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(71) Applicant: **Trend Marine Products Limited**
Great Yarmouth
Norwich
NR29 5GB (GB)

(72) Inventors:
- **Miller, David Frederick**
  Great Yarmouth
  Norwich NR29 5GB (GB)
- **Edwards, Lucien Fred**
  Great Yarmouth
  Norwich NR29 5GB (GB)

(74) Representative: **Harrison, Paul Richard**
Novagraaf Norwich Limited
Willow Lane House
Willow Lane
Norwich NR2 1EU (GB)

(54) A sunroof system

(57) The invention disclosed relates to a sunroof system designed primarily for a pleasure boat. The system includes a panel (12) moveable between an open and a closed position. A motor driven chain (17) is provided, held within a guide rail (10), to drive the panel (12) between positions.

A carriage means connects the panel (12) to the chain (17) and is supported on rollers (44) resting on flanges (15, 16) or the guide rail (10). In order to dampen vibrations and minimise noise during operation of the panel (12), a block (46) incorporating resilient elements is incorporated into the carriage means. Moreover a tensioner (80) is also included to take up or provide slack in the chain and (17), to allow for differential thermal expansion between the rail 13 and the chain 17.

In order to prevent ingress of dirt, into the carriage, brushed (26) are included in the guide rails (10).

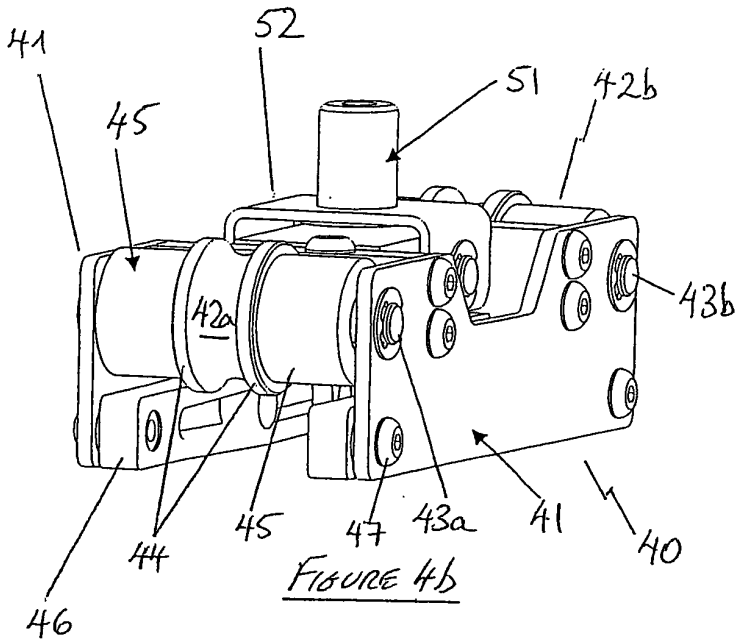

FIGURE 4b

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Description

Field of the Invention

[0001] The present invention relates to a sliding sunroof system. The system is particularly suitable for use on a boat, especially a luxury pleasure boat.

Background to the Invention

[0002] Increasingly, luxury pleasure boats primarily for private use, include large sliding roof panels, similar in concept to a car sunroof. Such roofs provide the user with a degree of flexibility when steering a boat in respect of their being open to the weather conditions. Although roof panels are constructed from lightweight materials they are nevertheless still heavy and means are normally included to facilitate movement between the closed position and a partially or fully open position. Features which provide smooth or low friction movement are known, but increasingly motors are included to drive the panel.

[0003] A problem which then remains is how best to incorporate the motor and drive connections. Any system which is to be used must be robust enough to deal with the forces which are exerted on the panel. The lightweight materials used provide panels which are normally square or rectangular in shape, and flexible both laterally and longitudinally. In rough or choppy seas forces are generated which act to bend the panel and therefore exert pressure on any drive mountings to which the panel is connected. In extreme cases this can lead to the sunroof coming loose or sliding across the aperture it is covering.

[0004] Because of the nature of the boats in which sliding panels are to be installed, a further user requirement is for operation of the panel to be quiet. Any drive system must therefore ensure that noise generated is kept to a minimum.

[0005] A final consideration for a sunroof system is its ease of installation and, where necessary, repair. It would be advantageous therefore if a system were to be easy to incorporate into a boat design.

[0006] It is an object of the invention to provide a sunroof system which addresses the above problems.

Summary of the Invention

[0007] According to a first aspect of the invention there is provided a sunroof system for a pleasure boat having a sliding roof panel, and further including an endless chain, connected to a panel by connection means, and a motor to drive the endless chain;

the chain being constrained to run within a guide rail having a base section, with side walls depending from the edge thereof to form a U-shaped channel, the free edge of each side wall ending in a flange element orientated perpendicularly thereto and whereby the flange elements define a space therebetween, leaving the channel open along one surface,

the connection means engaging and being supported by the surfaces of the flange elements.

[0008] The system can be easily installed and allows the panels to move freely between an open and closed position whilst allowing the panel to safely flex.

[0009] Preferably, the system includes a chain guide located within the channel, the chain guide separating portions of the chain moving in opposite directions. The guide reduces wear and tear on the chain and prevents undesired motion and harmonics building up. The chain guide is particularly preferably in two sections to facilitate assembly. Especially preferably the two sections are so profiled to provide one or more gaps between the sections along contacting surfaces. The provision of the gaps minimises the chance of the sections not sitting well against each other.

[0010] The connection means preferably engages the flange elements by means of rollers. The rollers run on the flange elements to provide a smooth operation. Especially preferably the or each roller includes one or more flanges, engaging the edge of the flange elements. The flanges on the roller prevent lateral movement of the panel with respect to the guide rails.

[0011] The connection means optionally includes a block engaging the underside of a flange element and gripping the flange element between the block and a roller. Further optionally, the block is formed of resilient material to dampen down vibrations. Alternatively, the block includes resilient means. Such vibrations, arising for example from the motion of the boat or from the engine can cause noise and also wear on the system elements. The block is yet further optionally urged against the flange element by a pin or similar fixing means to ensure good contact.

[0012] Preferably the connection means is operably connected to the chain by a toothed pick up, the teeth of the pick up sitting into the gaps between the links in the chain.

[0013] A brush pile is advantageously located in the guide rail to reduce noise and to hinder ingress of dirt into the rail which might cause damage.

[0014] The system preferably includes tensioning means adjustable to remove slack from the chain.

[0015] According to a second aspect of the invention there is provided a sunroof system for a pleasure boat having a sliding roof panel, and further including a rack and a pinion, connected to a panel by connection means, a motor to drive the rack and a pinion;

the rack being constrained to a guide rail having a base section with side walls depending from the edge thereof to form a U-shaped channel, the free edge of each wall ending in a flange element orientated perpendicularly thereto and whereby the flange elements define a space there between, leaving the channel open along one surface,

the connection means engaging and being supported by the surfaces of the flange elements.

Brief Description of the Drawings

[0016] The invention will now be described with respect to the accompanying drawings which show by way of example only, two embodiments of a sunroof system. In the drawings:

Figure 1 is an end view of a first embodiment of a guide rail and chain support;

Figure 2 is a perspective view of a guide rail in a panel gutter;

Figures 3a and 3b show respectively a tension means and sprocket connection;

Figures 4a and 4b show respectively an end view and a perspective view of a connection means;

Figure 5 illustrates a guide block;

Figure 6 is a perspective view of a pick up link;

Figure 7 is a second embodiment of a guide rail including a rack and pinion;

Figures 8a-8d illustrate a chain tensioner incorporated into a carriage; and

Figures 9a-9c show respectively a rear-drive system, a centre-drive system and a mid-drive system.

Detailed Description of the Invention

[0017] The attached drawings show a system to enable a sunroof panel to be moved between an open and closed position. The system moreover provided is designed to be robust towards flexing of the panel and to minimise the noise produced during panel movement. The system is designed primarily for use within luxury boats. Typically such boats are of length 15 to 30 metres and the panels under consideration approximately rectangular in shape and of dimension 2-4 metres. Such panels are designed to be relatively strong but lightweight and can be formed of plastics materials, glass fibre or carbon composites.

[0018] Referring initially to Figures 1 and 2, part of the mechanism for a control system is shown. A prime component is an elongate guide rail 10, formed from aluminium or steel, which is set into a gutter or channel 11 beneath a roof panel 12. The guide rail 10 has a base plate 13. Two side walls 14 depend perpendicularly upwardly, from the base plate 13 to define a U-shaped channel. Flanges 15, 16 are located perpendicularly across the free edge of each side wall 14, and provide support for movement of the panel 12.

[0019] In order to move the panel 12, an endless chain 17 of typically ⅜" (0.95cm) pitch is provided, the chain being operably connected to a motor and to the panel 12. The chain 17 is located wholly within the U-shaped channel of the guide rail 10, and describes an upper path 18 and a lower path 19 as part of a loop. The lower path 19 of the chain 17 is supported by a ridge 21 on a lower chain guide 20. Resting on the lower chain guide 20 is an upper chain guide 22. The upper chain guide 22 has a first ridge 23 which depends downwardly from the upper chain guide 22, co-operating with the ridge 21 to constrain lateral and vertical motion of the chain 17.

[0020] This feature reduces wear on the chain 17, and also noise due to rattling of the chain 17. Moreover, impact of the boat's motion on the chain's motion is minimised.

[0021] A second ridge 24 is also provided on the upper chain guide 22 to support the chain 17 as it moves along the upper path 18. To secure the upper chain guide 22 in position, ridges 25a, 25b are provided on the guide rail 10.

[0022] Further features of the system are shown in Figures 3a and 3b, which illustrate the tensioning block and the drive means. In order to minimise undesirable slack in the chain, tensioning means are provided. Two options for tensioning means are illustrated, which act in similar fashion. The tensioning means comprise an idle sprocket 30 around which the chain (not shown in Figures 3a, 3b) passes.

[0023] The sprocket 30 is connected to the tensioning block 31 whose operation enables the position of the sprocket 30 to be moved within the guide rail 10. By suitable adjustment of this position the effective path length of the chain 17 is altered. This feature facilitates installation of the system and also provides rapid correction if the chain 17 becomes slack after having been in use. The location of the sprocket 30 and the tensioning block 31 is at the discretion of the operator and depends upon compatibility with the particular boat in which the system is being used.

[0024] Motion of the chain 17 is provided by a motor which connects through, via a drive shaft 32, to a drive sprocket 33 located within the guide rail 10. Figure 3a provides two options for the location of the tensioning block 31. Figure 3b shows two options for the location of the drive sprocket 33, the choice of location depending upon the installation position of the motor. The drive sprocket 33 is supported by a block which supports the drive shaft 32 and also provides clearance for a carriage (see below) to run over the elements of the tensioning means.

[0025] The drive shaft 32 can be connected to the drive motor via universal joints and coupled shafts, although alternative connections such as flexible drive shafts can be used where suitable.

[0026] Motion of the chain 17 is coupled to the roof panel 12 through a carriage 40 illustrated in Figures 4a, 4b and 5. Simply put, the carriage 40 is connected to and supports the panel 12 and the chain 17, and is itself supported on the guide rail 10. As the motor drives the chain

17 therefore, the carriage 40 and the panel 12 are moved along in the same direction.

[0027] The carriage 40 has two carriage brackets 41 to provide a support framework for the other carriage elements. At the front and rear of the carriage 40 two rollers 42a, 42b are mounted on axles 43a, 43b. The axles 43a, 43b pass through holes defined in the brackets 41. Where suitable, the axles can be incorporated as an integral part of the rollers 42a, 42b. Each roller 42a, 42b is profiled by incorporation of roller flanges 44. In use, the rollers surfaces 45 rest on the upper surface of the guide rail flanges 15, 16 whilst the roller flanges 44 are contiguous with the inwardly facing edges of the flanges 15,16. The roller flanges 44 and the roller surfaces 45 co-operate therefore with the flanges 15,16 to keep the carriage 40 correctly aligned.

[0028] Each bracket 41 also supports a generally elongated block 46 held in position on the bracket 41 by means of fixing means 47 passing through holes in the bracket 41 and into the block 46. The block 46 is resilient in nature, resilience being provided firstly by the shape of the block 46 having a cut away portion 48 allowing the remaining portions 49 to flex. In an alternative embodiment, not illustrated, the block 46 is formed of a resilient material. In use the block 46 engages and is urged against the underside of the lower surface of the flange 15, 16. To further urge the block 46 against the flange 15,16 a pin 50 passes through the block 46.

[0029] The roller surfaces 45 therefore co-operate with the block 46 to restrict vertical movement of the carriage 40. Such vertical movement may be occasioned by motion of the boat or engine vibrations.

[0030] The carriage 40 is coupled to the panel 12 by a connection system, simply illustrated as the connection column 51. The connection column 51 is typically formed of a material such as to provide a strong member able to withstand the forces generated by the boat and the panel's movement. A connection bracket 52 supports and connects the column 51 to the carriage 40. In order to connect the carriage 40 to the chain 17, a pick-up 60 (shown in Figure 6) is fixed to the lower portion of the carriage 40 by fixing means which pass through the apertures 61. The pick-up 60 is provided with teeth 62 which sit between the links of the chain 17 and thereby couple the chain 17 to the carriage 40.

[0031] In order to prevent ingress of dirt into the carriage or chain and to reduce the noise generated on operation of the system, a brush pile 26 is located within the upper portion guide rail 10. The angle of the pile 26 is such that damaging engagement with the flanges 44 is avoided.

[0032] The carriage 40 so described firmly connects the panel 12 to the guide rail 10. Due to the elements of the carriage 40, the panel 12 is free to move in the direction of the guide rail 10 to open and cover an aperture. However, flexing of the panel 12 is restricted so minimising the risk of the panel 12 or the drive means detaching.

[0033] In Figure 7 a second embodiment of a system is shown. The carriage in Figure 7 is similar to that described above. The prime difference between the first and second embodiment is that the chain is replaced by a rack 70 and pinion 71.

[0034] Figures 8a-8d illustrate alternative means of tensioning the chain 17 in addition to or in conjunction with the means disclosed above. The tensioner 80 acts to ensure that the effective length of the chain 17 remains constant irrespective of the motion of the boat or the panel 12 or of thermal expansion between the rail 13 and the chain 17.

[0035] A floating housing 81 houses a series of springs 82-84, connected together in series. The housing pins 82a, 84a, attached to the free end of the springs 82, 84 respectively, connect the tensioner 80 within the loop of the chain 17. Further housing pins 83a, 83b connect the central spring 83 to the housing 81, butting up against the downwardly depending wall of the floating housing 81. The incorporation of the tensioner 80 within the loop of the chain 17 itself ensures that the tension within the chain 17 remains relatively constant. Moreover, by suitable adjustment of the housings, the tension can be set to a desired value.

[0036] The motor to drive motion of the panel can be incorporated in a number of positions depending upon the particular boat in which the system is installed. In Figure 9a, the motor 90 is mounted at the rear of the boat 91. The panel 12 is supported on two guide rails 10 and drive shafts 92 link the motor 90 to the chain 17 within the guide rails 10.

[0037] Figure 9b illustrates a centre-drive option. Again the motor 90 is mounted at the rear of the boat 91. The drive for the panel 12 is however mounted solely in the central guide rail 93. The panel 12 is additionally supported by the side guide rail 94, but no drive mechanism is located within the side guide rail 94.

[0038] Figure 9c illustrates a mid-drive option. In this embodiment, the motor 90 is mounted centrally with respect to the aperture. The panel 12 is supported by and the drive means located in each side guide rail 94, with drive shaft 92 linking the motor to the chain 17 with each guide rail 94.

[0039] It will of course be understood that the invention is not limited to the specific details described herein, which are given by way of example only, and that various modifications and alterations are possible within the scope of the invention.

Claims

1. A sunroof system for a pleasure boat having a sliding roof panel (12) moveable between an open and a closed position the system including an endless chain (17) connected to a panel (12) by a carriage means;
   a motor to drive the endless chain (17);
   the chain (17) being constrained to run within a guide

rail (10) having a base section, with side walls (14) depending therefrom to form a U-shaped channel, the free edge of each side wall (14) ending in a flange element (15, 16) orientated perpendicularly thereto and whereby the flange elements (15, 16) define a space therebetween, leaving the channel open along one surface,
the carriage means engaging and being supported by the surfaces of the flange element (15, 16).

2. A sunroof system according to Claim 1, **characterised in that** the system includes a chain guide located within the channel, the chain guide separating portions of the chain (17) moving in opposite directions.

3. A system according to Claim 2, **characterised in that** the chain guide is in two sections to facilitate assembly.

4. A system according to Claim 3, **characterised in that** the two sections are so profiled to provide one or more gaps between the sections along contacting surfaces.

5. A system according to any preceding Claim, **characterised in that** the carriage means engages the flange elements by means of rollers.

6. A system according to Claim 5, **characterised in that** the or each roller includes one or more flanges, engaging the edge of the flange elements.

7. A system according to any preceding Claim, **characterised in that** the carriage means includes a block engaging the underside of a flange element and gripping the flange element between the block and a roller.

8. A system according to Claim 7, **characterised in that** the block is formed of resilient material to dampen down vibrations.

9. A system according to Claim 7, **characterised in that** the block includes resilient means.

10. A system according to any one of Claims 7-9, **characterised in that** block is urged against the flange element by a pin or similar fixing means to ensure good contact.

11. A system according to any preceding Claim, **characterised in that** the carriage means is operably connected to the chain by a toothed pick up, the teeth of the pick up sitting in the gaps between the links in the chain.

12. A system according to any preceding Claim, **characterised in that** a brush pile is located in the guide rail to reduce noise and to hinder ingress of dirt into the rail which might cause damage.

13. A system according to any preceding Claim, including tensioning means adjustable to remove slack from the chain.

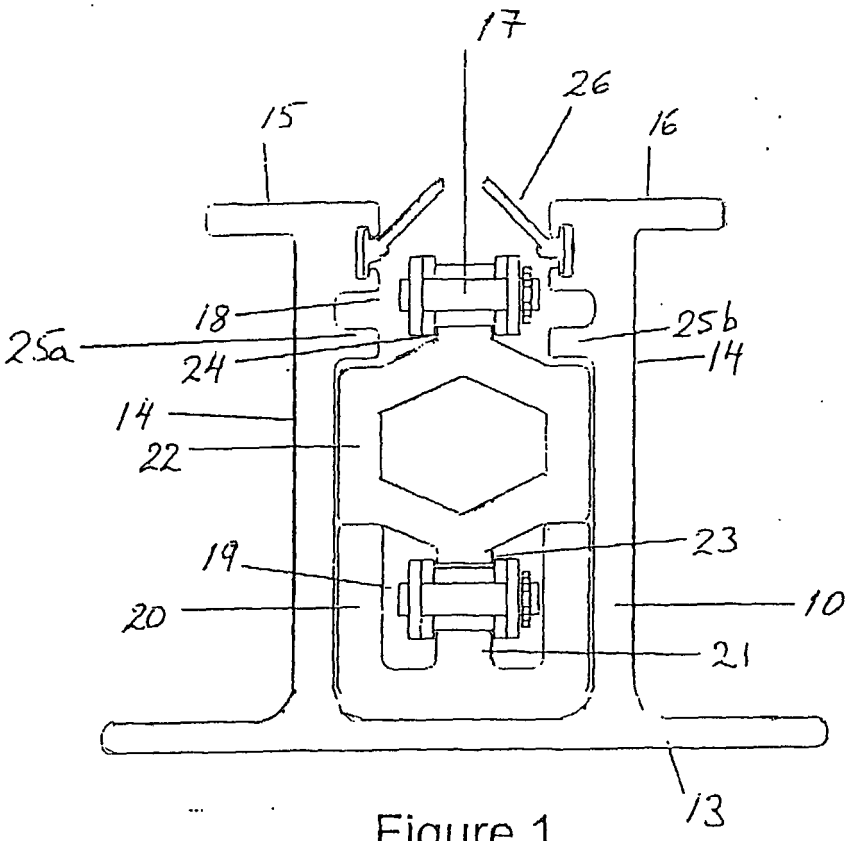

Figure 1

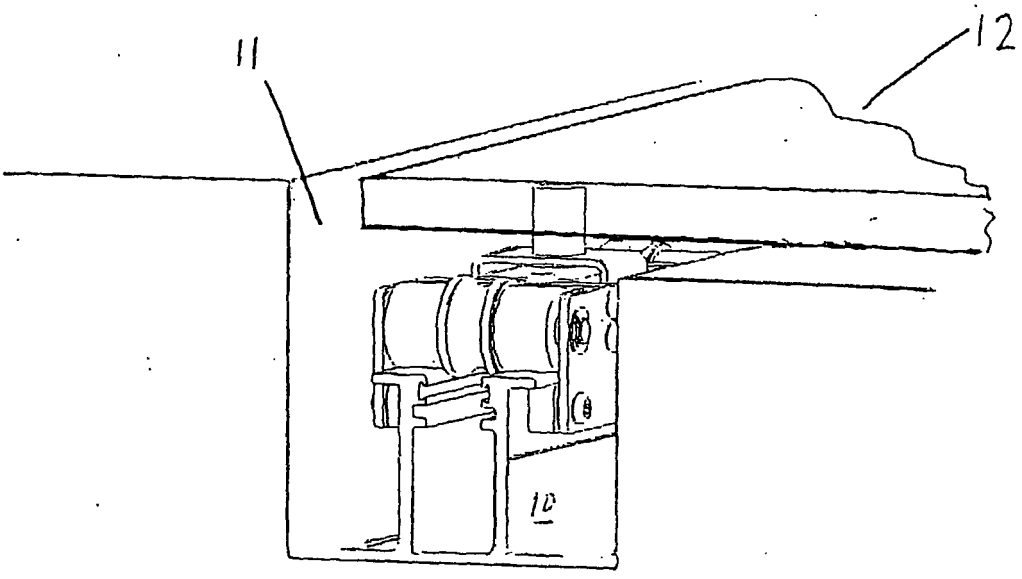

FIGURE 2

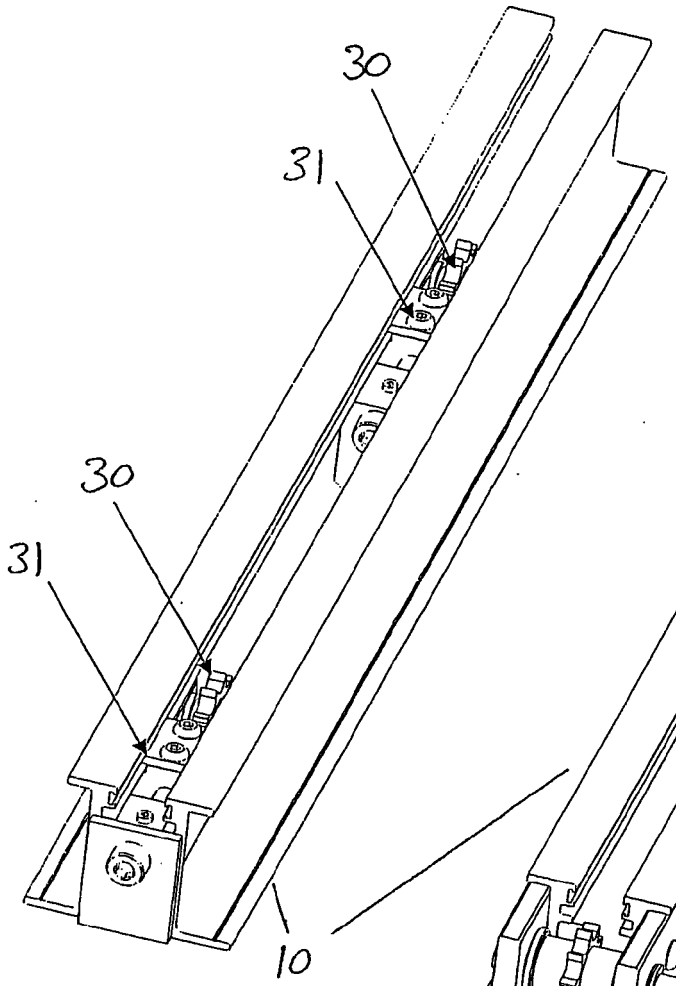

FIGURE 3a

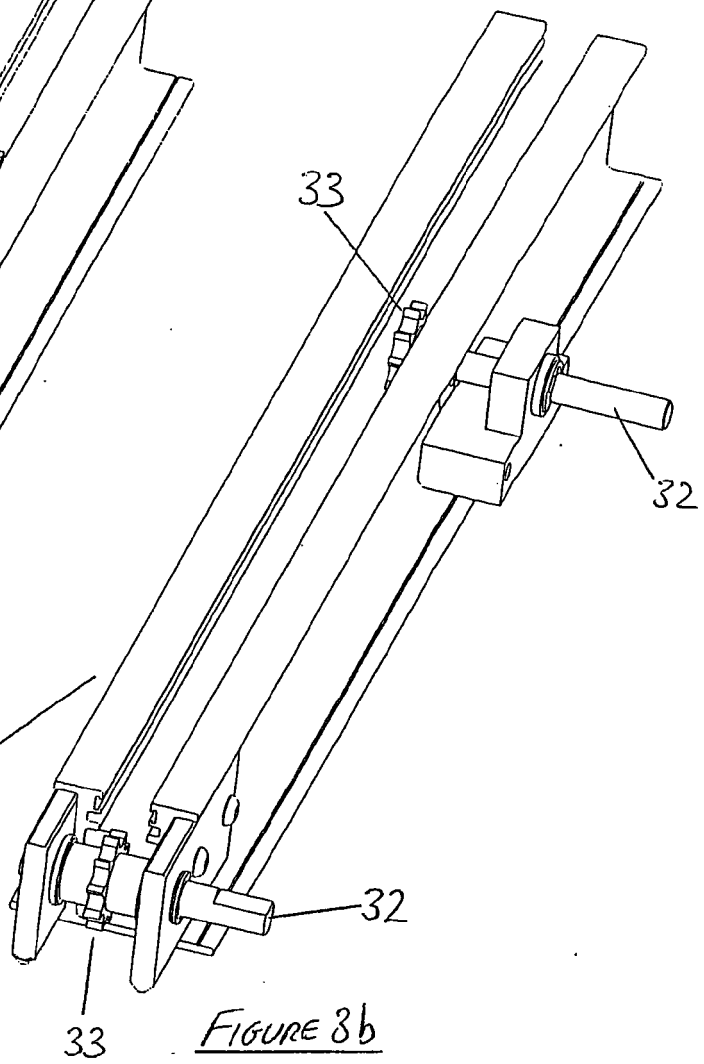

FIGURE 3b

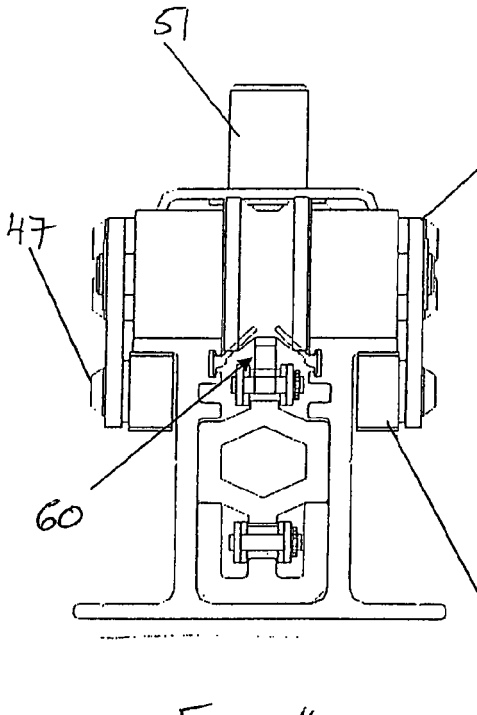

FIGURE 4a

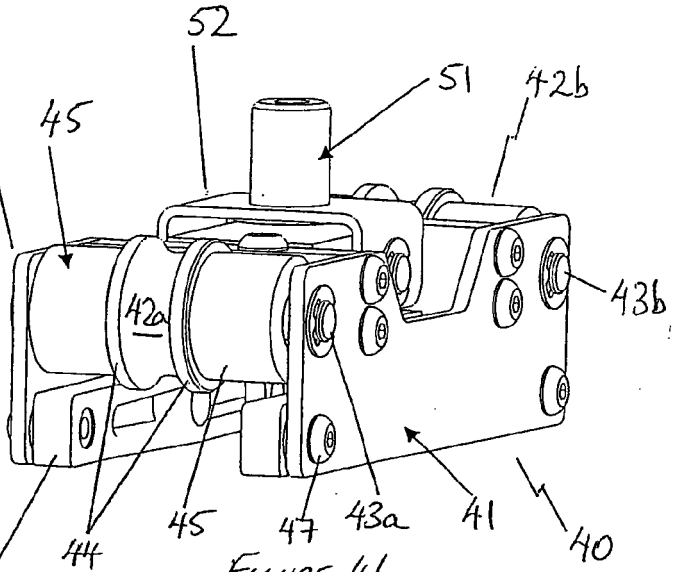

FIGURE 4b

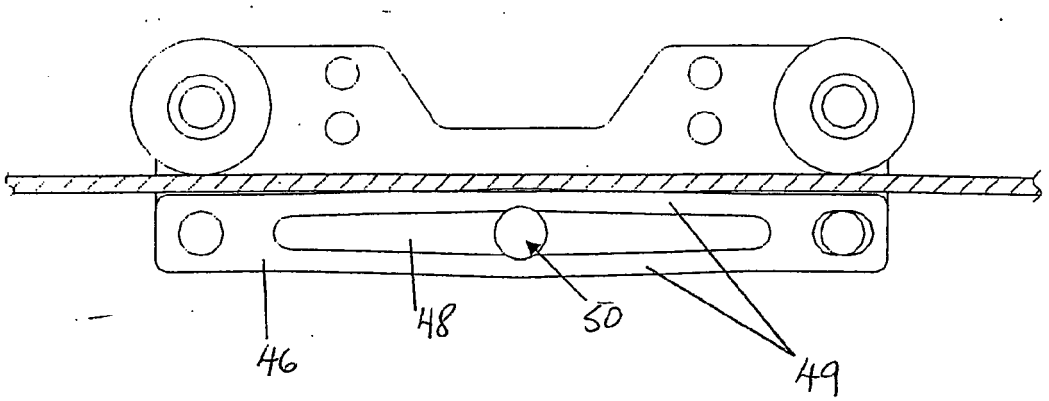

FIGURE 5

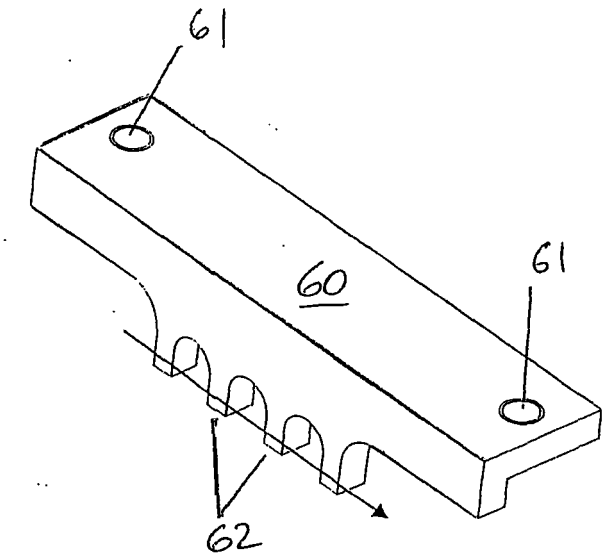

FIGURE 6

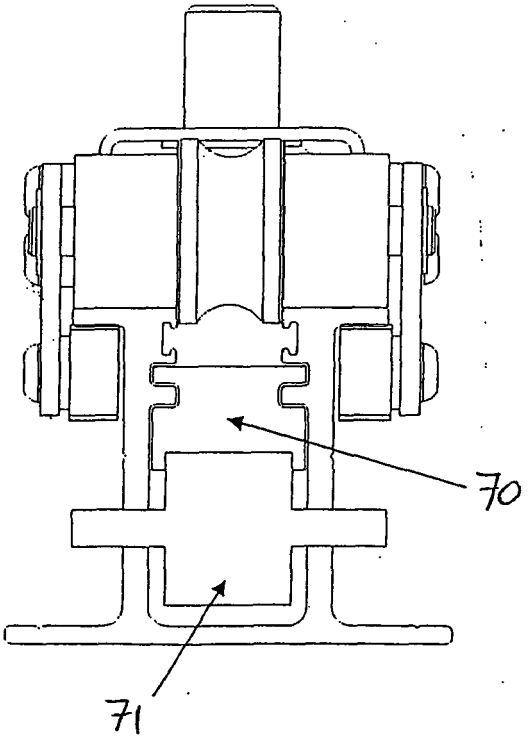

FIGURE 7

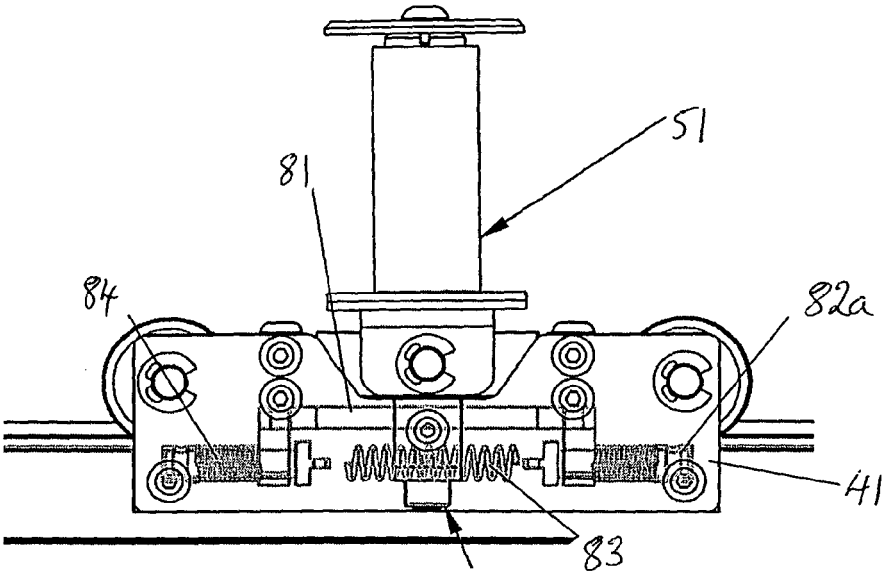

FIGURE 8a

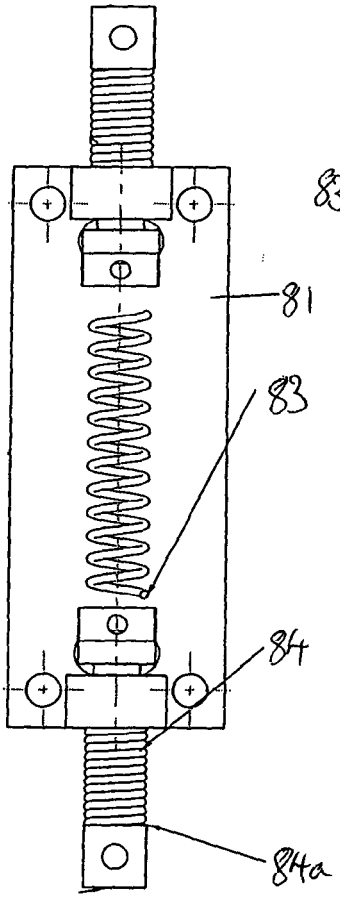

FIGURE 8b

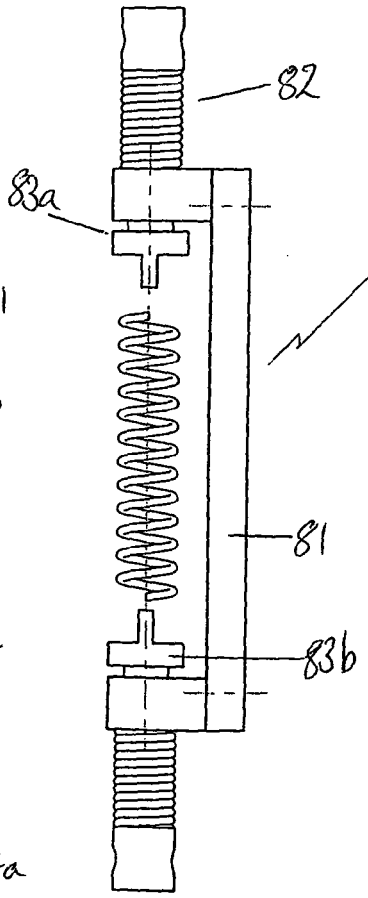

FIGURE 8c

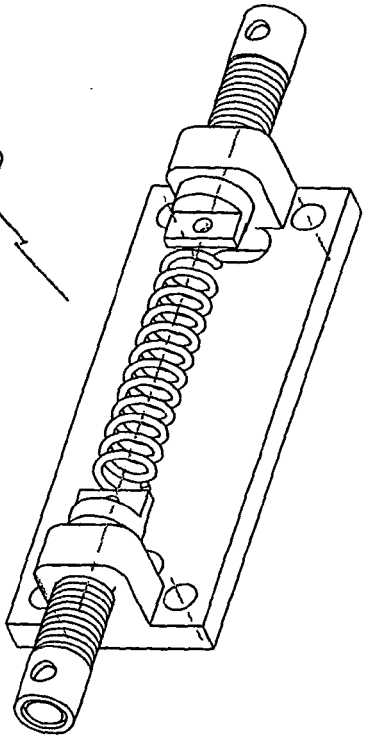

FIGURE 8d

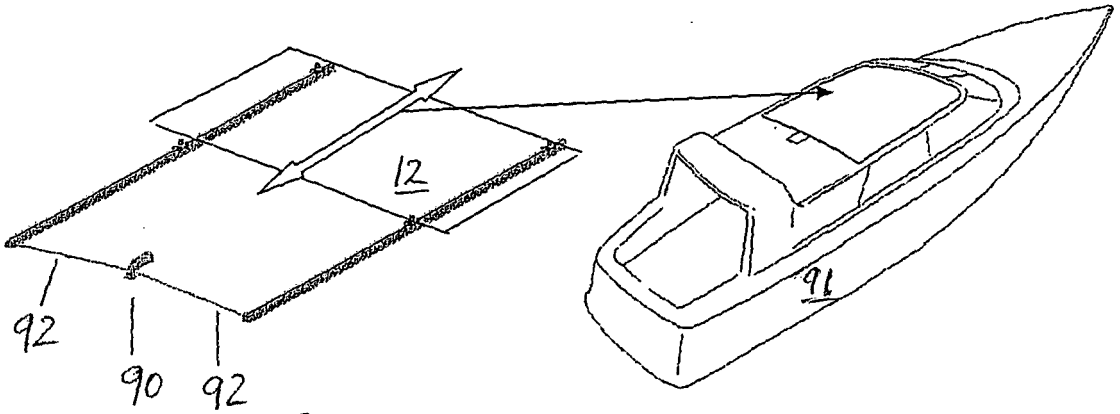

FIGURE 9a

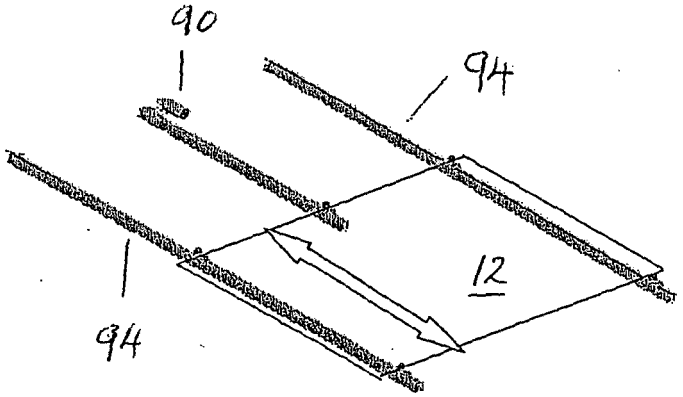

FIGURE 9b

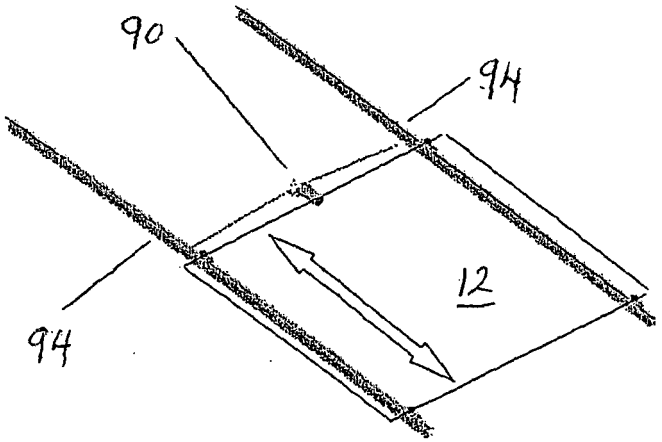

FIGURE 9c