

**EUROPEAN PATENT APPLICATION**  
 published in accordance with Art. 158(3) EPC

Application number: 88906044.8

Int. Cl.<sup>3</sup>: **B 63 H 9/06**

**B 63 H 9/08, B 63 B 15/02**

Date of filing: 27.06.88

Data of the international application taken as a basis:

International application number:  
**PCT/JP88/00642**

International publication number:  
**WO88/10208 (29.12.88 88/28)**

Priority: 27.06.87 JP 160359/87  
15.03.88 JP 62861/88

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Date of publication of application:  
14.06.89 Bulletin 89/24

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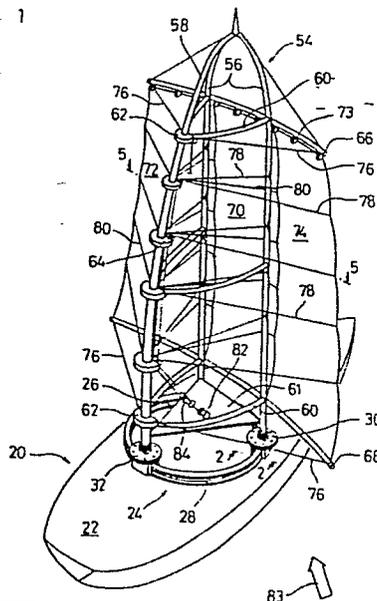
Designated Contracting States:  
**DE FR GB IT**

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**SAILBOAT.**

The sailboat of the present invention comprises sail support means (56) extending upward from a hull to expand the sail, a stay (58) for supporting the sail support means on the hull, a round guide orbit (24) placed horizontally on the hull, and a moving member (32) meshing with the guide orbit (24) in such a manner as to be capable of moving circularly, the lower end of the stay (58) being coupled to the moving member (32).

Fig. 1



## SPECIFICATION

### "Sailboat"

#### Field of Technology

This invention relates to a sailboat, especially to the turning mechanism of the sail.

#### Background Technology

In the past, because tall masts were supported by multiple stays secured to the hull, the turning range of the yard with square-rigged sails, and of the boom with fore-and-aft-rigged sails, was limited. Thus, it was difficult to adjust the wing-shape formed by the mast and the sail in order to obtain good lift performance in accordance with the direction of the wind. In addition, each time the relative positions of the yard or boom and the sail stays were changed as a result of the turning the boom, it was necessary to adjust the tensile force of the sail stays.

In consideration of the drawbacks described above, the overall objective of this invention is to propose a sailboat equipped with stays capable of being turned.

### **Outline of the Invention**

The sailboat of this invention is characterized in that: it has a sail support means which extends upward from the hull and stretches out the sail, and a stay which supports said support means on the hull; a circular guide track is mounted horizontally on the hull; a moving member is engaged with said guide track so as to be circularly moveable along the guide track; and the lower end of said stay is joined to said moving member.

### **Brief Explanation of the Drawings**

Preferred embodiments of this invention are shown in the attached drawings.

Fig. 1 is a perspective view of a square-rigged sailboat in accordance with one embodiment of this invention.

Fig. 2 is an enlarged fragmentary view in cross section along line 2—2 in Fig. 1.

Fig. 3 is a schematic view showing the arrangement of the moving members shown in Figs. 1 and 2.

Fig. 4 is a side view showing the detail of the sail and part of the mast shown in Fig. 1

Fig. 5 is a schematic cross-sectional view along line 5—5 in Fig. 1.

Figs. 6 and 7 are schematic cross-sectional views like Fig. 5 which show the flow of the wind with respect to the sail.

Fig. 8 is a schematic view showing a method for raising and lowering the mast shown in Fig. 1.

Fig. 9 is a schematic view of another embodiment of the invention applied to the yard of a square-rigged sail.

Fig. 10 is a cross-sectional view along line 10—10 in Fig. 9.

Figs. 11 and 12 are, respectively, a schematic perspective view and a schematic side view of a fore-and-aft-rigged sailboat in accordance with another embodiment of the invention.

Fig. 13 is an enlarged fragmentary view in cross section of the support structure at the bottom of the mast shown in Figs. 11 and 12.

Fig. 14 is a partially cut-away view in cross section along line 14—14 in Fig. 13.

Fig. 15 is an enlarged detailed fragmentary view in cross section along line 15—15 in Fig. 11.

Fig. 16 is a fragmentary perspective view of another embodiment applied to a fore-and-aft-rigged sail.

Fig. 17 is a side view partially in cross section of yet another embodiment applied to a fore-and-aft-rigged sail.

Fig. 18 is an enlarged detailed view of the winch shown in Fig. 17.

### **Preferred Embodiments of the Invention**

In Figs. 1 and 2, a circular guide track 24 is mounted horizontally on the deck 22 of the hull 20 of the sailboat. The guide track 24 has an inner peripheral channel 26 and an outer peripheral channel 28. In the guide track 24 are engaged a pair of fore moving members 30 and a single aft moving member 32.

As shown diagrammatically in Fig. 3, it is possible to position multiple spare moving members 34 engaged with the guide track 24 between the moving members 30 and 32. The spare members 34 can be substituted for the moving members 30 and 32 at appropriate periods, and also, in times of strong winds, reinforcement stays (not shown) for the mast can be connected to these spare members 34. Adjacent moving members can be connected with rods 36 in order to maintain uniform distances between all of the moving members. The fore and aft moving members 30 and 32 are positioned at the apexes of an isosceles triangle.

The moving members 30, 32, and 34 all have essentially the same structure, and an enlarged view of a fore moving

member 30 is shown in Fig. 2.

Each moving member consists of an upper part and a lower part. The upper part includes a horizontal disc 38 and a pair of eyeplates 44 which extend upward from that disc. A pin 46 is passed through the eyeplates 44 and held in the eyeplates 44 by a nut (not shown). The lower part of the moving member includes a horizontal disc 40, and a pair of feet 50 extend downward from that disc. A wheel 52 having a horizontal axle is provided on the inside of each of these feet 50. Each of the wheels 52 is rotatably engaged in either the inner or outer channel 26 or 28 of the guide track.

The upper and lower discs 38 and 40 are secured together by multiple bolts 42 and nuts 43. The relative angle of the upper and lower discs 38 and 40 is adjusted so that the axes 47 (Fig. 3) of the pins 46 of the two fore moving members 30 are aligned before the discs are bolted.

In order to absorb a shock such as that of a squall, tough rubber or a spring (not shown) can be inserted between the two discs 38 and 40. In the same way, springs can be inserted between the bolts 42 and the nuts 43.

As shown in Fig. 1, the mast 54 is comprised of a pair of fore stays 56 and a single back stay 58 all secured together at the top. The lower end of each of the fore stays 56 and back

stay 58 is hinged-connected by the pin 46 (Fig. 2) of one of the fore moving members 30 and aft moving member 32, respectively. The fore stays 56 and back stay 58 are secured together by three pairs of spars 60. A horizontal stage 61 is secured near the lower ends of the fore and back stays.

It is also possible to insert intermediate pieces between the upper and lower discs 38 and 40 of the two fore moving members 30 in order to tilt the mast toward the rear so that the center of the sail's wind pressure is close to the turning center of the mast 54. In the same way, an intermediate piece can be inserted between the discs of only one of the fore members 30 in order to tilt the mast to the right or left.

Note that it is also possible for the locations at which the stays 56 and 58 are hinged-connected to the moving members 30 and 32 to be above the horizontal stage 61.

As shown in Fig. 1, an upper yard 66 and a lower yard 68 are secured to the fore stays 56, or supported slidably. When the yards 66 and 68 are perfectly lateral, the aft moving member 32 is in the aftmost position. A series of three separate sails, a middle sail 70, a port sail 72, and a starboard sail 74 are stretched between the upper and lower yards 66 and 68 so that they are positioned between and to each outward side of the fore stays 56, respectively.

A detailed view of the means used to unfurl the sails is shown in Fig. 4. Multiple rings 67 are guided by a guide wire 65 strung between the upper and lower yards 66 and 68. Multiple bars 69 mounted in the lateral direction to each of the sails 70, 72, and 74 are coupled to the corresponding rings 67. Multiple unfurling lines 71 (only one is shown) attached to the topmost bars 69 are routed through multiple pulleys 73 mounted to the upper yard 66 and wound around a winch (not shown) on the stage 61 (Fig. 1). Likewise, multiple furling lines 75 attached to the topmost bars 69 are also wound around the same winch.

Through the operation of this winch, the sails can be furled and unfurled smoothly along the guide wires 65 without flapping, even in the turbulence of strong winds.

As shown in Figs. 1 and 5, multiple blocks 62 mounted at intervals along the back stay 58 each have multiple guide pulleys 64. Yard camber control lines 76 are connected to both ends of the upper and lower yards 66 and 68. The upper and lower lines 76 are routed through the pulleys 64 of the respective uppermost and lowermost blocks 62 on the back stay 58 and then led to a winch (not shown) on the stage 61.

At the positions corresponding to the remaining intermediate blocks 62, sail edge control lines 78 and 80 are

connected to the right and left edges, respectively, of each of the sails 70, 72, and 74. The lines 78 and 80 at each position are routed through the guide pulleys 64 of the intermediate block 62 and then led to reels 82 and 84, respectively, on the stage 61.

As best illustrated in Fig. 5, the sail edge control lines 78 and 80 for the middle sail 70 are routed to the outside of the two fore stays 56, while the starboard control lines 78 for the port sail 72 and the port control lines 80 for the starboard sail 74 are routed to the inside of the fore stays 56.

By pulling in the starboard edge control lines 78 and slackening the port edge control lines 80, the right edges of the middle sail 70 and the port sail 72 are pulled in tight against the fore stays 56 and the left edges of the middle sail 70 and the starboard sail 74 separate from the fore stays 56, thus forming gaps between the three sails.

When the wind is blowing in the direction indicated by the arrows 83 in Figs. 1, 5, and 6, the flow of the wind will be as shown in Fig. 6. Generally, the lift of the wing-shape (sail) is increased in proportion to the angle of attack. At a certain angle (approximately 20 degrees), however, the flow at the back of the wing-shape will break away and lose speed, thus causing a sudden drop in the lift.

For the wings of a airplane, during take-off and landing, when the angle of attack is large, slats, flaps, etc., are used to create gaps in the wings in order to prevent a loss of speed, thus causing the wing lift coefficient to increase more than 2.5 times that during cruising. This invention is designed to make use of this gapped-wing effect.

Fig. 8 shows a simplified illustration of the method used to lower the mast 54.

First, the sails are furled or removed. If the upper yard 66 (Fig. 1) is capable of sliding, it is slid down. The moving members 30 and 32 are lashed to the deck by using eyes and ropes (not shown). The pin 46 of the aft moving member 32 is pulled out and the pins 46 of the fore moving members 30 are used as fulcrums to lower the mast 54.

Even if the mast 54 is very tall, using winches 59 and lines 61 positioned fore and aft as shown in Fig. 8, the mast can be lowered safely by gradually slackening the aft line and winding up the fore line. The lowermost spars 60 act as a lever, and the mast is lowered safely.

With the construction of this embodiment of the invention, a tall mast can be freely rotated together with the sails and yards, and, when necessary, the mast can be folded downward. Because the gaps between the separately stretched

sails are controlled, they are gapped square-rigged sails for which, using the same action as the high-lift devices, i.e. the slats and flaps, of an airplane, there is no loss of speed, i.e. separation of the air flow, even at large angles of attack.

Furthermore, by separately unfurling the sails to catch air with each of the fore stays, which form the mast, as part of the front edge of the sails, the sails can be formed in an ideal wing shape having rounded front edges and sharp rear edges.

Figs. 9 and 10 show a means for using the action of a plate spring to provide the yards 66 and 68 with elasticity. The yard 66A is formed by overlapping multiple flat plates 86, with the shortest flat plate positioned to the rear, and securing these flat plates with bands 88 at multiple locations. By changing the tension of the lines 76 connected to both ends of the yard, the yard can be flexibly bent like a fishing rod, thus allowing easy control of the yard's camber.

Figs. 11 through 15 show an embodiment of the invention applied to a fore-and-aft-rigged sailboat. A single mast 154 is positioned at the center of the deck 122 of the hull 120. Note that, for yachts, dinghies, etc., which do not have a deck, the mast is mounted directly to the hull.

A fore spreader 138 and port and starboard spreaders 140 extend outward approximately horizontally from the top

part of the mast 154, and port and starboard spreaders 142 extend outward approximately horizontally from the bottom part of the mast 154.

An aft boom 144 extends from the top part of the mast 154, and a fore and aft booms 146 and 148 extend from the bottom part. One end of each boom is connected to the mast via a gooseneck 151 or hinge so as to be capable of turning left and right and up and down within a prescribed range.

As shown in Fig. 12, the sails consist of the fore and aft sails Sf and Sa. The fore sail Sf is stretched between the fore spreader 138 and the fore boom 146, and the aft sail Sa is stretched between the upper and lower aft booms 144 and 148.

As shown in Fig. 13, the mast foot 158 is rotatably inserted into a cylindrical support fixture 153 mounted approximately in the center of the deck 122. An eyeplate 160 is formed in the top of the mast foot 158. The fork-shaped bottom end 162 of the mast 154 is pivotably coupled to the eyeplate 160 by a bolt 164 and a nut 166. The bottom of the support fixture 153 is supported by a pillar 168, and the mast 154 is supported securely to the hull.

Thus, the mast 154 is rotatable on its axis, and is also tiltable on the axis of the bolt 164.

Eight horizontal arms 161, one end of each of which is

secured to a flange 159 formed at the upper part of the mast foot 158, extend outward at prescribed angle intervals. The four fore, aft, port, and starboard arms 161 are arranged at intervals of 90 degrees, and the intermediate arms 161 are positioned between them. The other end of each arm is secured to a moving member 150 as shown in Fig. 15. A circular stage 130 which is formed by joining together four fan-shaped members is secured to the upper surfaces of the arms 161.

As shown in Fig. 15, a locking fixture 156 is pivotably mounted to the upper end of each moving member 150 by a pin 157. The axis of the pin 157 and that of the bolt 164 (Fig. 13) are on the same horizontal plane. The two ends of a horizontal rotating shaft 149 journalled at the lower end of the moving member 150 are supported by a pair of wheels 152.

Circular inner and outer peripheral guide tracks 126 and 128 (Fig. 15) are installed in parallel on the deck 122 centered around the mast 154. Each of the wheels is capable of running inside one of the guide tracks 126 or 128. Thus, the stage 130 is rotatable together with the mast 154.

The sail stay 170 which supports the mast 154 and the fore sail Sf (Fig. 12) is secured to the top of the mast at its upper end, secured to the ends of the fore spreader 138 and the

fore boom 146, and then, at its lower end, secured to the locking fixture 156 of the forwardmost moving member 150 (Fig. 15).

In the same way, the sail stay 172 which supports the mast 154 and the aft sail Sa is secured to the top of the mast at its upper end, secured to the ends of the two aft booms 144 and 148, and then, at its lower end, secured to the aftmost moving member 150.

A pair of port and starboard mast stays 174 are each secured to the top of the mast 154 at their upper ends, secured to the ends of the upper and lower port and starboard spreaders 140 and 142, and then, at their lower ends, secured to the port and starboard moving members 150, respectively. Furthermore, two pairs of port and starboard mast stays 176 are each secured to the top of the mast 154 at their upper ends, and secured to the port and starboard moving members 150, respectively, at their lower ends. Two pairs of intermediate mast stays 177 are each secured to the top of the mast at their upper ends, and each is secured to a separate corresponding moving member 150 at its lower end.

Thus, the sail and all of the stays are rotatable together with the mast.

Note that it is also possible to secure the mast 154 to the

deck 122 so that it is not rotatable. In this case, the stage 130 and arms 161 are rotatably mounted to the mast using bearings (not shown), etc. Also, all of the spreaders and booms are supported by rotating rings (not shown) installed on the mast using bearings.

The upper port and starboard spreaders 140 are positioned 180 degrees from each other, and are secured to a single rotating ring together with the fore spreader 138, so that each is positioned 90 degrees from the fore spreader 138. The lower port and starboard spreaders 142 are also secured to a single rotating ring so that they are positioned in a straight line. Each of the booms 144, 146, and 148 are supported by a gooseneck secured to a single rotating ring.

Fig. 16 shows a different embodiment of the invention applicable to a fore-and-aft-rigged sailboat. The mast 254 is positioned on the deck 222 in the same way as the mast 154 in Fig. 13, and it is supported, rotatably and tiltably with respect to the deck, by a mast foot 258, which is essentially the same as the mast foot 158. A circular guide track 224 is installed on the deck 222.

The inward ends of a single fore bar 226, a pair of port and starboard bars 228, and a pair of aft bars 230 which extend in the radial direction of the guide track 224 are secured to the

mast foot 258. The port and starboard bars 228 extend out at right angles with respect to the fore bar 226. The aft bars 230 are positioned so that they are at prescribed angles to the port and starboard bars 228 and at a prescribed angle to each other.

Moving members 232, 234, and 236, which are secured to the outward ends of the various bars, are slidably engaged with the guide track 224. An independent moving member 238 is slidably engaged with the guide track 224 between the aft moving members 236.

A fixture 242 on the top of the independent moving member 238 is slidably engaged with a line 240 strung between the aft moving members 236. By securing the fixture 242 with the line 240, it is possible to maintain the independent moving member 238 at a desired position.

To the fore and independent moving members 232 and 238 are connected at least fore and aft sail stays 270 and 272, respectively, and to the port and starboard moving members 234 are connected mast stays 276.

By independently making slight changes in the angle of the aft sail through the movement of the independent moving member 238, it is possible to adjust the camber of all of the sails and constantly maintain the optimum camber with respect to the direction of the wind. Note that, because most of the

wind pressure is applied to the fore sail, the operation just described would be difficult for that sail, so the fore sail stay 270 is commonly designed so that it is not capable of being turned independently.

Figs. 17 and 18 show an embodiment of the invention including a means for tilting a fore-and-aft-rigged mast 354.

The circular guide track 324 installed on the deck 322 has a reverse-L-shaped radial cross section. Multiple moving members 350 are secured to the outer periphery of the circular stage 350 which is secured to the mast foot 358. The lower part of each of these moving members 350 has an L-shaped radial cross section. These lower parts of the moving members are slidably engaged with the guide track 324 via balls 326 or rollers. Guide pulleys 332 and 334 are mounted to the upper ends of the fore and aft moving members 350, respectively.

A winch 336 is provided on the stage 330. As shown in Fig. 18, the drum 338 of the winch 336 is divided by a partition plate 340. The stays 370a and 372a connected to the fore and aft booms 346 and 348, respectively, are routed through the pulleys 332 and 334 and are wound around the separated parts of the drum 338. When one of the stays 370a or 372a is wound up by operating the handle 342, the other stay is simultaneously played out.

All other parts of the structure are essentially the same as the structure shown in Figs. 11 through 15.

By tilting the mast 354 fore or aft through the operation of the winch 336, the relative position of the center of the wind pressure being applied to the sails with respect to the turning center of the hull can be changed, thus allowing the wind pressure to be used to turn the hull, in the same way as for wind surfing. Note that, in place of the winch 336, it is also possible to use a tackle or a turnbuckle.

If the tilting of the mast 354 is not considered, it is also possible for the sail stay 370 on the end into which the wind flows to be comprised of a pipe similar to that used for the mast. By doing this, because the front edge of the sail is rounded, the lift performance is improved, and also the strength of the mast is increased.

With these embodiments applied to a fore-and-aft-rigged sailboat, because not only the sail stays, but also the mast stays, are constructed so as to be rotatable around the mast as a center, even if the boom rotates and the position of the sail is displaced, because the relative positions of the stays and the sail (boom) do not change, the sail stays can be handled easily without having to be restrung.

By designing the mast and its stays so that they are

rotatable together, the wing-shape comprised of the sail and the mast can be constantly adjusted extremely easily and quickly to the position of optimum lift performance with respect to all wind directions. For the fore-and-aft-rigged sailboat in Figs. 11 and 12, because the sails are stretched out fore and aft of the mast, by positioning the center of the wind pressure slightly aft of the mast, it is possible to greatly reduce the amount of force required to turn the sails, just as for the operation of the balanced rudder of a ship.

In addition, by tilting the mast in an appropriate direction in order to change the relative positions of the center of the wind pressure being applied to the sail and the turning center of the hull, the wind pressure can be used to easily turn and steer the boat.

With this invention, the booms or yards and the mast which stretch out the great sail with the same kind of high lift performance as the slats and flaps of an airplane wing are extremely easy to turn 360 degrees as a single unit. Especially, by making this turning operation automatic, it becomes possible to very efficiently use non-polluting wind energy for ship propulsion.

When this invention is applied to a catamaran, trimaran, etc., the circular guide track becomes the member which joins

the multiple hulls together, and, moreover, it is possible to use a large sail on hulls having a large initial righting moment.

In the construction shown in Figs. 1 through 3, in order to increase the strength of the rotating support structure, it is also possible to concentrically arrange multiple circular guide tracks 24. In this case, the lower discs 40 of the moving members 30, 32, and 34 would be enlarged and multiple pairs of feet 50 would be mounted to the lower discs.

The reels, winches, etc., for furling, unfurling, and controlling the sails can be safely and centrally controlled on the stage 61, 130, or 330.

Because the mast can be folded down, the possible sailing area is not limited by the presence of bridges, etc.

## CLAIMS

1. A sailboat, characterized in that: it has a sail support means which extends upward from the hull and stretches out the sail, and a stay which supports said support means on the hull; a circular guide track is mounted horizontally on the hull; a moving member is engaged with said guide track so as to be circularly movable along said guide track; and the lower end of said stay is joined to said moving member.
2. A sailboat, characterized in that: it has a pair of interconnected mast members which extend upward from the hull and stretch out the sail, and a stay which is connected to said mast members and which supports said mast members on the hull; a circular guide track is mounted horizontally on the hull; multiple moving members are engaged with said guide track so as to be circularly movable along said guide track; and the lower end of each of said mast members and said stay is joined to one of said moving members.
3. A sailboat as described in Claim 2, characterized in that: the lower end of each of said mast members and said moving members are pivotably coupled; each pivot axis is positioned on a direct line with the other pivot axis; the lower end of said stay is detachably coupled to said moving member; and it is

- possible to fold down said mast members.
4. A sailboat as described in Claim 2, characterized in that: a pair of horizontal upper and lower yards are supported by said mast members; multiple sails arranged in parallel along said yards are stretched out between said yards; and the gaps between said sails can be controlled by sail edge control lines connected to each left and right edge of each sail.
  5. A sailboat, characterized in that: it has a mast which extends upward from the hull, mast stays which are connected to said mast and which support said mast on the hull, and sail stays which are connected to said mast and which stretch out the sails; a circular guide track is mounted horizontally on the hull; multiple moving members are engaged with said guide track so as to be circularly movable along said guide track; and the lower end of each of said stays is joined to one of said moving members.
  6. A sailboat as described in Claim 5, characterized in that said mast is supported on the hull so as to be rotatable on its axis.
  7. A sailboat as described in Claim 5, characterized in that: the lower end of said mast is pivotably mounted to the hull; and said mast is capable of being folded down.
  8. A sailboat as described in Claim 5, characterized in that: said sails include a pair of a fore sail and an aft sail; said sail stays

include a pair of a fore sail stay and an aft sail stay which respectively support said fore and aft sails; said moving members coupled to said fore sail stay and said mast stays are inter-connected; and said aft sail stay is coupled to another one of said moving members.

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Fig. 1

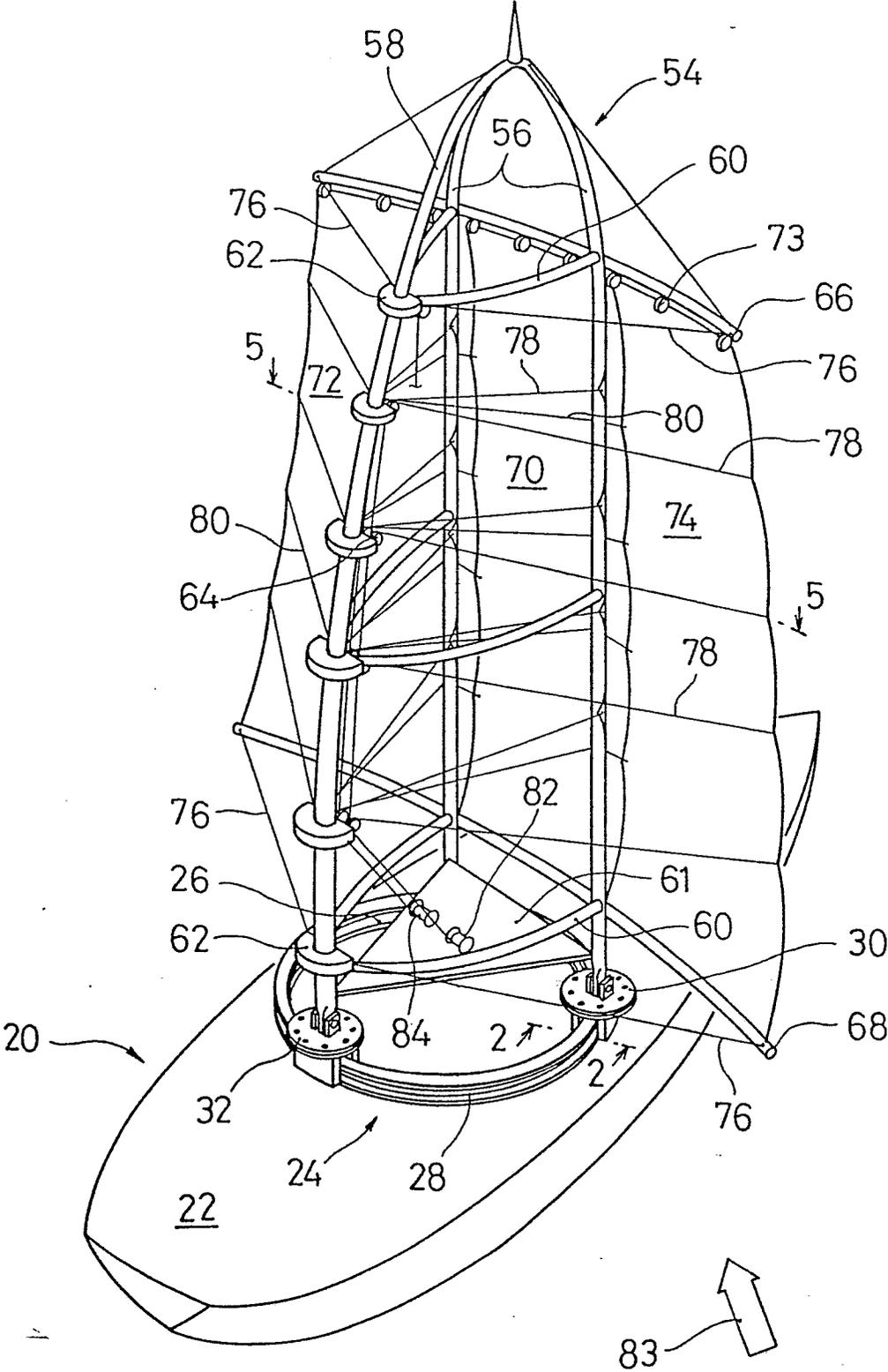


Fig. 2

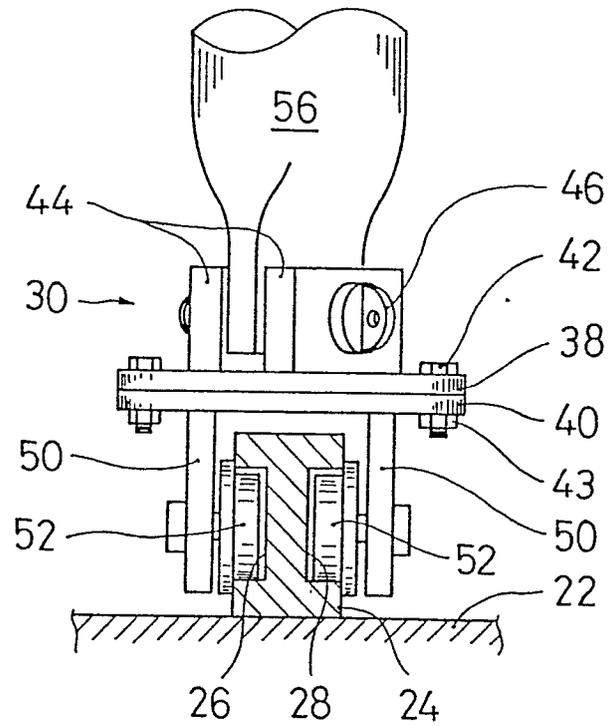


Fig. 3

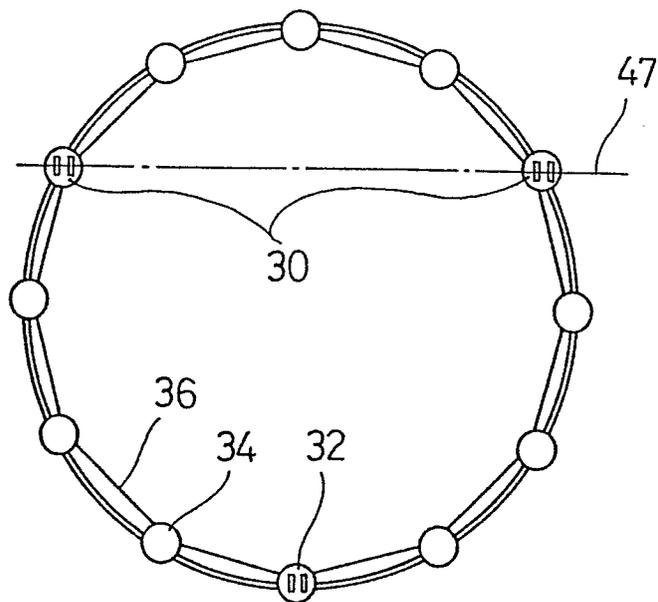


Fig. 4

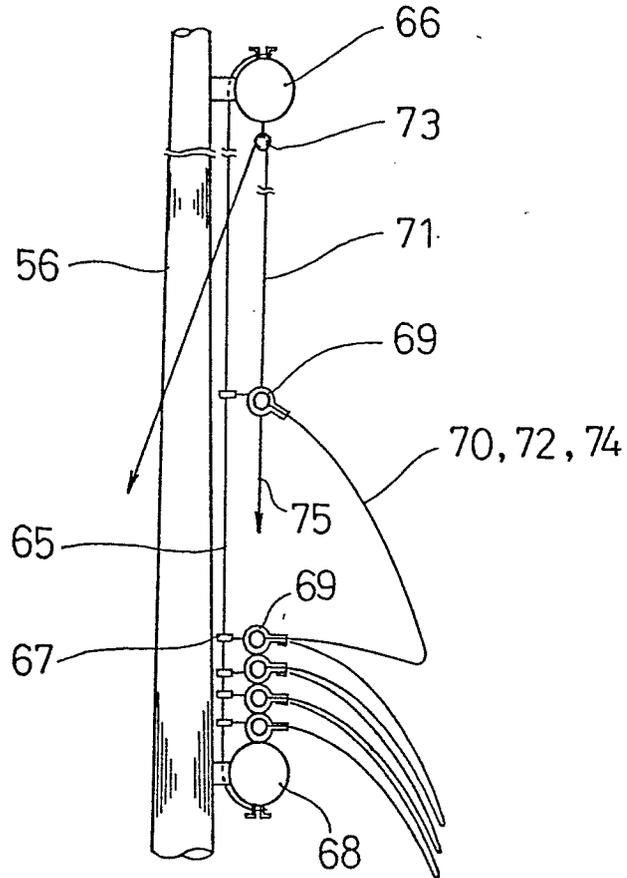


Fig. 5

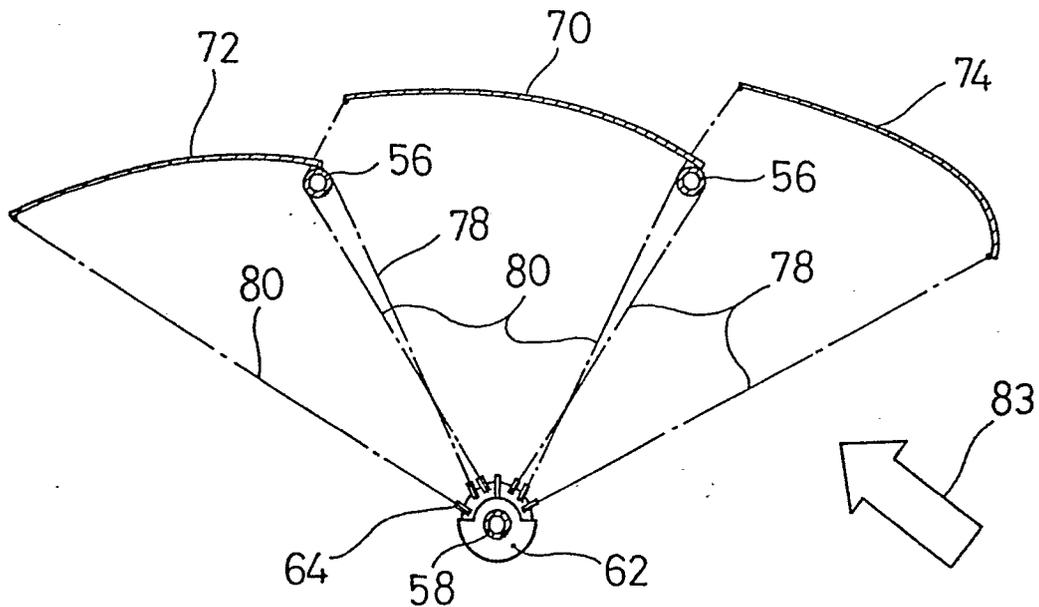


Fig. 6

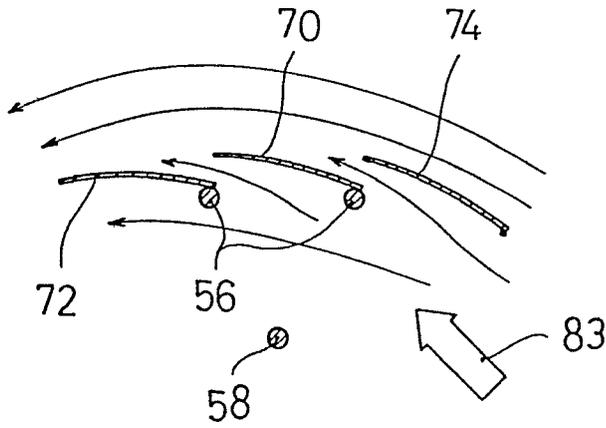


Fig. 7

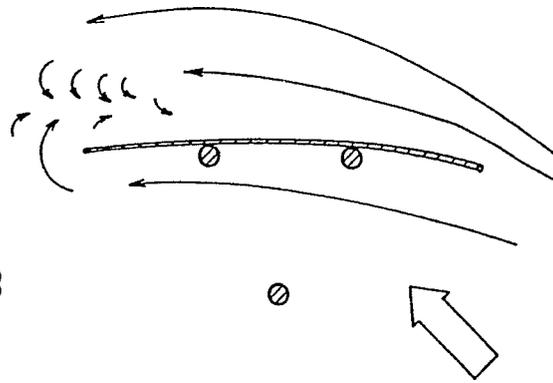


Fig. 8

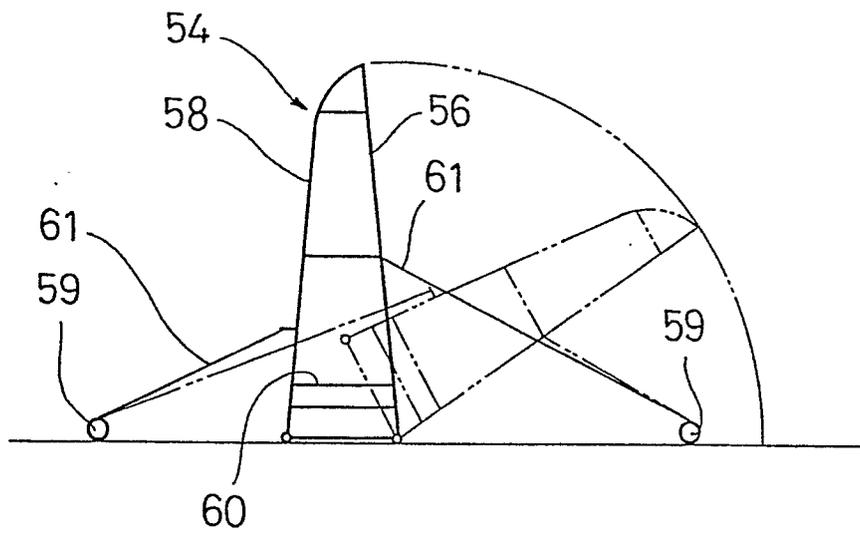


Fig. 9

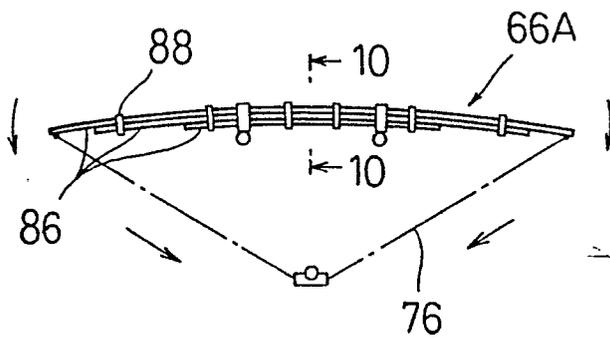


Fig. 10

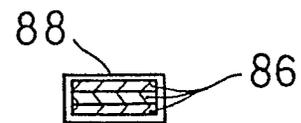




Fig. 12

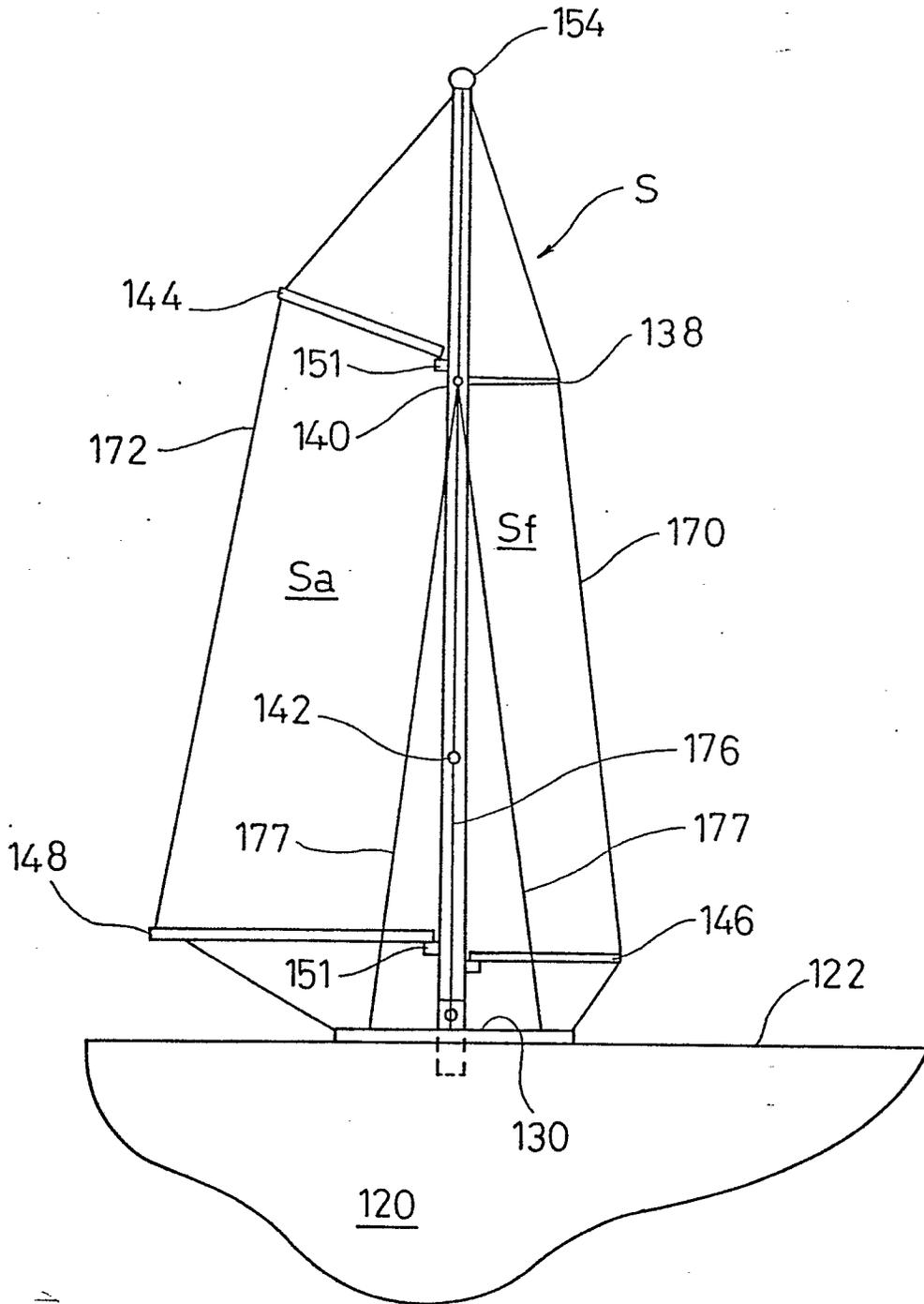




Fig. 16

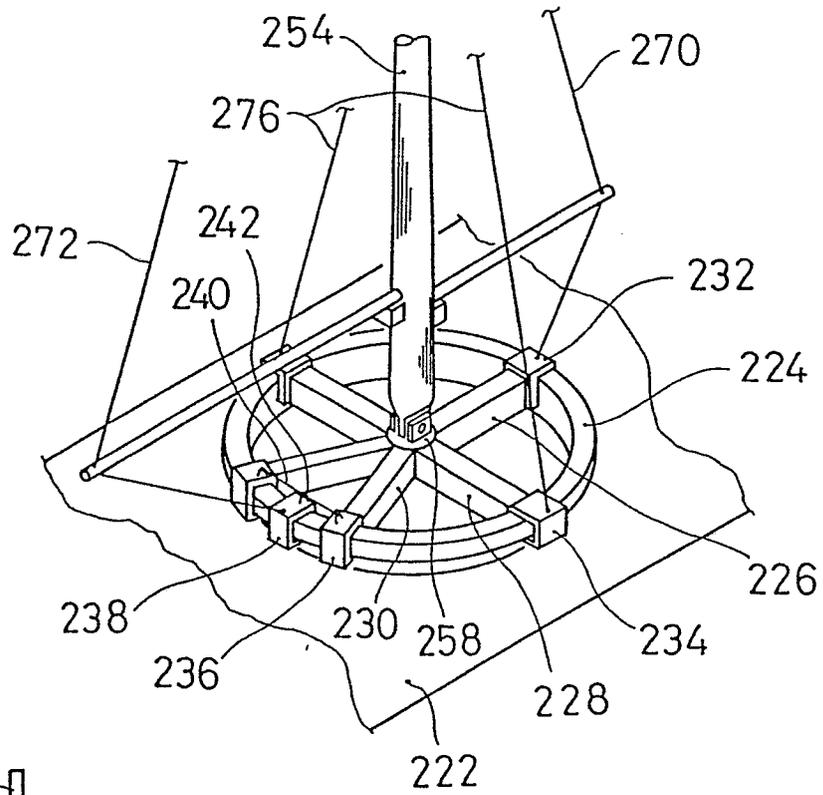


Fig. 18

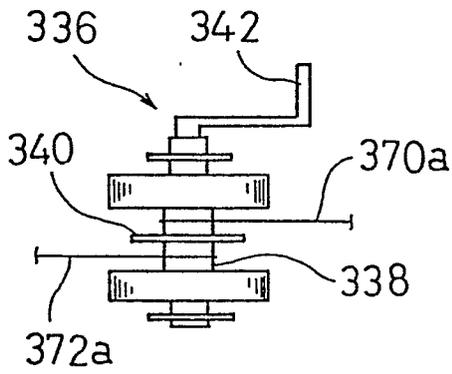
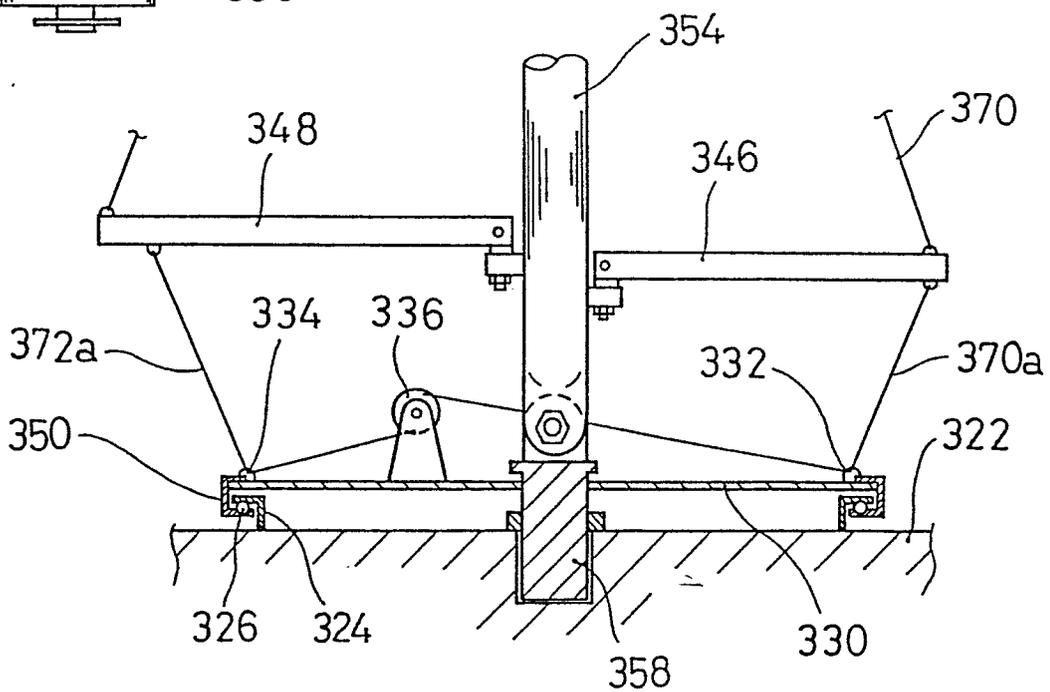


Fig. 17



## INTERNATIONAL SEARCH REPORT

International Application No PCT/JP88/00642

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) <sup>6</sup>		
According to International Patent Classification (IPC) or to both National Classification and IPC		
Int.Cl <sup>4</sup> B63H9/06, 9/08, B63B15/02		
II. FIELDS SEARCHED		
Minimum Documentation Searched <sup>7</sup>		
Classification System	Classification Symbols	
IPC	B63H9/00-9/10, B63B15/02	
Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched <sup>8</sup>		
Jitsuyo Shinan Koho	1922 - 1987	
Kokai Jitsuyo Shinan Koho	1971 - 1987	
III. DOCUMENTS CONSIDERED TO BE RELEVANT <sup>9</sup>		
Category <sup>10</sup>	Citation of Document, <sup>11</sup> with indication, where appropriate, of the relevant passages <sup>12</sup>	Relevant to Claim No. <sup>13</sup>
Y	JP, B2, 60-2240 (Zaidan Hojin Nihon Hakuyo Kiki Kaihatsu Kyokai, Nippon Kokan Kabushiki Kaisha) 19 January 1985 (19. 01. 85) (Family: none)	1-3, 5-7
Y	JP, A, 58-112895 (Nippon Kokan Kabushiki Kaisha) 5 July 1983 (05. 07. 83) (Family: none)	6-7
Y	JP, A, 58-164495 (Hitachi Zosen Corporation) 29 September 1983 (29. 09. 83) (Family: none)	1-3, 5-7
Y	JP, U, 58-28098 (Hitachi Zosen Corporation) 23 February 1983 (23. 02. 83) (Family: none)	1-3, 5-7
<p><sup>10</sup> Special categories of cited documents:</p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> <p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step</p> <p>"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art</p> <p>"Z" document member of the same patent family</p>		
IV. CERTIFICATION		
Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report	
September 5, 1988 (05. 09. 88)	September 19, 1988 (19. 09. 88)	
International Searching Authority	Signature of Authorized Officer	
Japanese Patent Office		

## FURTHER INFORMATION CONTINUED FROM THE SECOND SHEET

Y	SU, A, 982968 (OLSHANSKII E I) 23 December 1982 (23. 12. 82) (Family: none)	1-3, 5-7
Y	JP, U, 58-100889 (Mitsubishi Heavy Industries, Ltd.) 8 July 1983 (08. 07. 83) (Family: none)	3, 7
Y	JP, A, 59-134089 (Senpaku Gijutsu Kaihatsu Kabushiki Kaisha, Hanshin Nainenki Kabushiki Kaisha, Zaidan Hojin Nihon Hakuyo Kiki Kaihatsu Kyokai) 1 August 1984 (01. 08. 84) (Family: none)	3, 7

V.  OBSERVATIONS WHERE CERTAIN CLAIMS WERE FOUND UNSEARCHABLE<sup>10</sup>

This international search report has not been established in respect of certain claims under Article 17(2) (a) for the following reasons:

1.  Claim numbers..... because they relate to subject matter<sup>12</sup> not required to be searched by this Authority, namely:

2.  Claim numbers..... because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out<sup>13</sup>, specifically:

VI.  OBSERVATIONS WHERE UNITY OF INVENTION IS LACKING<sup>11</sup>

This International Searching Authority found multiple inventions in this international application as follows:

1.  As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims of the international application.

2.  As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims of the international application for which fees were paid, specifically claims:

3.  No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims. It is covered by claim numbers

4.  As all searchable claims could be searched without effort justifying an additional fee, the International Searching Authority did not invite payment of any additional fee

Remark on Protest

The additional search fees were accompanied by applicant's protest

No protest accompanied the payment of additional search fees

## FURTHER INFORMATION CONTINUED FROM THE SECOND SHEET

Y	JP, A, 60-42196 (Hardtmuth Berthold Scheidt, Blumer Fluhkan A.G. Schiffbau und Maschinenfabrik) 3 July 1985 (03. 07. 85) & DE, A1, 3316139 & US, A, 4546718 & EP, A1, 127004 & DK, A, 219884 & FI, A, 841723 & NO, A, 841694	1-3
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V.  OBSERVATIONS WHERE CERTAIN CLAIMS WERE FOUND UNSEARCHABLE<sup>10</sup>

This international search report has not been established in respect of certain claims under Article 17(2) (a) for the following reasons:

1.  Claim numbers..... because they relate to subject matter<sup>12</sup> not required to be searched by this Authority, namely:

2.  Claim numbers..... because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out<sup>13</sup>, specifically:

VI.  OBSERVATIONS WHERE UNITY OF INVENTION IS LACKING<sup>14</sup>

This International Searching Authority found multiple inventions in this international application as follows:

1.  As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims of the international application
2.  As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims of the international application for which fees were paid, specifically claims:
3.  No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claim numbers:
4.  As all searchable claims could be searched without effort justifying an additional fee, the International Searching Authority did not invite payment of any additional fee

## Remark on Protest

- The additional search fees were accompanied by applicant's protest
- No protest accompanied the payment of additional search fees