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MOVING BED ASSEMBLY

Abstract

A moving bed assembly includes a base frame supporting a bed frame via a plurality of pairs of swing arms. A drive motor mounted on the base frame drives the bed frame through a continuous motion cycle through a drive shaft. Cranks are mounted at opposite ends of the drive shaft and connected to respective swing arms through respective drive arms. A shaft brake engages the drive shaft to prevent perceptible surges as the bed frame transitions through opposite extremes of the motion cycle.

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Background/Summary

FIELD OF THE INVENTION

[0001] The present invention is directed to moving bed assemblies, and more particularly to

moving bed assemblies with bed frames supported by swing arms.

BACKGROUND OF THE INVENTION

[0002] While the benefits of a good night's sleep have been appreciated since time immemorial, modern research continues to add depth and breadth to that understanding. Beyond the social, economic and medical costs stemming from a lack of alertness following poor sleep, it is now appreciated that sleep loss (including poor quality sleep) is associated with a litany of other problems, including increased risks of obesity, type 2 diabetes, high blood pressure, memory loss, poor balance, etc.

[0003] Equally ancient is the understanding that a rocking motion can facilitate sleep, to which countless generations of tired new parents can attest. While babies are the population segment most likely to experience the sleep benefits of gentle, repetitive motion, there have been numerous proposals for adult beds capable of imparting a repetitive side-to-side or rocking motion. While there is data supporting potential improved sleep from such beds, they are not widely accepted or commercially available.

[0004] One likely obstacle to the real world success of such beds is the fact that any sudden discontinuity to the motion cycle of the bed can create a perturbation easily noticeable to a sleeping user. Such perturbations can potentially awaken the user or at least cause an undesirable disruption to the sleep cycle, thereby mitigating the intended sleep benefits of the motion cycle, at best, or decreasing the quality of sleep relative to a stationary bed, at worst.

SUMMARY OF THE INVENTION

[0005] In view of the foregoing, it is an object of the present invention to provide an improved moving bed assembly. According to an embodiment of the present invention, a moving bed assembly includes a base frame and bed frame supported over the base frame by first and second pairs of swing arms, a drive shaft driving the bed frame through engagement with the swing arms through first and second driver arms, and a drive motor mounted to the base frame and imparting rotational motion thereto.

[0006] The base frame includes pairs of upper and lower base side members and a plurality of upper base cross members extending between the pair of upper base side members, a plurality of base vertical members supporting the pair of upper base side members over the pair of lower base side members. The bed frame arranged over the base frame includes a pair of bed side members and a plurality of bed cross members extending therebetween.

[0007] Each of the first and second pairs of swing arms is commonly connected between a respective one of the upper base cross members and a respective one of the bed cross members. Each swing arm of the at least first and second pairs of swing arms includes a pair of base members extending downwardly from base member upper ends attached to opposite sides of the respective one of the upper base cross members to base member lower ends, and a pair a bed members extending downwardly from bed member upper ends attached to opposite sides of the respective one of the bed cross members to bed member lower ends, the pair of base members being located between the pair of bed members.

[0008] A first pivot joint pivotably connects the base member upper ends to the respective one of the upper base cross members, and a second pivot joint pivotably connects the base member lower ends to the bed member lower ends.

[0009] The drive shaft rotatably mounts to the base frame and extends between a first shaft end and a second shaft end, the first shaft end carrying a first crank located between the first pair of swing arms, the second shaft end carrying a second crank located between the second pair of swing arms. The first drive arm extends between a first drive arm crank end pivotably attached to the first crank and a first drive arm swing end pivotably connected to a first arm mount attached between the pair of base members of one of the first pair of swing arms. The second drive arm extends between a second drive arm crank end rotatably attached to the second crank and a second drive arm swing end rotatably connected to a second arm mount attached between the pair of base members of one

of the second pair of swing arms.
[0010] According to an aspect of the present invention, the moving bed assembly further includes a shaft brake engaging the drive shaft between the first and second drive arm ends to apply a braking force thereto. The braking force can be adjustable and the shaft brake can be mounted to a side of a transmission through which the drive motor engages the drive shaft.
[0011] These and other objects, aspects and advantages of the present invention will be better appreciated in view of the drawings and following detailed description of preferred embodiments.

Description

BRIEF DESCRIPTION OF THE DRAWINGS
[0012] FIG. **1** is lower perspective view of a moving bed assembly, according to an embodiment of the present invention;
[0013] FIGS. **2** and **3** are upper perspective views of the moving bed assembly of FIG. **1**;
[0014] FIG. **4** is a top view of the moving bed assembly of FIG. **1**;
[0015] FIG. **5** is a partial sectional view taken along line **5-5** of FIG. **4**, with a engagement of a bed frame mounting block within a bed frame cross member;
[0016] FIG. **6** is a partial sectional view taken along line **6-6** of FIG. **4**, with an side view a representative swing arm;
[0017] FIG. **7** is a sectional view taken along line **7-7** of FIG. **4**, with an end view of a representative pair of swing arms;
[0018] FIG. **8** is a detail view of a representative drive shaft end bearing of the moving bed assembly of FIG. **1**;
[0019] FIG. **9** is a detail view of a representative crank at an end of a drive shaft of the moving bed assembly of FIG. **1**;
[0020] FIGS. **10** and **11** are end views of the moving bed assembly of FIG. **1**, with a bed frame thereof at opposite extremes of movement;
[0021] FIG. **12** is a detail perspective view of a shaft brake of the moving bed assembly of FIG. **1**;
[0022] FIG. **13** is a detail perspective view of the shaft brake of FIG. **12**, with a nut and spring thereof removed to show internal details;
[0023] FIG. **14** is a side view of the shaft brake of FIG. **12** with a brake housing thereof removed to show internal details;
[0024] FIG. **15** is a detail perspective view of a representative swing arm having an alignment pin therein;
[0025] FIG. **16** is a perspective view of a modular moving bed assembly, according to another embodiment of the present invention, incorporating the moving bed assembly of FIG. **1** as a base unit thereof; and
[0026] FIG. **17** is a perspective view of a moving bed assembly, according to a further embodiment of the present invention, including a bed frame with an articulated mattress arrangement thereon.
DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS
[0027] According to an embodiment of the present invention, referring to FIG. **1**, a moving bed assembly **10** includes a base frame **12** with a bed frame **14** movably supported thereabove by a plurality of swing arms **16**. A drive motor **20** is mounted to the base frame **12** and drives the bed frame **14** through a reciprocating motion via a drive shaft **22** and one or more drive arms **24**.
[0028] The base frame includes a pair of lower base side members **26** with a plurality of lower base cross members **30**, **32**, **34** extending therebetween. The lower base side and cross members **26**, **30** collectively define a lower base frame that supports the base frame **12** on an underlying surface. Outermost lower base cross members **30** collectively define a perimeter of the lower base frame **32** together with the pair of lower base side members **26**.

[0029] Intermediate lower base cross members **32** support drive shaft end bearings **36** thereabove. Adjustable feet **40** mounted to the intermediate lower base cross members **32** allow a level of the base frame **12** to be adjusted relative to the underlying surface, allowing the lower base frame **32** to be oriented horizontally, regardless of irregularities in the underlying surface. A drive motor mount **42** is supported across the innermost base cross members **34**.

[0030] Referring also to FIG. **2**, a plurality of vertical base members **44** support a pair of upper base side members **46** over the lower base side members **26**. A plurality of upper base cross members **50**, **52**, **54** extend between the upper base cross members **46**, collectively defining an upper base frame.

[0031] Outermost upper base cross members **50** define a perimeter of the upper base frame together with the upper base side members **46**. A pair of swing arms **16** are connected to each of the intermediate upper base cross members **52**. Innermost upper base cross members **54** add additional stiffness to the upper base frame.

[0032] Referring to FIG. **3**, the bed frame **14** includes a pair of bed side members **60** with a plurality of bed cross members **62**, **64**, **66** extending therebetween. A perimeter of the bed frame **14** is defined by the bed side members **60** and the bed cross members **62**, **64**, **66**. Advantageously, the bed cross members **62**, **64**, **66** have an inverted-U cross-section. Referring also to FIG. **5**, this configuration allows bed frame mounting blocks **70** to extend into the intermediate bed cross members **64** for connecting the bed frame **14** to the swing arms **16**. An innermost bed cross member **66** adds additional stiffness to the bed frame **14**.

[0033] Referring to FIGS. **6** and **7**, respective pairs of the swing arms **16** connect each intermediate upper base cross member **52** to the overlying intermediate bed cross member **64**. Each swing arm **16** includes a pair of base members **72** extending downwardly from opposite sides of the respective upper base cross member **52** and a pair of bed members **74** extending downwardly from opposite sides of the respective bed cross member **64**.

[0034] A first pivot joint **76** connects the base member **72** upper ends to the respective intermediate upper base cross member **52** while a second pivot joint **80** connects the lower ends of the base members **72** and the bed members **74**. Each pivot joint **76**, **80** preferably includes a respective bearing block **82** with a ball bearing mounted therein. Upper and lower ends of the base members **72** connect to the ball bearings of the first and second pivot joints **76**, **80** respectively.

[0035] The bearing block **82** of each first pivot joint **76** is mounted to the top of the respective intermediate upper base cross member **52**. The bearing block **82** of each second pivot joint **80** is mounted to a bottom plate **90**. Lower ends of each pair of bed members **74** are fixed to opposite sides of the respective bottom plate **90**.

[0036] A common upper plate **92** connects the upper ends of the bed members **74** of each pair of swing arms **16**. A pair of the bed frame mounting blocks **70** connect to an upper surface of each upper plate **92**, with the bed frame mounting blocks **70** being secured within the respective intermediate bed frame cross member **64**.

[0037] Referring to FIGS. **4** and **8**, near each end, the drive shaft **22** is supported by of the drive shaft end bearings **36** located proximate to a respective pair of the swing arms **16**. Each drive shaft end bearing **36** is preferably a plain bearing including a bushing **94** mounted in a bearing support plate **96** connected to the respective intermediate lower base cross member **32**. The drive shaft end bearings **36** help prevent any radial misalignment of the drive shaft **22** during operation and eliminate corresponding noticeable perturbations to the motion cycle of the bed frame **14**.

[0038] Referring to FIGS. **7** and **9**, each end of the drive shaft **22** carries a crank **100** fixed to rotate therewith. Each drive shaft **22** end extends through a shaft passage **102** formed through one end of the respective crank **100**. Each passage **102** opens onto **104** an adjacent end of the crank **100**, allowing the drive shaft **22** to be securely clamped within the shaft passage **102** via an endplate **104**. Each end of the drive shaft **22** includes a flat surface **106** that engages the endplate **104**, ensuring proper radial alignment of each crank **100** on the drive shaft **22** and inhibiting rotation of

the shaft **22** relative to the crank during operation. Preferably, the radial alignment of the crank **100** on each end of the drive shaft **22** is identical.

[0039] An opposite end of each crank **100** is connected to a crank end of a respective one of the drive arms **24** via a rotatable crank joint **114**. A swing end of each drive arm **24** extends between, and is rotatably connected to, the base members **72** of one of each pair of swing arms **16** via a rotatably swing joint **116**. Each of the joints **114**, **116** is preferably a ball and socket joint (see also FIG. **3**) allowing some rotation of each drive arm **24** about its axis during operation to accommodate some degree of misalignment between its crank and swing ends.

[0040] The radial displacement of each crank joint **114** from the drive shaft **22** by the crank **100** allows conversion of the rotation of the drive shaft **22** to a reciprocal motion of the drive arms **24**. As used herein, in a “neutral” position of the drive shaft **22**, there is no horizontal displacement between the rotational axes of the crank joints **114** and drive shaft **22**. FIG. **7** depicts the drive shaft **22** in the neutral position, with the cranks **100** oriented vertically in the “twelve o'clock” direction. It will be appreciated that the drive shaft **22** would also be in the neutral position with each crank oriented vertically in the “six o'clock” direction.

[0041] In the neutral position, vertical levels L of the drive shaft **22** and the swing joints **116** of the swing ends of the drive arms **24** are equal. As used herein, the “vertical level” is referenced to a horizontal plane extending below a horizontally leveled base frame **12**. This configuration results in the most direct application of force from the drive shaft **22** through the drive arms **24** throughout the entire motion cycle and further helps eliminate noticeable perturbations thereto. Additionally, the vertical level of the swing joints **116** is closer to lower ends of the base members **72** than upper ends thereof.

[0042] Opposite ends side-to-side motion of the bed frame **14** are achieved with the cranks **100** oriented in the “three o'clock” (FIG. **10**) and “nine o'clock” (FIG. **11**) directions. Advantageously, the total horizontal motion between the opposite extremes is between 4 and 5 inches, and more particularly, between 4.5 and 5 inches. Due to the angular motion of the swing arms **16**, the bed frame **14** will also rise slightly with respect to, while remaining parallel with, a horizontal reference plane during each transition from a neutral position to either end of the motion cycle.

[0043] The present inventors have determined that another source of noticeable perturbations to the motion cycle occurs during the direction change at these opposite ends of the motion cycle. With reference to the drive shaft **22** position, these occur when the cranks **100** transition through the “three o'clock” and “nine o'clock” directions where the drive arms **24** switch from pushing to pulling and vice versa. In particular, under some load conditions on the bed frame **14**, a noticeable “lurching” or “falling” sensation can sometimes be experienced.

[0044] Advantageously, referring to FIG. **4** a shaft brake **120** is used to provide a constant preload on the drive shaft **22** during rotation and can effectively eliminate noticeable perturbations associated with these transitions in the motion cycle. Referring to FIGS. **12-14**, the shaft brake **120** includes a stationary disc **122** through which the drive shaft **22** passes and which is engaged on opposite surfaces thereof by rotating friction pads **124**, **126** carried by the drive shaft **22**. In the depicted embodiment, the stationary disc **122** is held in place by a brake housing **130** mounted to a side of a transmission **132**.

[0045] The friction pads **124**, **126** are carried by a hub **134**, with the friction pad **124** being located within the housing **130** and the friction pad **126** being located externally. The hub **134** is internally keyed to the drive shaft **22** to ensure rotation therewith. Externally, splines **136** are formed on the hub **134**, the splines **136** having an increased diameter at an inner end of the hub **134** within the housing **130**. Outer sections of the splines **136** are threaded.

[0046] The friction pads **124**, **126** are internally splined so as to be rotationally coupled to the hub **134** and drive shaft **22** while being able to move axially relative thereto. The expanded diameter inner end of the splines **136** prevents the inner pad **124** from sliding off the hub **124** within the housing, while a nut **140** threads onto the splines **136** externally, retaining the outer pad **126**.

[0047] A spring **142** is arranged between the nut **140** and the outer pad **126**, allowing the braking force of the shaft brake **120** to be adjusted by tightening and loosening the nut **140**. The spring **142** is internally splined like the pads **124**, **126** and is preferably a toothed spring washer. The braking force can be advantageously adjusted if desired based on the anticipated bed loading.
[0048] Referring again to FIG. **4**, the drive motor **20** preferably engages the drive shaft **22** through the transmission **132**. With the rotational axis of the drive motor **20** being perpendicular to that of the drive shaft **22**, the transmission **132** function both to change the direction of the rotational output of the drive motor **20** as well as to decrease the rotational speed (while increasing torque).
[0049] Referring to FIG. **15**, for ensuring proper alignment during assembly and transport, alignment pins **144** are inserted through aligned holes in the base members **72** and bed members **74** of each swing arm **16**. Connecting the bed frame **14** to the upper plates **92** connecting pairs of swing arms **16** allows the base frame **12** and swing arms **14** to remain fully assembled and aligned while still allowing the bed frame **14** to be readily detached and re-attached.
[0050] While it would be appreciated that a moving bed assembly according to the present invention could be made in any desired size, the above-described embodiment is dimensioned to accommodate a twin extra-long (XL) mattress on the bed frame **14**. Besides simply changing the overall size to accommodate different mattress sizes, a modular approach can be used to make larger beds using the moving bed assembly **10** as a base unit with additional units added to achieve the desired size. In FIG. **16**, a king-sized moving bed assembly **10**A is formed by connecting the base frame **12** to an additional base frame **12**A side-by-side such that respective ones of upper and lower pairs of additional base side members **26**A, **46**A abut respective ones of the upper and lower pairs of base side members **26**, **46** and the additional base cross members extend in parallel with the base cross members. Likewise, the bed frame **14** is connected to an additional bed frame **14**A such that one of the additional bed frame side members **60**A abuts one of the bed frame side members **60** and the additional bed cross members extend in parallel with the bed cross members. The additional bed frame **14**A is supported over the additional base frame **12**A by additional swing arms **16**A substantially identical to the swing arms **16**.
[0051] With the exception of the absence of the motor **20**, drive shaft **22** and other drive components, in the depicted king embodiment, the base frames **12**, **12**A and bed frames **14**, **14**A are substantially identical. However, to ensure proper centering of the adjoined bed frames **14**, **14**A over the adjoined base frames **12**, **12**A, attachment points of the bed frame mounting blocks to the intermediate bed cross members can be adjusted relative to the twin XL configuration. Preferably, the base frames **12**A is connected to the side of the base frame **12** on which the drive arms **24** are connected to respective swing arms **16**, making the contact points between the drive arms **24** and swing arms **16** closer to the center of the combined bed.
[0052] For other sizes of modular moving bed assemblies, it will be appreciated that additional base frames and additional bed frames having different widths than the initial base frame **12** and bed frame **14** could be used. For instance, to achieve a queen bed, the additional base and bed frames would be smaller than initial base and bed frames **12**, **14**.
[0053] Referring to FIG. **17**, in addition to supporting standard mattresses, a moving bed assembly **10**B can support a bed frame **14**B having an articulated mattress arrangement **150**B located thereon. The bed frame **12**B, swing arms **16**B, motor **20**B and associated drive components remain substantially identical to those discussed above in connection with the moving bed assembly **10**. To reduce the overall height of the assembly **10**B, as well as to more readily accommodate use of commercially-available articulated mattress arrangements, the bed frame **14**B can mount directly to the upper plates **92**B connecting the pairs of swing arms **16**B, rather than mount via bed frame mounting blocks.
[0054] The above-described embodiments are provided for illustrative purposes; the present invention is not necessarily limited thereto. Rather, those skilled in the art will appreciate that

various modifications, as well as adaptations to particular circumstances, will fall within the scope of the invention herein shown and described and of the claims appended hereto.

Claims

1. A moving bed assembly comprising: a base frame including pairs of upper and lower base side members and a plurality of upper base cross members extending between the pair of upper base side members, a plurality of base vertical members supporting the pair of upper base side members over the pair of lower base side members; a bed frame arranged over the base frame including a pair of bed side members and a plurality of bed cross members extending therebetween; at least first and second pairs of swing arms supporting the bed frame for movement over the base frame, each of the pairs of swing arms being commonly connected between a respective one of the upper base cross members and a respective one of the bed cross members, each swing arm of the at least first and second pairs of swing arms including: a pair of base members extending downwardly from base member upper ends attached to opposite sides of the respective one of the upper base cross members to base member lower ends; a pair a bed members extending downwardly from bed member upper ends attached to opposite sides of the respective one of the bed cross members to bed member lower ends, the pair of base members being located between the pair of bed members; a first pivot joint pivotably connecting the base member upper ends to the respective one of the upper base cross members; and a second pivot joint pivotably connecting the base member lower ends to the bed member lower ends; a drive shaft rotatably mounted to the base frame and extending between a first shaft end and a second shaft end, the first shaft end carrying a first crank located between the first pair of swing arms, the second shaft end carrying a second crank located between the second pair of swing arms; a first drive arm extending between a first drive arm crank end pivotably attached to the first crank and a first drive arm swing end pivotably connected to a first arm mount attached between the pair of base members of one of the first pair of swing arms; a second drive arm extending between a second drive arm crank end rotatably attached to the second crank and a second drive arm swing end rotatably connected to a second arm mount attached between the pair of base members of one of the second pair of swing arms; and a drive motor mounted to the base frame and engaging the drive shaft and operable to impart rotational motion thereto.
2. The moving bed assembly of claim 1, further comprising a shaft brake engaging the drive shaft between the first and second drive arm ends to apply a braking force thereto.
3. The moving bed assembly of claim 1, wherein the braking force applied by the shaft brake is adjustable.
4. The moving bed assembly of claim 1, further comprising a transmission mounted on the base frame, the drive motor engaging the drive shaft through the transmission.
5. The moving bed assembly of claim 4, wherein the shaft brake is mounted to a side of the transmission.
6. The moving bed assembly of claim 4, wherein a rotational axis of the drive motor is perpendicular to a rotational axis of the drive shaft.
7. The moving bed assembly of claim 1, wherein, in a neutral position of the bed frame, vertical levels of the drive shaft and the first and second drive arm swings ends are equal.
8. The moving bed assembly of claim 7, wherein the vertical levels of the first and second drive arm swing ends are closer to the base member lower ends than to the base member upper ends.
9. The moving bed assembly of claim 1, further comprising: an additional base frame including upper and lower pairs of additional base side members and a plurality of upper additional base cross members extending between the upper pair of additional base side members, a plurality of additional base vertical members supporting the upper pair of additional base side members over the lower pair of additional base side members, the additional base, the additional base frame being

connected to the base frame such that respective ones of the upper and lower pairs of additional base side members abut respective ones of the upper and lower pairs of base side members and the additional base cross members extend in parallel with the base cross members; an additional bed frame arranged over the additional base frame including a pair of additional bed side members and a plurality of additional bed cross members extending therebetween, the additional bed frame being connected to the bed frame such that one of the additional bed frame side members abuts one of the bed frame side members and the additional bed cross members extend in parallel with the bed cross members; at least first and second additional swing arms supporting the additional bed frame for movement over the additional base frame, each of the additional swing arms being commonly connected between a respective one of the upper additional base cross members and a respective one of the additional bed cross members, each of the first and second additional swing arms being substantially identical to the first and second pairs of swing arms.

10. The moving bed assembly of claim 9, wherein the bed frame and the additional bed frame collectively define a king-sized bed frame.

11. The moving bed assembly of claim 1, wherein the bed frame is a twin extra long (XL) bed frame.

12. The moving bed assembly of claim 1, wherein the bed frame carries an articulated mattress support thereon.

13. A moving bed assembly comprising: a base frame including upper and lower pairs of base side members and a plurality of upper base cross members extending between the upper pair of base side members, a plurality of base vertical members supporting the upper pair of base side members over the lower pair of base side members; a bed frame arranged over the base frame including a pair of bed side members and a plurality of bed cross members extending therebetween; at least first and second pairs of swing arms supporting the bed frame for movement over the base frame, each of the pairs of swing arms being commonly connected between a respective one of the upper base cross members and a respective one of the bed cross members, each swing arm of the at least two pairs of swing arms; a drive shaft rotatably mounted to the base frame and extending between a first shaft end and a second shaft end, the first shaft end carrying a first crank; a first drive arm extending between a first drive arm crank end rotatably attached to the first crank and a first drive arm swing end rotatably connected to drive the bed frame; a drive motor mounted to the base frame and engaging the drive shaft and operable to impart rotational motion thereto; and a shaft brake engaging the drive shaft between the first and second drive arm ends to apply a braking force thereto.

14. The moving bed assembly of claim 13, wherein the braking force applied by the shaft brake is adjustable.

15. The moving bed assembly of claim 13, further comprising a transmission mounted on the base frame, the drive motor engaging the drive shaft through the transmission.

16. The moving bed assembly of claim 14, wherein the shaft brake is mounted to a side of the transmission.

17. The moving bed assembly of claim 14, wherein a rotational axis of the drive motor is perpendicular to a rotational axis of the drive shaft.

18. The moving bed assembly of claim 13, wherein each swing arm of the at least first and second pairs of swing arms includes: a pair of base members extending downwardly from base member upper ends attached to opposite sides of the respective one of the upper base cross members to base member lower ends; a pair a bed members extending downwardly from bed member upper ends attached to opposite sides of the respective one of the bed cross members to bed member lower ends, the pair of base members being located between the pair of bed members; a first pivot joint pivotably connecting the base member upper ends to the respective one of the upper base cross members; and a second pivot joint pivotably connecting the base member lower ends to the bed member lower ends.

19. The moving bed assembly of claim 18, wherein the first shaft end is located between the first pair of swing arms and the first drive arm swing end is pivotably connected to a first arm mount attached between the pair of base members of one of the first pair of swing arms.
20. The moving bed assembly of claim 19, wherein the second shaft end carries a second crank located between the second pair of swing arms, and a second drive arm extends between a second drive arm crank end pivotably attached to the second crank and a second drive arm swing end pivotably connected to a second arm mount attached between the pair of base members of one of the second pair of swing arms.
21. The moving bed assembly of claim 20, wherein, in a neutral position of the bed frame, vertical levels of the drive shaft and the first and second drive arm swings ends are equal.
22. The moving bed assembly of claim 21, wherein the vertical levels of the first and second drive arm swing ends are closer to the base member lower ends than to the base member upper ends.