CONSTRUCTION OF STABILISED PLATFORM

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Field of Search ............. 296/19; 5/62; 248/371, 248/396, 188.2, 188.3; 280/6 H

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FOREIGN PATENTS OR APPLICATIONS
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ABSTRACT

The platform is mounted for tilting about longitudinal and transverse axes, and a level sensor operates, through an actuator control, to effect operation of an actuator to continually maintain the platform in a horizontally stabilized position. The actuator is further mounted on a vertically extending variable height actuator which, through a motion sensor, maintains the platform at a constant height in space despite movement of the floor of the vehicle on which the platform may be mounted. Thereby a patient riding in an ambulance and lying on the platform is prevented from being subjected to various vibrations resulting from motion of the vehicle.

Primary Examiner—Philip Goodman
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3 Claims, 13 Drawing Figures
CONSTRUCTION OF STABILISED PLATFORM

FIELD AND BACKGROUND OF THE INVENTION

The present invention relates to a construction of stabilised platform for use in vehicles and in particular for use in ambulances.

When considering the problem of human vibration the body can for all practical purposes be treated as a number of coupled spring-mass-damper systems. It will be appreciated that the body has a number of internal organs capable of movement relative to the body. When all these internal organs are taken into account, the overall mechanical system becomes extremely complex. Any vibration of this complex structure of internal organs in the body will result in the movement of organs and parts of the body with relation to each other which will depend on the frequency and amplitude of oscillation.

It is not possible to predict with any accuracy the effects of vibration on a body because of the variation of body measurements and structures and the great number of possible modes of vibration to which the body may be subjected. Further the physiological reaction of people varies enormously and is conditioned by other environmental influences. Such as for example, the noise level, the temperature, the humidity and other factors. In the case of injured patients, there is the additional complication that in the injuries or body damage may be aggravated by mechanical shock or vibrations and that pain may well be intensified. Obviously, the tolerance level to vibration of a subject with fractured bones will be less than the tolerance of a completely healthy person.

The most commonly experienced symptom of vibration is that of motion sickness due to low frequencies and large amplitude, for example, in aircraft and ships. It has been established that motion sickness can be induced in practically any person if the vibration level is of sufficient intensity and duration. The symptoms can be described as a sudden onset of malaise and nausea, cold sweating and feeling of great dejection and apathy. Vomiting often brings temporary relief. In the case of a healthy individual the symptom rapidly vanishes when the vibration ceases, but in the case of an unhealthy person it is possible that further damage may already be sustained. For example, a cardiac patient who has just suffered a heart attack may develop ventricular fibrillation if the vibration level is too high as for example in a bumping ambulance.

Motion sickness is generally experienced as a result of frequencies below 1 Hz. resulting from disturbances of the organs of balance. Higher frequencies in the range 1-30 Hz. produce different physiological effects depending on particular body conditions. Thus speech and breathing may be impaired and there can be widespread effects upon the nervous system.

<table>
<thead>
<tr>
<th>Lateral acceleration 'g'</th>
<th>0.03</th>
<th>0.08</th>
<th>0.14</th>
<th>0.20</th>
<th>0.36</th>
<th>0.85</th>
<th>1.22</th>
</tr>
</thead>
<tbody>
<tr>
<td>Angle of tilt</td>
<td>0°34'</td>
<td>4°34'</td>
<td>8°1'</td>
<td>11°20'</td>
<td>19°47'</td>
<td>40°24'</td>
<td>50°30'</td>
</tr>
<tr>
<td>% Increase in body wt.</td>
<td>0.5</td>
<td>0.31</td>
<td>0.98</td>
<td>1.99</td>
<td>6.97</td>
<td>31.3</td>
<td>57.2</td>
</tr>
</tbody>
</table>

In an ambulance the peak acceleration is of the order of 0.25 g.
It will be appreciated that when a vehicle is carrying equipment, materials or other cargo susceptible to vibration that the provision of a stabilized platform is very desirable.

SUMMARY OF THE INVENTION

The present invention is directed towards providing an improved construction of stabilized platform for vehicles. Accordingly the invention provides a stabilized platform for mounting in a vehicle comprising: a base platform; pivot means for supporting the base platform so to allow the base platform to tilt about a longitudinal axis and a horizontal axis; means for controlling the tilt of base platform in response to lateral forces; a vertical variable height actuator for support of the base platform in a vehicle; a motion sensor operatively connected between the height actuator and the floor of the vehicle; and means for causing the height actuator to raise and lower the base platform in opposition to the motion of the floor.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be more clearly understood from the following description of some embodiments thereof given by way of example only with reference to the accompanying drawings in which

FIG. 1 is a diagrammatic side view of a stabilized ambulance platform according to the invention,

FIG. 2 is a further diagrammatic side view of a stabilized ambulance platform according to the invention,

FIG. 3 is a cross-sectional view of a typical double acting force balance pneumatic cylinder used in some embodiments of the invention,

FIG. 4 is a diagrammatic side view of a further stabilized ambulance platform according to the present invention,

FIG. 5 is an end view of a stabilized ambulance platform illustrated in FIG. 4,

FIG. 6 is a view illustrating the forces acting on the stabilized ambulance platform illustrated in FIGS. 4 and 5,

FIG. 7 is a diagrammatic side view of a still further stabilized ambulance platform according to the invention,

FIG. 8 is a perspective view of another stabilized ambulance platform mounted in an ambulance,

FIG. 9 is a side view of the stabilized ambulance platform of FIG. 8,

FIG. 10 is an end view of the stabilized platform of FIG. 8,

FIG. 11 is a plan view of the stabilized ambulance platform of FIG. 8,

FIG. 12 is a typical longitudinal cross-sectional view of portion of the stabilized ambulance platform illustrated in FIG. 8 and FIG. 13 is a typical transverse cross-sectional view of portion of the ambulance platform illustrated in FIG. 8.

Referring to the drawings and initially to FIGS. 1 and 2 thereof, there is illustrated a stabilized platform for mounting in a vehicle, in this case a stabilized ambulance platform. For clarity and to illustrate the principles of the invention this FIG. 1 illustrates the compensation of lateral forces only while FIG. 2 illustrates the compensation of vertical forces or vibration. Referring to FIG. 1 the stabilized ambulance platform comprises a base platform 1 mounted on pivot means 2. The pivot means 2 are adapted to tilt the base platform about a longitudinal axis and a horizontal axis. An actuator 3 is connected between the base platform 1 and the floor of an ambulance. The actuator 3 is adapted to tilt the base platform 1 in the direction of the arrow, that is to say about a transverse axis through the pivot means 2. The actuator 3 is connected to an actuator control 5 which is in turn operatively connected to a level sensor 6 above the base platform 1. A similar actuator, actuator control, and level sensor is provided to control the tilting of the phase platform 1 about the longitudinal axis. In operation, when the base platform 1 experiences a lateral acceleration the actuator control 5 feeds a signal to the actuator 3 and causes the base platform 1 to tilt.

When the level sensor 6 is in an unbalanced condition due to lateral forces, a signal is fed to the actuator control 5 which in turn moves the actuator 3 to tilt the base platform 1. When the base platform 1 and the level sensor 6 are in balance the actuator control 5 is stopped. If the level sensor 6 is a pendulum, balance is achieved when the pendulum acts at right angles to the base platform 1. Referring to FIG. 2 the base platform 1 is mounted by means of a vertical variable height actuator 7 on the floor 4. A motion sensor, for example, an inertial transducer 8 is mounted between the base platform 1 and the floor 4. The displacement of any floor movement is detected by the motion sensor and a signal fed to the actuator 7 in order to drive the actuator 7 in opposition to the motion of the floor 4 so that a patient remains virtually vibration free. A displacement transducer 9 stabilises the actuator 7 by fixing a mean suspension height. Referring to FIG. 3 there is illustrated a double acting force balanced pneumatic cylinder indicated generally by the reference numeral 10. This is one typical construction of a double acting force balanced pneumatic cylinder. There are, however, many such cylinders in commercial use. The force balanced pneumatic cylinder 10 comprises a positioner 11 and a pneumatic cylinder 12 and piston 13. The positioner 11 has a control signal port 15, outlet ports 16 and 17, an inlet port 18 and an exhaust port 19. The outlet ports 17 and 18 are connected to the pneumatic cylinder 13. A piston 20 and diaphragm 21 are mounted in the positioner 11 and are connected by means of a rod 22 to a piston 23 controlled by a compression spring 24. The compression spring 24 provides a feed back signal force to the positioner. The compression of the compression spring 24 and hence the feedback signal force is controlled by a pivotally mounted lever 25. The pivotally mounted lever 25 is connected in known manner by a follower 26 and a cam 27 on the piston rod of the cylinder 13 to the prime mover it is desired to control. A valve stem 28 is mounted between the exhaust outlet ports 16 and 17. The double acting force balanced pneumatic cylinder 10 operates in conventional manner. An increase in the control signal pressure into the control signal port 13 causes the combined assembly namely the piston 20, the rod 22 and the piston 23 to move to the left under the increased pressure which is acting against the piston 20 and the diaphragm 21. The resulting position of the valve stem 28 causes air to flow through the port 16 from the supply port 18 to the pneumatic cylinder 13 changing the piston 12 position. The compression spring 24 is further compressed. When the condition is reached
whereby the force from the compression spring 24 equals the force of the control pressure on the piston 20 and diaphragm 21 the movement of the rod 22 will stop and the new position relative to control signal now exists. A decrease in the pressure of control signal into the control port 13 will cause the valve stem 28 to move to the right, increase the pressure on the right hand side of the piston 20 and diaphragm 21 and hence decrease the pressure on the left hand side of the piston 20 and diaphragm 21 thereby causing the piston rod 22 to move to the left thus causing a decrease in the compression of the compression spring 24 with the result that the control force and feed back force again equalise and further movement of the piston rod 22 is prevented.

If the positioner 11 is supplied with air under constant pressure then any movement of the positioner 11 relative to the cylinder will cause the piston 12 to move in the opposite direction. Referring to FIGS. 4, 5 and 6 there is illustrated means for controlling the tilt of the base platform 1 about its longitudinal axis. A pendulum 30 is mounted beneath a base platform 1 and rigidly connected thereto. The base platform 1 is adapted for pivoting about a longitudinal axis in the direction of the arrow B as illustrated in FIGS. 4, 5 and 6. This stabilised platform is for simplicity shown only pivoting about this one axis. In operation the forces on the pendulum are illustrated in FIG. 6. The forces acting on the pendulum are the weight W of the pendulum and the centrifugal force F. These forces may be resolved into a resultant force R in conventional manner by a simple triangle of forces. Needless to say the base platform 1 may be adapted to pivot about a transverse axis as well.

The pendulum 30 may be connected by a universal joint to the vehicle and connected rigidly by transversely and longitudinally disposed links to the base platform 1. Many arrangements of this will readily come to mind to those skilled in the art. Dampers may be incorporated to adjust the response of the base platform 1 to the movement of the pendulum 30.

Referring to FIG. 7 there is illustrated in partially diagrammatic form a variable height actuator which comprises a support bellows 40, an inlet valve 41 controlled by an electro magnet 42 and an outlet valve 43 controlled by an electro magnet 44. The support bellows 40 supports the base platform 1 and a displacement transducer 45 is connected between the base platform 1 and the floor 4 of the vehicle. The displacement transducer 45 is fed through a conventional delay 46 to a comparator 47. Also fed through the comparator 47 is a mean pressure control signal from an electrical height control 48. The signal from the comparator 47 is fed to valve control circuits 49 which control in conventional manner the operation of the electro magnets 42 and 44. A pressure transducer 50 is operatively connected between the support bellows 40 and the comparator 47. In this embodiment of the invention any motion of the floor 4 relative to the base platform 1 causes a change in internal air pressure in the bellows 40 and is measured directly by the pressure transducer 50 which feeds a signal through to the comparator 47. This causes the comparator 47 to compare the signal fed through to it by the displacement transducer with that of the height control 48. The signal is then sent to the valve control circuits 49 and either the inlet valve 41 or the outlet valve 43 is opened, thus causing the pressure in the support bellows 40 to be increased or decreased, thus raising or lowering the base platform 1 relative to the floor 4. The patient lying on the base platform 1 does not therefore experience the motion of the floor. Under very slow changes in internal pressure the reaction of pressure transducer 50 may not be adequate. The displacement transducer 45 and the delay 46 act to stabilise the system and prevent large movements or "creep" of the base platform 1. Needless to say the arrangements previously described for the compensation of lateral forces may be incorporated in this embodiment and previously would be. However, for clarity they have been omitted.

Referring to FIGS. 8 to 13 there is illustrated an alternative embodiment of the invention which is a stabilised platform for mounting in a vehicle and in particular a stabilised platform for mounting in an ambulance, having a floor 60 and a wall 61. The stabilised platform comprises a base platform 62, pivotally mounted at 63, within a frame 64 which is in turn pivotally mounted at 65 within a frame 66. It will be appreciated that the base platform 62 is capable of tilting about a longitudinal axis and transverse axis, that is to say the axis connected by the supports at 63 and 65. Compensation for lateral forces may be achieved as hereinbefore described, and they are omitted from the drawings for clarity. The frame 66 is supported by means of a pair of cantilevered arms 67. The cantilevered arms are mounted by means of rollers 68 on bars 69, rigidly mounted between support members 70 and 71 on the wall 61. A double acting force balanced pneumatic cylinder 72 is mounted on the wall 61 by a support plate 73. The double acting force balanced pneumatic cylinder 72 supports on its piston rod 74 a pulley 75. A length of flexible wire 76 is connected between the support member 71 and the frame 66. It will be appreciated that vertical movement of the piston rod 74 will cause vertical movement of the frame 66.

The double acting force balanced pneumatic cylinder 72 is fed and operated as described with reference to FIG. 3. In operation the base platform 62 in response to lateral forces may be tilted, while the double acting force balanced pneumatic cylinder 72 will raise and lower the base platform 62 in the opposite direction to any motion imparted to the floor 60 by the vehicle travelling over the road.

We claim:

1. A stabilised platform for mounting in a vehicle comprising: a base platform; pivot means supporting the base platform so as to allow the base platform to tilt about a longitudinal axis and a horizontal axis; means controlling the tilt of the base platform in response to lateral forces; a vertical variable height actuator supporting the base platform in a vehicle and comprising a double acting force-balanced pneumatic cylinder; a motion sensor operatively connected between the height actuator and the floor of the vehicle; and means causing the height actuator to raise or lower the base platform in opposition to the motion of the floor.

2. A stabilized platform as claimed in claim 1 in which the means controlling the tilt of the base platform about each axis comprises a tilt actuator; a level sensor; and control means operatively connected between the tilt actuator and the level sensor whereby the resultant forces of gravity and lateral forces acts downwards at right angles to the base platform.

3. A stabilised platform as claimed for the base platform about each axis comprises a double acting force balances pneumatic cylinder.