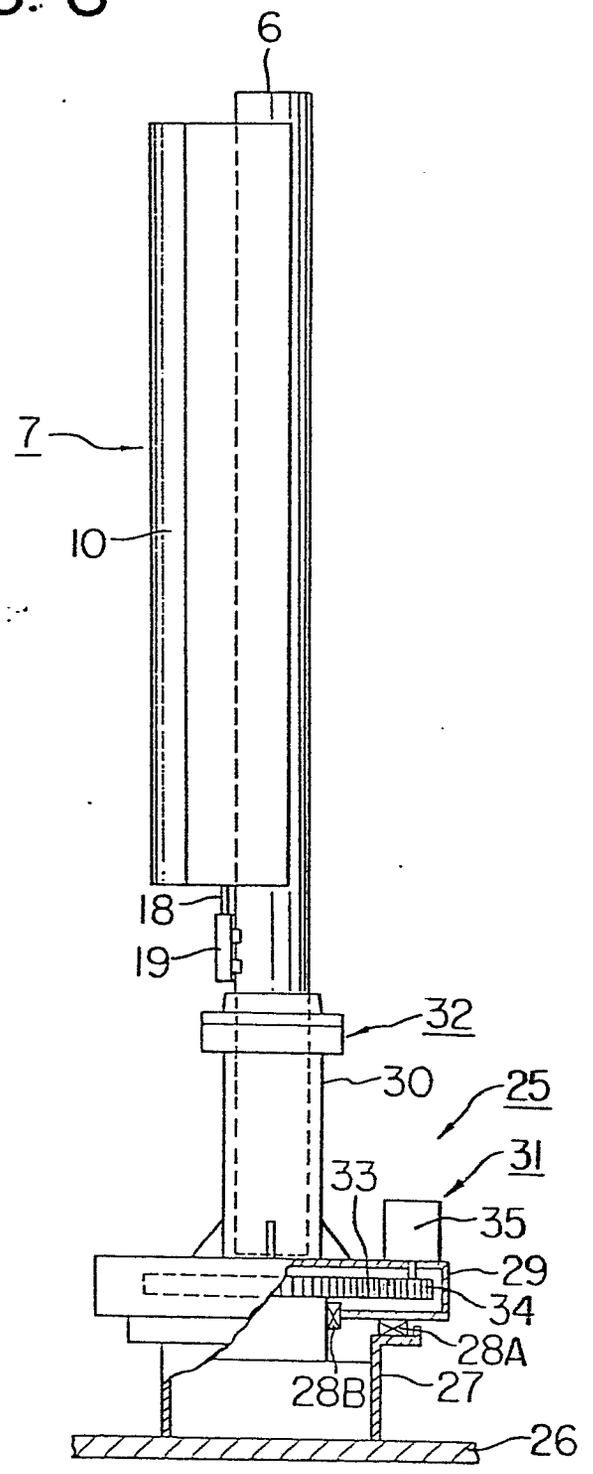


FIG. 7

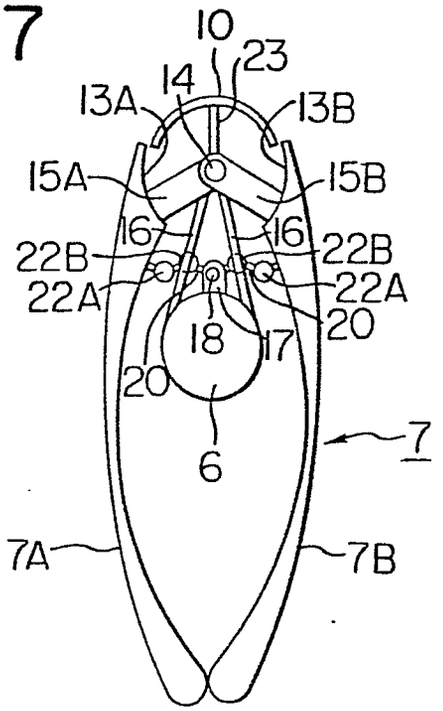
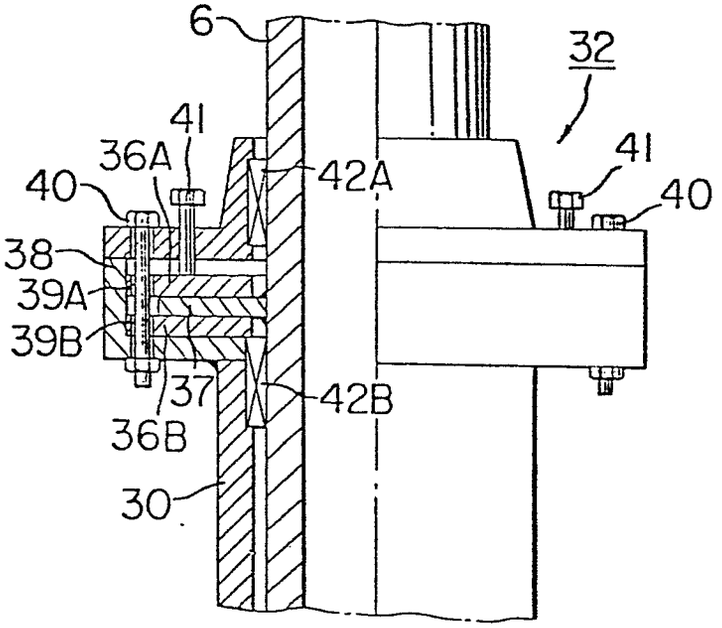

10
23
14
13A
13B
15A
15B
16
16
22B
22B
22A
22A
18
17
20
20
6
7
7A
7B

FIG. 9


6
32
41
36A
42A
41
40
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38
39A
39B
37
42B
36B
30

European Patent Office

EUROPEAN SEARCH REPORT

Application number EP 81 30 2002

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim
	GB - A - 1 410 175 (WAINWRIGHT) * The whole document * --	1,4,5
	MARINE ENGINEERS REVIEW, October 1980 Warley, West Midlands, GB "Japan launches first wind-assisted ship", page 19. * Whole article * --	1
A	FR - A - 1 013 642 (CAMOLLI) ----	

CLASSIFICATION OF THE APPLICATION (Int Cl.³)

B 63 H 9/06

TECHNICAL FIELDS SEARCHED (Int Cl.³)

B 63 H

CATEGORY OF CITED DOCUMENTS

X: particularly relevant
A: technological background
O: non-written disclosure
P: intermediate document
T: theory or principle underlying the invention
E: conflicting application
D: document cited in the application
L: citation for other reasons

&: member of the same patent family, corresponding document

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	04-01-1982	DE SCHEPPER