

Description

This invention relates to a caster which, although compliant against horizontal loads, resists oscillations under vertical loading.

Casters are known in the art for resiliently carrying heavy loads. The problem, however, is that for a caster to have resiliency, for example, when encountering a horizontal force delivered when the support surface changes abruptly in height, the casters in the past have used energy absorbers which are sensitive to resonances caused by vertical loads. The resiliency of the absorbers applies in the vertical direction as well, so that there are some frequencies under a vertical load which can induce harmonic oscillations. Examples of casters of this construction are described in US-A-2 738 542. These casters are constructed to "give" under a sudden vertical load as well as a sudden horizontal load. Such harmonic oscillations created by vertical loads being "bounced", for example, are unacceptable when the load in question is a fine-tuned instrument. For example, clinical analyzers while transported by truck will not tolerate vertical harmonic oscillations due to bumps in the road.

Resistance to vertical loading is provided by conventional casters in frames having a solid vertical connection to the load itself. However, these are deficient in that they also totally lack resiliency in the horizontal direction, so that horizontal shock is either fully transmitted to the load, or the shock breaks the caster.

The problem has been to provide a caster that will resist oscillations caused by any sudden increases in vertical loading, and still provide resiliency against a sudden increase in horizontal force so as to protect the load from damage.

Although casters of the type described in US-A-2 442 831 might seem to provide resistance to vertical loading due to a direct vertical coupling through a stud, while providing a resilient damper to give resiliency under horizontal loading, such casters in fact are not free from susceptibility to vertical oscillations. One reason is that the long moment arm of the caster preloads the damper to the point at which it has a significant harmonic resonance to induced vertical oscillations.

In accordance with the present invention, there is provided a caster arrangement for mounting a heavy instrument comprising:-

a caster having a frame, a wheel and journal means for journalling the wheel to the frame;

mounting means attached to the instrument and to which the caster is attached;

resilient damper means positioned in the mounting means; and

connecting means for pivotably connecting the

frame of the caster to the resilient damper means, the connecting means including a load-bearing plate and a stud fixed to the plate and having an axis, the plate bearing directly over one of its surfaces on to a surface of the mounting means, the damper means being disposed to surround the stud with the plate bearing on the damper means, the frame being secured to the stud so as to deliver vertical forces directly on to the load-bearing plate with no vertical displacement of the frame relative to the instrument;

characterized in that the wheel is journaled to be off-center from the stud of the connecting means and in that one surface of the plate extends horizontally to create a moment arm from the axis which is longer than any horizontal moment arm created by the journal means from the axis so that the stud can bend against the damper means out of a vertical alignment and the plate can depress a portion of the damper means when the wheel encounters only a horizontally-directed force.

Accordingly, it is an advantageous feature of the invention that a caster is provided which is as free of vertically induced harmonic oscillations as it can be while still providing resiliency under horizontal loading.

For a better understanding of the present invention, reference will now be made, by way of example only, to the accompanying drawings in which:-

Figure 1 is a partially sectioned elevational view of a caster constructed in accordance with the present invention;

Figure 2 is a sectioned view taken generally along the line II-II of Figure 1;

Figure 3 is an elevational view similar to that shown in Figure 1, showing the caster's behavior under a horizontal load, and

Figure 4 is an elevational view similar to that shown in Figure 1, but of an alternative embodiment.

The invention is described in connection with the preferred embodiments, wherein the caster is used to render transportable a clinical analyzer as the instrument in question. In addition, the invention is useful in casters for any heavy instrument which can not tolerate either sudden horizontal jarring or vertical harmonic oscillations, for example, other health instruments or even instruments such as concert pianos.

Referring to Figure 1, instrument 10 is a heavy clinical analyzer having a variety of stations for dispensing biological liquids on to test elements which feed into an incubator and reading stations for detection, not shown. Any construction of the analyzer can be used, as this invention resides in the casters which allow the instrument to be moved along a horizontal surface. Useful examples are

described in EP-A-0 356 250. Such analyzers can weigh as much as 300kg.

Instrument 10 has a bottom plate 12 with a housing plate 14 bolted thereto which is preferably hat-shaped. A generally flat load-bearing plate 16 is confined within plate 14 with surface 18 of plate 16 bearing against housing plate 14 over the entire surface 18. Extending from and secured to plate 16 (such as by welding) is a stud 20 which threadably engages connecting member 22 which is directly vertically coupled to frame 32 of caster 30 via a bearing 24, thereby ensuring a rigid vertical coupling of frame 32 to load-bearing plate 16. In this embodiment, stud 20 is internally threaded at 34 to receive the male threads 36 of member 22.

(As shown in Figure 2, bearing 24 is conventional, comprising for example a race 26 formed in top plate 28 of frame 32, with a double row of balls 29, 29' confined to race 26 by housing flanges 38, 39 welded to connecting member 22.)

Any conventional locking means can be used to lock member 22 at a particular vertical height relative to stud 20, for example a jam nut 40 (Figure 1).

Frame 32 of caster 30 conventionally is journaled to a roller 42 at journal axis 44. Axis 44 is located at a moment arm m_1 from the axis 50 of connection member 22 (also of stud 20).

Such a construction, by itself, gives rigidity to vertical loads on instrument 10. In addition, however, resiliency to horizontal loading is needed. To that end, an elastomeric damper 60 is mounted within housing plate 14 so as to surround stud 20, and to bear against plate 18. An exterior plate 62 is used to sandwich damper 60 into this position. The function of damper 60, as shown in Figure 3, is to allow connecting member 22, and hence stud 20, to flex out of the vertical by an angle α , when encountering a horizontal loading force "L". In particular, damper 60 is compressed on the side of the loading, as shown, with plate 18 pivoting about its exterior edge surface 64.

The resiliency of damper 60 is selected on the basis of the horizontal loading expected by instrument 10, as is well-known. For instrument 10 being a clinical analyzer weighing about 300kg, it is preferred that damper 60 have approximately the following resiliency and hardness: 60 - 70 Shore A durometer hardness. Various rubber compounds provide this property.

In accordance with one aspect of the invention, plate 18 is provided with a sufficient horizontal, load-bearing extension, to edge 64, such that edge 64 provides a moment arm m_2 (Figure 1) which exceeds moment arm m_1 . This is a crucial feature, since it minimizes any tendency of moment arm m_1 to preload damper 60 to the extent of creating a harmonic response to vertical oscillations of in-

strument 10. Most preferably, the amount at which m_2 is greater than m_1 is the amount which ensures that m_2/m_1 is at least 1.1/1.0.

It is not crucial that stud 20 be internally threaded to receive a male thread on member 22. As shown in Figure 4, these parts can be reversed. Parts similar to those previously described bear the same reference numeral to which the distinguishing suffix "A" is appended.

Thus, instrument 10A moves on a caster 30A having a frame 32A pivotable via a bearing 24A fixed at a vertical location on a connecting member 22A which threadably engages stud 20A on plate 18A. Stud 20A is surrounded by damper 60A to give resiliency under horizontal loading, all as described before. In addition, moment arm m_2 of plate 18A exceeds moment arm m_1 created by journal axis 44A by its horizontal spacing from axis 50A. However, in this embodiment, stud 20A is externally threaded to receive female threads 36A of connecting member 22A.

Claims

1. A caster arrangement for mounting a heavy instrument (10; 10A) comprising:-
 - a caster (30, 32, 42, 44; 30A, 32A, 44A) having a frame (32; 32A), a wheel (42) and journal means (44, 44A) for journalling the wheel (42) to the frame (32; 32A);
 - mounting means (12, 14) attached to the instrument (10; 10A) and to which the caster (30, 32, 42, 44; 30A, 32A, 44A) is attached;
 - resilient damper means (60, 62, 64; 60A) positioned in the mounting means (12, 14); and
 - connecting means (16, 18, 20, 22, 24, 26, 28, 29, 29', 34, 36, 38, 39, 64; 18A, 20A, 22A, 24A, 36A) for pivotably connecting the frame (32; 32A) of the caster (30, 32, 42, 44; 30A, 32A, 44A) to the resilient damper means (60, 62; 60A), the connecting means (16, 18, 20, 22, 24, 26, 28, 29, 29', 34, 36, 38, 39, 50, 64; 18A, 20A, 22A, 24A, 36A) including a load-bearing plate (16, 18, 64; 18A) and a stud (20, 34; 20A) fixed to the plate (16, 18, 64; 18A) and having an axis (50; 50A), the plate (16, 18, 64; 18A) bearing directly over one of its surfaces (18; 18A) on to a surface (14) of the mounting means (12, 14), the damper means (60, 62; 60A) being disposed to surround the stud (20, 34; 20A) with the plate (16, 18, 64; 18A) bearing on the damper means (60, 62; 60A), the frame (32; 32A) being secured to the stud (20, 34; 20A) so as to deliver vertical forces directly on to the load-bearing plate (16, 18, 64; 18A) with no vertical displacement of the frame (32, 32A) relative to the instrument (10; 10A);



described in EP-A-0 356 250. Such analyzers can weigh as much as 300kg.

Instrument 10 has a bottom plate 12 with a housing plate 14 bolted thereto which is preferably hat-shaped. A generally flat load-bearing plate 16 is confined within plate 14 with surface 18 of plate 16 bearing against housing plate 14 over the entire surface 18. Extending from and secured to plate 16 (such as by welding) is a stud 20 which threadably engages connecting member 22 which is directly vertically coupled to frame 32 of caster 30 via a bearing 24, thereby ensuring a rigid vertical coupling of frame 32 to load-bearing plate 16. In this embodiment, stud 20 is internally threaded at 34 to receive the male threads 36 of member 22.

(As shown in Figure 2, bearing 24 is conventional, comprising for example a race 26 formed in top plate 28 of frame 32, with a double row of balls 29, 29' confined to race 26 by housing flanges 38, 39 welded to connecting member 22.)

Any conventional locking means can be used to lock member 22 at a particular vertical height relative to stud 20, for example a jam nut 40 (Figure 1).

Frame 32 of caster 30 conventionally is journaled to a roller 42 at journal axis 44. Axis 44 is located at a moment arm m_1 from the axis 50 of connection member 22 (also of stud 20).

Such a construction, by itself, gives rigidity to vertical loads on instrument 10. In addition, however, resiliency to horizontal loading is needed. To that end, an elastomeric damper 60 is mounted within housing plate 14 so as to surround stud 20, and to bear against plate 18. An exterior plate 62 is used to sandwich damper 60 into this position. The function of damper 60, as shown in Figure 3, is to allow connecting member 22, and hence stud 20, to flex out of the vertical by an angle α , when encountering a horizontal loading force "L". In particular, damper 60 is compressed on the side of the loading, as shown, with plate 18 pivoting about its exterior edge surface 64.

The resiliency of damper 60 is selected on the basis of the horizontal loading expected by instrument 10, as is well-known. For instrument 10 being a clinical analyzer weighing about 300kg, it is preferred that damper 60 have approximately the following resiliency and hardness: 60 - 70 Shore A durometer hardness. Various rubber compounds provide this property.

In accordance with one aspect of the invention, plate 18 is provided with a sufficient horizontal, load-bearing extension, to edge 64, such that edge 64 provides a moment arm m_2 (Figure 1) which exceeds moment arm m_1 . This is a crucial feature, since it minimizes any tendency of moment arm m_1 to preload damper 60 to the extent of creating a harmonic response to vertical oscillations of in-

strument 10. Most preferably, the amount at which m_2 is greater than m_1 is the amount which ensures that m_2/m_1 is at least 1.1/1.0.

It is not crucial that stud 20 be internally threaded to receive a male thread on member 22. As shown in Figure 4, these parts can be reversed. Parts similar to those previously described bear the same reference numeral to which the distinguishing suffix "A" is appended.

Thus, instrument 10A moves on a caster 30A having a frame 32A pivotable via a bearing 24A fixed at a vertical location on a connecting member 22A which threadably engages stud 20A on plate 18A. Stud 20A is surrounded by damper 60A to give resiliency under horizontal loading, all as described before. In addition, moment arm m_2 of plate 18A exceeds moment arm m_1 created by journal axis 44A by its horizontal spacing from axis 50A. However, in this embodiment, stud 20A is externally threaded to receive female threads 36A of connecting member 22A.

Claims

1. A caster arrangement for mounting a heavy instrument (10; 10A) comprising:-
 - a caster (30, 32, 42, 44; 30A, 32A, 44A) having a frame (32; 32A), a wheel (42) and journal means (44, 44A) for journalling the wheel (42) to the frame (32; 32A);
 - mounting means (12, 14) attached to the instrument (10; 10A) and to which the caster (30, 32, 42, 44; 30A, 32A, 44A) is attached;
 - resilient damper means (60, 62, 64; 60A) positioned in the mounting means (12, 14); and
 - connecting means (16, 18, 20, 22, 24, 26, 28, 29, 29', 34, 36, 38, 39, 64; 18A, 20A, 22A, 24A, 36A) for pivotably connecting the frame (32; 32A) of the caster (30, 32, 42, 44; 30A, 32A, 44A) to the resilient damper means (60, 62; 60A), the connecting means (16, 18, 20, 22, 24, 26, 28, 29, 29', 34, 36, 38, 39, 50, 64; 18A, 20A, 22A, 24A, 36A) including a load-bearing plate (16, 18, 64; 18A) and a stud (20, 34; 20A) fixed to the plate (16, 18, 64; 18A) and having an axis (50; 50A), the plate (16, 18, 64; 18A) bearing directly over one of its surfaces (18; 18A) on to a surface (14) of the mounting means (12, 14), the damper means (60, 62; 60A) being disposed to surround the stud (20, 34; 20A) with the plate (16, 18, 64; 18A) bearing on the damper means (60, 62; 60A), the frame (32; 32A) being secured to the stud (20, 34; 20A) so as to deliver vertical forces directly on to the load-bearing plate (16, 18, 64; 18A) with no vertical displacement of the frame (32, 32A) relative to the instrument (10; 10A);



characterized in that the wheel (42) is journaled to be off-center from the stud (20, 34; 20A) of the connecting means (16, 18, 20, 22, 24, 26, 28, 29, 29', 34, 36, 38, 39, 50, 64; 18A, 20A, 22A, 24A, 36) and in that one surface (64) of the plate (16, 18, 64; 18A) extends horizontally to create a moment arm (m_2) from the axis (50; 50A) which is longer than any horizontal moment arm (m_1) created by the journal means from the axis (50; 50A) so that the stud (20, 34; 20A) can bend against the damper means (60, 62; 60A) out of a vertical alignment and the plate (16, 18, 64; 18A) can depress a portion (62) of the damper means (60, 62; 60A) when the wheel (42) encounters only a horizontally-directed force (L).

2. An arrangement according to claim 1, wherein the stud (20, 34) is internally threaded to receive an externally threaded rod (22, 36) pivotally connected to the frame (32).
3. An arrangement according to claim 1, wherein the stud (20A) is externally threaded to receive an internally threaded connecting member (22A) pivotally connected to the frame (32A).
4. An arrangement according to any one of claims 1 to 3, wherein the longer moment arm (m_2) of the plate (16, 18, 64; 18A) exceeds the any horizontal moment arm (m_1) of the journal means (44, 44A) so that the ratio of the longer moment arm (m_2) to the any moment arm (m_1) is at least 1.1/1.0.

Patentansprüche

1. Schwenkrananordnung zum Befestigen eines schweren Gerätes (10; 10A), umfassend: eine Schwenkrananordnung (30, 32, 42, 44; 30A, 32A, 44A) mit einem Gestell (32; 32A), einem Laufrad (42) und einem Achslager (44, 44A) zur drehbaren Lagerung des Schwenkrades (42) an dem Gestell (32; 32A); einer an dem Gerät (10; 10A) angebrachten Befestigungsvorrichtung (12, 14), an der die Schwenkrananordnung (30, 32, 42, 44; 30A, 32A, 44A) befestigt ist; eine elastische Dämpfungsvorrichtung (60, 62, 64; 60A), die in der Befestigungsvorrichtung (12, 14) positioniert ist; und eine Verbindungsvorrichtung (16, 18, 20, 22, 24, 26, 28, 29, 29', 34, 36, 38, 39, 64; 18A, 20A, 22A, 24A, 36A) für die schwenkbare Verbindung des Gestells (32; 32A) der Schwenkrananordnung (30, 32, 42, 44; 30A, 32A, 44A) mit der elastischen Dämpfungsvorrichtung (60, 62; 60A), wobei die Verbindungsvorrichtung (16,

18, 20, 22, 24, 26, 28, 29, 29', 34, 36, 38, 39, 50, 64; 18A, 20A, 22A, 24A, 36A) eine lasttragende Platte (16, 18, 64; 18A) und einen an der Platte (16, 18, 64; 18A) befestigten Drehzapfen (20, 34; 20A) mit einer Achse (50; 50A) umfaßt, wobei die Platte (16, 18, 64; 18A) genau über einer ihrer Flächen (18; 18A) an einer Fläche (14) der Befestigungsvorrichtung (12, 14) gelagert ist und die Dämpfungsvorrichtung (60, 62; 60A) den Drehzapfen (20, 34; 20A) umgibt, wobei die Platte (16, 18, 64; 18A) auf der Dämpfungsvorrichtung (60, 62; 60A) lagert und das Gestell (32; 32A) an dem Drehzapfen (20, 34; 20A) derart befestigt ist, daß senkrechte Kräfte unmittelbar auf die lasttragende Platte (16, 18, 64; 18A) ohne senkrechte Verstellung des Gestells (32, 32A) in bezug auf das Gerät (10; 10A) übertragen werden, dadurch gekennzeichnet, daß das Schwenkrad (42) derart schwenkbar ist, daß es gegenüber dem Drehzapfen (20, 34; 20A) der Verbindungsvorrichtung (16, 18, 20, 22, 24, 26, 28, 29, 29', 34, 36, 38, 39, 50, 64; 18A, 20A, 22A, 24A, 36A) eine exzentrische Lage einnimmt, und daß eine Fläche (64) der Platte (16, 18, 64; 18A) sich horizontal erstreckt, um einen Kraftarm (m_2) gegenüber der Achse (50; 50A) zu bilden, der länger als irgendein horizontaler Kraftarm (m_1) ist, der von dem Lagerzapfen gegenüber der Achse (50; 50A) hervorgerufen wird, so daß der Drehzapfen (20, 34; 20A) gegenüber der Dämpfungsvorrichtung (60, 62; 60A) aus einer senkrechten Ausrichtung herausgeschwenkt werden kann und die Platte (16, 18, 64; 18A) einen Teil (62) der Dämpfungsvorrichtung (60, 62; 60A) mit Druck beaufschlagen kann, wenn auf das Schwenkrad (42) nur eine horizontal gerichtete Kraft (L) einwirkt.

2. Anordnung nach Anspruch 1, wobei der Drehzapfen (20, 34) mit einem Innengewinde zur Aufnahme einer mit einem Außengewinde versehenen Stange (22, 36) versehen ist, die mit dem Gestell (32) schwenkbar verbunden ist.
3. Anordnung nach Anspruch 1, wobei der Drehzapfen (20A) mit einem Außengewinde zur Aufnahme eines mit Innengewinde versehenen Verbindungsgliedes (22A) versehen ist, das mit dem Gestell (32A) schwenkbar verbunden ist.
4. Anordnung nach einem der Ansprüche 1 bis 3, wobei der längere Kraftarm (m_2) der Platte (16, 18, 64; 18A) den beliebigen, horizontalen Kraftarm (m_1) des Achslagers (44, 44A) überschreitet, so daß das Verhältnis des längeren Kraftarms (m_2) zu dem beliebigen Kraftarm (m_1)



mindestens 1.1/1.0 beträgt.

Revendications

1. Agencement formant roulette destiné à monter un instrument lourd (10; 10A) comprenant :
 - une roulette (30, 32, 42, 44; 30A, 32A, 44A) ayant un châssis (32; 32A), une roue (42) et des moyens formant tourillon (44, 44A) pour relier la roue (42) au châssis (32; 32A) ;
 - des moyens de montage (12, 14) fixés à l'instrument (10; 10A) et auxquels la roulette (30, 32, 42, 44; 30A, 32A, 44A) est fixée ;
 - des moyens amortisseurs résilients (60, 62, 64; 60A) placés dans les moyens de montage (12, 14) ; et
 - des moyens de connexion (16, 18, 20, 22, 24, 26, 28, 29, 29', 34, 36, 38, 39, 64; 18A, 20A, 22A, 24A, 36A) pour relier de manière pivotante le châssis (32; 32A) de la roulette (30, 32, 42, 44; 30A, 32A, 44A) aux moyens amortisseurs résilients (60, 62; 60A), les moyens de connexion (16, 18, 20, 22, 24, 26, 28, 29, 29', 34, 36, 38, 39, 50, 64; 18A, 20A, 22A, 24A, 36A) comprenant un plateau portant (16, 18, 64; 18A) et un goujon (20, 34; 20A) fixé au plateau (16, 18, 64; 18A) et ayant un axe (50; 50A), le plateau (16, 18, 64; 18A) portant directement sur une de ses surfaces (18; 18A) sur une surface (14) des moyens de montage (12, 14), les moyens amortisseurs (60, 62; 60A) étant disposés pour entourer le goujon (20, 34; 20A) avec le plateau (16, 18, 64; 18A) en appui sur les moyens amortisseurs (60, 62; 60A), le châssis (32; 32A) étant fixé au goujon (20, 34; 20A) afin de fournir des forces verticales directement sur le plateau portant (16, 18, 64; 18A) sans déplacement vertical du châssis (32; 32A) par rapport à l'instrument (10; 10A) ;
 - caractérisé en ce que la roue (42) est reliée pour être décentrée du goujon (20, 34; 20A) des moyens de connexion (16, 18, 20, 22, 24, 26, 28, 29, 29', 34, 36, 38, 39, 50, 64; 18A, 20A, 22A, 24A, 36A) et en ce qu'une surface (64) du plateau (16, 18, 64; 18A) s'étend horizontalement pour créer un bras de levier (m_2) depuis l'axe (50; 50A) qui est plus long qu'un bras de levier horizontal quelconque (m_1) créé par les moyens formant tourillon depuis l'axe (50; 50A) de sorte que le goujon (20, 34; 20A) peut être courbé contre les moyens amortisseurs (60, 62; 60A) hors d'un alignement vertical et le plateau (16, 18, 64; 18A) peut déprimer une partie (62) des moyens amortisseurs (60, 62; 60A) lorsque la roue (42) rencontre seulement une force (L) orientée horizontalement.
2. Agencement selon la revendication 1, dans lequel le goujon (20, 34) est fileté à l'intérieur pour recevoir une tige (22, 36) filetée à l'extérieur reliée de manière pivotante au châssis (32).
3. Agencement selon la revendication 1, dans lequel le goujon (20A) est fileté à l'extérieur pour recevoir un élément de connexion (22A) fileté à l'intérieur relié de manière pivotante au châssis (32A).
4. Agencement selon l'une quelconque des revendications 1 à 3, dans lequel le bras de levier le plus long (m_2) du plateau (16, 18, 64; 18A) dépasse un bras de levier horizontal quelconque (m_1) des moyens formant tourillon (44; 44A) de sorte que le rapport du bras de levier le plus long (m_2) et du bras de levier quelconque (m_1) est d'au moins 1.1/1.0.