Aug. 25, 1970 L. H. CROSBY ET AL 3,525,514

SPRING CONSTRUCTION

Original Filed Nov. 28, 1966 2 Sheets-Sheet 1

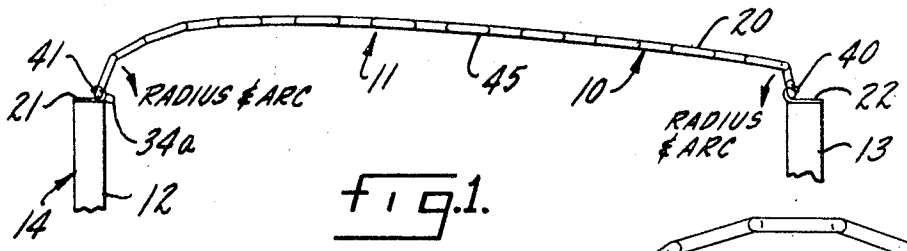


Fig. 1.

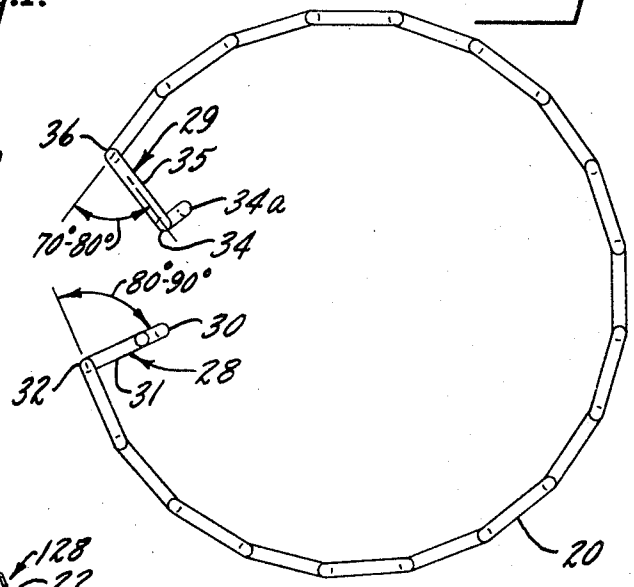


Fig. 2.

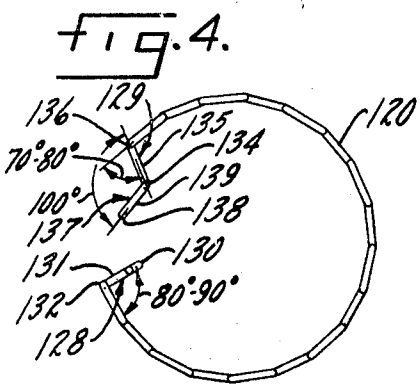


Fig. 4.

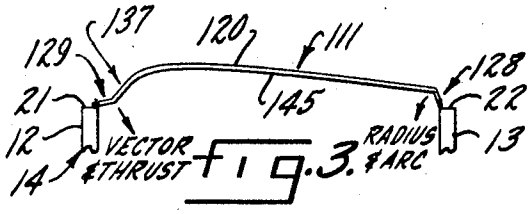


Fig. 3.

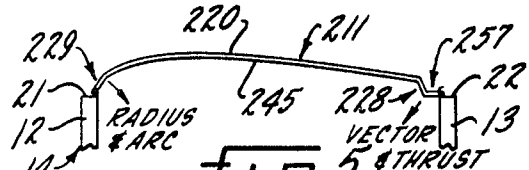


Fig. 5.

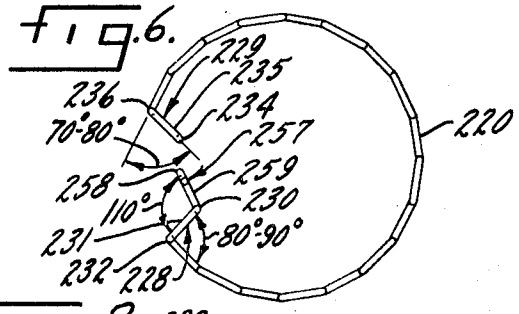


Fig. 6.

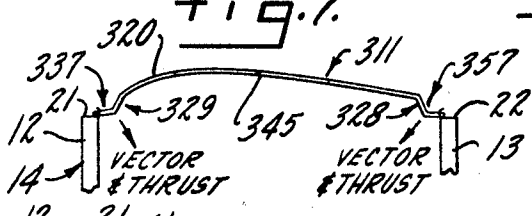


Fig. 7.

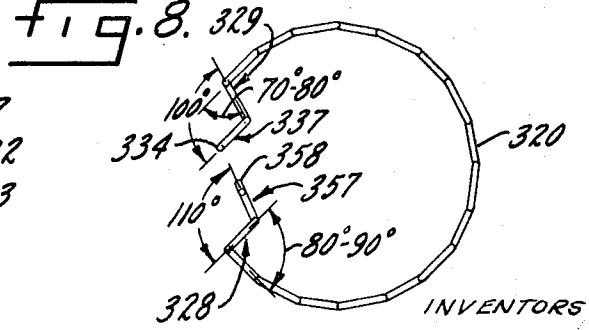


Fig. 8.

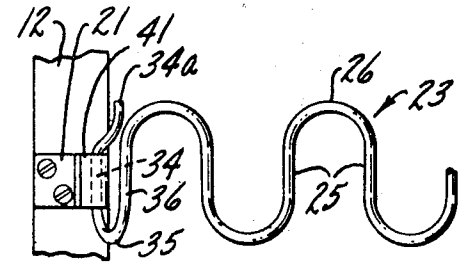
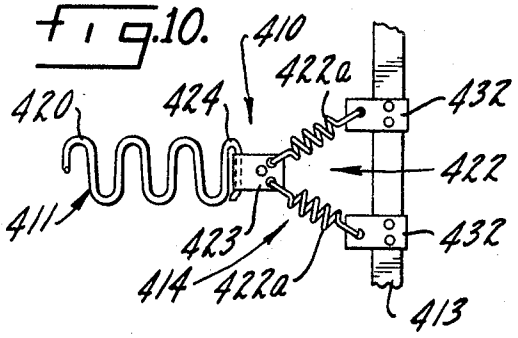


Fig. 9.

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Fig. 10.



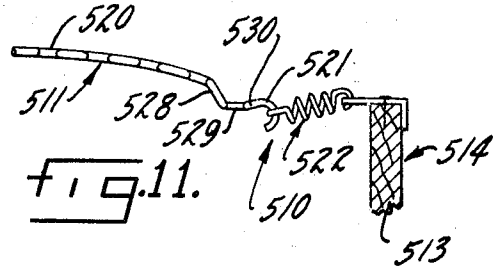
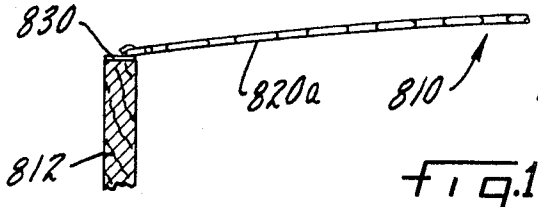


Fig. 11.



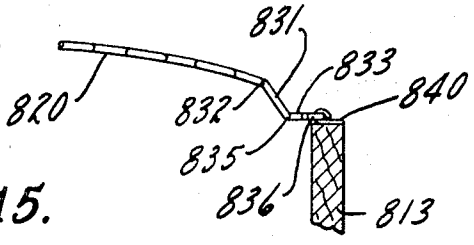


Fig. 15.

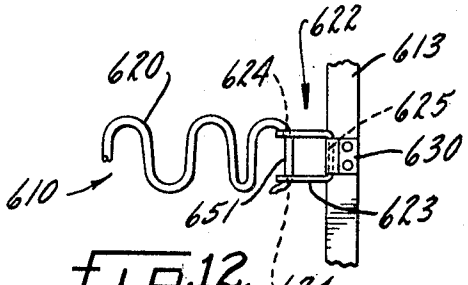


Fig. 12.

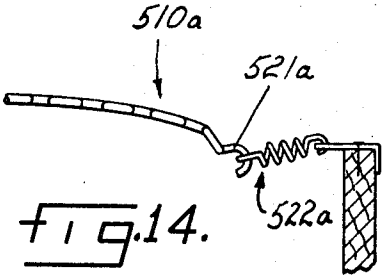
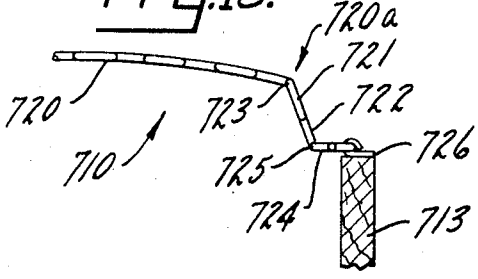


Fig. 14.

Fig. 13.



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SPRING CONSTRUCTION

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Application Nov. 28, 1966, Ser. No. 602,448, now Patent No. 3,388,904, dated June 18, 1968, which is a continuation-in-part of applications Ser. No. 301,552, Aug. 12,1963, and Ser. No. 434,563, Feb. 23, 1965. Divided and this application Jan. 10, 1968, Ser. No. 719,808
Int. Cl. A47l *23/16*
U.S. Cl. 267—110 3 Claims

ABSTRACT OF THE DISCLOSURE

This invention relates to furniture and other seating arrangements, and more particularly to a seating arrangement employing springs of the sinuous band type wherein portions of the band adjacent the front and back rails of the furniture frame are bent downwardly to provide deep drop support of the seated subject without attendant bucketing and jack-knifing of the spring band.

This is a division of application Ser. No. 602,448, filed Nov. 28, 1966, now Pat. No. 3,388,904, issued June 18, 1968. The latter is a continuation-in-part application of our copending applications Ser. No. 301,552, filed Aug. 12, 1963, and Ser. No. 434,563, filed Feb. 23, 1965, both now abandoned.

It is an object of the present invention to provide a greatly improved spring assembly for a seating arrangement.

It is another object to provide a new and improved sinuous spring band construction which introduces luxurious resilience to a seating arrangement heretofore found only in more expensive spring constructions such as tied coil springs and the like.

It is still another object to provide a sinuous spring band construction which eliminates "bucketing" (contour-arc reversal) of the center portion of the band.

It is yet another object to provide a sinuous spring band construction which eliminates "jackknifing" (contour-arc reversal) of the rear portion of the band immediately adjacent the rear frame rail.

It is a further object to provide a sinuous spring band construction which produces "deep-drop" support of the subject seated on the furniture seat, for example.

It is still a further object to provide a sinuous spring band construction which assures substantial assisting uplift to the seated subject when rising from the seat.

It is yet a further object to provide a sinuous spring band construction which provides much more effectively resilient support to the seated subject than heretofore considered possible without accompanying hardness, and permits adjustable control of resilience.

It is still a further object to provide a sinuous spring band construction which inherently develops a highly desirable seat contour to eliminate the cushion gap found in other sinuous spring assemblies.

It is yet another object to provide a sinuous spring band construction which facilitates the establishment of a wide range of choices from firmness to softness in seating arrangements.

It is still another object to provide a sinuous spring band construction which is readily used in frames of varying size, without modification.

It is another object to provide a sinuous spring band construction which has all the aforementioned advantages forthcoming whether used in standard and long span frames or ultra-short frames.

The foregoing and other objects are realized in accord with the present invention by providing a sinuous spring band assembly which permits a full-range of seating effects to be achieved using basically the same or similar spring bands. In one aspect of the invention, downwardly bent portions of the band are formed adjacent both the front and back rails of a furniture frame or the like, with the free ends of the band connected to corresponding rails. As a result, downward pressure applied to the band by a subject being seated, for example, effects travel of the downwardly bent portions relative to their rail mountings and stored resilience is developed in the body of the band. Deep-drop support of the seated subject is assured and bucketing at the center of the band and jackknifing adjacent the rear rail are eliminated.

In another aspect of the invention, specifically advantageous effects are achieved by the development of differential stored resilience in the band at the front and rear rails. The downwardly bent portion of the band adjacent the rear rail is bent at a greater angle to the remainder of the band than the correspondingly downward bent portion adjacent the front rail. As a result, the spring band assumes a greater torque at the rear rail and highly desirable rearwardly inclined contour is developed. Furthermore, relatively greater stored resilience is developed in the spring band adjacent the rear rail, where the bulk of the weight of a seated subject is carried when the subject is seated.

In yet another aspect of the present invention, subtle but significant variations in the differential stored resilience developed in the spring band by the downwardly bent portions of the band when a subject is seated are selectviely introduced through the use of generally horizontal, outwardly extending band portions or separate members connecting the downwardly bent portions to either the front rail or the back rail, or to both rails. These generally horizontally extending band portions or separate members act as translatory support members to vary the compression by introducing stored resilience in a less pronounced manner through translation and vector thrust rather than straight pivoting of the downwardly bent portions about their rail connections when a subject is seated.

In still another aspect of the invention, a horizontally extending band portion or separate member is employed to develop vector thrust and translation adjacent the back rail only. The translation once more induces stored resilience in a less pronounced manner than a direct pivotal connection, for example, to produce a "softer" seat.

The invention, both as to its construction and method of operation, is illustrated more or less diagrammatically in the attached drawings, in which:

FIG. 1 is a side elevational view of a furniture spring arrangement incorporating a sinuous spring band assembly embodying features of a first form of the present invention, with parts removed;

FIG. 2 is a side-elevational view of the relaxed sinuous spring band employed in the first form of spring band assembly illustrated in FIG. 1;

FIG. 3 is a diagrammatic side elevational view of a furniture spring arrangement incorporating a sinuous spring band assembly embodying features of a second form of the present invention;

FIG. 4 is a diagrammatic side elevational view of a relaxed sinuous spring band employed in the spring band assembly illustrated in FIG. 3;

FIG. 5 is a diagrammatic side elevational view of a furniture spring arrangement incorporating a sinuous spring band assembly embodying features of a third form of the present invention;

FIG. 6 is a diagrammatic side elevational view of a

relaxed sinuous spring band employed in the spring arrangement illustrated in FIG. 5;

FIG. 7 is a diagrammatic side elevational view of a furniture spring arrangement incorporating a sinuous spring band assembly embodying features of a fourth form of the present invention;

FIG. 8 is a diagrammatic side elevational view of a relaxed sinuous spring band employed in the spring arrangement illustrated in FIG. 7; and

FIG. 9 is an enlarged plan view of a portion of the spring arrangement illustrated in FIG. 1;

FIG. 10 is an enlarged plan view of another form of "back-rail" connection for the spring assembly;

FIG. 11 is an enlarged elevational view of still another form of "back-rail" connection;

FIG. 12 is an enlarged plan view of yet another form of "back-rail" connection;

FIG. 13 is an enlarged elevational view of a further variation of the "back-rail" connection;

FIG. 14 is an enlarged elevational view of a modified variation of the "back-rail" connection; and

FIG. 15 is a side elevational view, with parts broken away, of a simplified spring arrangement embodying features of the present invention.

Referring now to the drawings, and particularly to FIGS. 1 and 9, a furniture spring arrangement of the sinuous spring band type is illustrated generally at **10**. The spring arrangement **10** includes a sinuous spring band assembly **11** embodying features of a first form of the present invention mounted between the front rail **12** and the back rail **13** of a conventional furniture frame **14** (only part of which is shown) for a chair, sofa, or vehicle or the like. Only one spring band assembly **11** is illustrated, but as will be readily understood, the frame **14** normally mounts a parallel series of these assemblies **11**.

Each of the spring band assemblies **11** includes a new and improved sinuous spring band **20** connected to the front rail **12** by EK clip **21** and to the back rail **13** by EK clip **22**, for pivotal movement about their connections. The spring band **20** inherently develops center area stored resilience in the band **20** as a subject is seated to assure deep-drop support of the subject, the avoidance of center area bucketing in the band, and the avoidance of rear-area jackknifing or the like. The new and improved spring band **20** develops a highly attractive and effective contour with a slight rearward incline and provides what is characterized relatively as a "firm" seat in any type of frame, regardless of its length.

In contrast to the sinuous spring band assembly **11**, the spring band assembly **111** illustrated in FIG. 3 and embodying features of a second form of the present invention develops a slightly softer seat; one which might be termed "medium firm" in the relative scale. This variation in firmness is achieved by providing a lesser rate of increase in stored resilience in the spring band **120** adjacent the front rail as the subject is seated.

A third form of sinuous spring band assembly embodying features of the present invention is illustrated at **211** in FIG. 5. The sinuous spring band assembly **211** provides a still softer seat on the relative scale, and might be termed "medium soft," by providing a lesser rate of increase in stored resilience in the spring band **220** adjacent the back rail **13** as a subject is seated.

Turning to FIG. 7, a fourth form of spring band assembly embodying features of the present invention is illustrated generally at **311**. The spring band assembly **311** produces the softest of seats on the relative scale and is generally referred to as "soft." In other words, even in the shortest of frames such as might be employed in private aircraft, recliners, and so on, for example, where other torque sinuous constructions cannot function properly, superior resilience and greater comfort in a sinuous spring band seating arrangement is afforded. In the spring band assembly **311**, increase in the rate of stored resilience in the band **320** is lessened adjacent both rails **12** and **13**.

Referring once more to FIGS. 1 and 9, in the sinuous spring band assembly **11** embodying features of the first form of the present invention, the sinuous spring band **20** illustrated is a regular loop sinuous spring band. In other words, its individual loops **23** are broadly of standard configuration and dimension. The linear segments **25** and interconnecting semicircular segments **26** which define each loop **23** are of a predetermined standard length and radius, respectively. Although the spring band **20**, embodying features of the first form of the present invention, is illustrated as a regular loop spring band, however, it should be understood that expanded loop (XL) and superloop spring bands (other forms well known in the furniture business) might also be used.

Precedent to describing the spring band **20** in its assembly **11**, a better understanding of the invention is facilitated by referring to FIG. 2 and the illustration of the band in relaxed relationship. The band **20** will be seen to describe the larger part of a complete circle. A rear end section **28** of the relaxed band **20** is bent inwardly of the circle at an angle of approximately 80°–90° thereto, and a front end section **29** is bent inwardly of the circle at a lesser angle of approximately 70°–80°. Varying these angles in proportion, however, can be done to control resilience. The rear end section **28** includes the last linear segment **30** in the band **20** and the last semicircular segment **31** thereof, bent inwardly about the second last linear segment **32**. Correspondingly, the front end section **29** includes the last linear segment **34** at the opposite end of the band, and the last semicircular segment **35** thereof, bent inwardly about the second last linear segment **36**.

Returning now to the spring assembly **11** as illustrated in FIGS. 1 and 9, the sinuous spring band **20** is connected to the front rail **12** by the EK clip **21** and the back rail **13** by the EK clip **22**, as has been pointed out. In this light, the last linear segment **30** of the rear end section **28** is held in the loop **40** of the EK clip **22** while the last linear segment **34** of the front section **29** in the band **20** is retained in the loop **41** of the EK clip **21**. It will thus be seen that each end of the band **20** is mounted for pivotal movement about corresponding end linear segments **30** and **34** held in EK clip loops **40** and **41**, respectively.

It will be noted also that a free end **34***a* of the last linear segment **34** in the front end section **29** is bent in an arc generally perpendicular to the plane defined by the linear segment **34** and **36** and the semicircular segment **35**. As such, the linear segment **34** cannot pull out of the EK clip loops **41** during flexing of the band **20**.

When the spring band **20** is stretched between the front rail **12** and the back rail **13** in the foregoing manner, it will be recognized that a downward torque or moment arm is introduced in the band adjacent the back rail **13** by the downwardly bent end section **28** of the band. At the same time, the downwardly bent attitude of the front end section **29** of the band **20** introduces a corresponding downward torque or moment arm in the band adjacent the front rail **12**. These opposing torques develop latent compression in the central body portion **45** of the band **20**.

As a subject lowers into seated relationship on the spring band assemblies **11** making up the spring arrangement **10**, the opposite end sections **28** and **29** of the band pivot about their mounting linear segments **30** and **34**, respectively, and compression in the spring band is progressively increased. As a result, the strength of the spring assembly **11** is progressively actually increased and "bucketing" of the band in the central body portion **45** (such as was frequently encountered with known sinuous spring band arrangements) is avoided. At the same time, the stored resilience developed in the body portion **45** of the band **20** adjacent the back rail **13** of the frame **14** obviates

jackknifing of the bands, a common occurrence in the aforementioned prior art sinuous spring band arrangements.

Since the read end section **28** of the spring band **20** is bent downwardly at a greater angle than the front end section **29**, greater stored resilience is developed in the rear of the body portion **45** of each band **20**. Thus support is provided to its greatest extent in that area under the spine of the seated subject where the bulk of weight is concentrated. This arrangement further enhances the antibucketing and, especially, antijackknifing features of the present invention.

At the same time, the differential in bend angles of the downwardly bent rear end section **28** and front end section **29** produces a lesser arc in the rear of the body portion **45** of the bend **20** than in the front portion thereof, as illustrated in FIG. 1. A highly desirable rearwardly sloping contour or profile of the sinuous spring band arrangement **10** is thus achieved as an added feature of the relative bend angle differential.

The seat afforded by the use of spring assemblies **11** embodying the first form of the present invention hereinbefore described can generally be characterized as a "firm" seat, as pointed out. The "firm" seat results from the arcuate movement of the inner linear segments **32** and **36** on opposite ends of the spring bands **20** with relatively high rate of increase in compression in the body portion **45** of the bands as the subject is seated. In contrast to this arrangement, a "medium firm" seat is afforded by the spring band assemblies **111** illustrated in FIG. 4, as has also been pointed out. This "medium firm" seat is afforded by providing lesser rate of increase in stored resilience developed in the spring bands **120** adjacent the front rail **12** of the frame **14** as a subject is seated.

Precedent to describing a spring band **120** in its assembly **111**, reference is made to FIG. 4 and the illustration of the band in relaxed relationship. The relaxed band **120** includes a rear end section **128** bent inwardly of the circle at an angle of approximately 80°–90° thereto, and a front end section **129** bent inwardly of the circle at an angle of approximately 70°–80°. The rear end section **128** includes the last linear segment **130** in the band **120** and the last semicircular segment **131** thereof, bent inwardly about the second last linear segment **132**. The front end section **129**, on the other hand, includes the second last linear segment **134** adjacent the opposite end of the band, and the second last semicircular segment **135** thereof, bent inwardly about the third last linear segment **136**.

In distinction from the spring band **20** hereinbefore described in relation to the spring band assembly **11** embodying features of a first form of the present invention, the spring band **120** includes an extension section **137** bent upwardly from the downwardly extending front end section **129**. The extension section **137** includes the last linear segment **138** at the front end of the band **120** and the last semicircular segment **139** thereof, bent upwardly about the second last linear segment **134** at an angle of approximately 100° to the plane of the linear segments **134** and **136** and their connecting semicircular segment **135**.

Referring to the spring assembly **111** as illustrated in FIG. 3, the sinuous band **120** is connected to the front rail **12** by the EK clip **21** and the back rail **13** by the EK clip **22**. In this light, the last linear segment **130** of the rear end section **28** is held in the loop **40** of the EK clip **22** while the last linear segment **138** on the extension section **137** of the band **20** is retained in the loop **41** of the EK clip **21**. Each end of the band **20** is thus mounted for pivotal movement about corresponding end linear segments **130** and **138** held in EK clip loops **40** and **41**, respectively.

When the spring band **120** is stretched between the front rail **12** and the back rail **13** in the foregoing manner, a downward torque or moment arm is introduced in the band adjacent the back rail **13** by the downwardly bent end section **128** of the band, in identical fashion to the first form of spring assembly **11** hereinbefore discussed. At the same time, the downwardly bent attitude of the front end section **129** of the band **120** introduces a downward torque or moment arm in the band adjacent the front rail **12** albeit through the extension section **137** of the band. These opposing torques develop stored resilience in the central body portion **145** of the band **120**.

As the subject lowers into seated relationship on the spring band assemblies **111**, the rear end section **128** of the band pivots about its mounting linear segment **130** and tends to further compress or develop stored resilience in the central body portion **145** of the band. At the same time, the actual pivot point of the front end section **129** of the band **120** is displaced from the linear segment **134** to the free end linear segment **138** of the extension section **137**. Accordingly, the effective pivot axis of the front end section **129** defined by its linear segment **134** moves linearly inward and downward of the spring band **120** in a translatory movement. The stored resilience developed in the body portion **145** of the spring band **120** by the front end section **129** thereof is, accordingly, increased at a substantially lesser rate than is the stored resilience developed by the front end section **29** of the spring band **20** hereinbefore discussed in relation to the first form of the present invention. Accordingly, a slightly softer seat, which on our relative scale is defined as "medium firm," is effected by the spring band assembly **111**.

Nevertheless, albeit at a lesser rate, stored resilience in the body portion **145** of the spring band **120** is progressively increased, increasing the strength of the spring assembly **111**. As a result, bucketing of the band in the central body portion **145** is avoided. Correspondingly, stored resilience developed in the body portion **145** of the band **120** adjacent the back rail **13** obviates jackknifing of the band.

Similarly to the spring band assembly **11** hereinbefore discussed, greater stored resilience forces are developed in the rear of the body portion **145** of each band **120** because of the greater angle of bend of the rear end section **128**. Support is once more provided to its greatest extent in the area under the spine of the seated subject where the bulk of weight is concentrated. Antibucketing and antijackknifing features of the present invention are further enhanced.

Once again, the differential in bend angles of the downwardly bent rear end section **128** and front end section **129** produce a lesser arc in the rear of the body portion **145** of the band **120** than in the front portion thereof, as illustrated in FIG. 3. The highly desirable rearwardly sloping contour or profile of the sinuous spring arrangement **10** is also achieved in this form of the present invention.

In contrast to the seats afforded by the use of spring assemblies **11** or **111** embodying the first or second forms of the present invention, as hereinbefore described, a "medium soft" seat s afforded by the spring band assembly **211** illustrated in FIG. 5, as has also been pointed out. This "medium soft" seat is the result of providing a lesser rate of increase in stored resilience development in the spring band **220** adjacent the back rail **13** of the frame **14**, as a subject is seated.

Precedent to describing the spring band **220** in its assembly **211**, reference is made to FIG. 6 and the illustration of the band in relaxed relationship. The relaxed band **220** includes a rear end section **228** bent inwardly of the circle at an angle of approximately 80°–90° thereto, and a front end section **229** bent inwardly of the circle at an angle of approximately 70°–80°. The rear end section includes the second-last linear segment **230** in the band **220** and the second-last semicircular segment **231** thereof, bent inwardly about the third last linear segment **232**. The front end section **229**, on the other hand, includes the last linear segment **234** adjacent the opposite end of the band,

and the last semicircular segment **235** thereof, bent inwardly about the second last linear segment **236**.

In distinction from the spring band **20** and **120** hereinbefore described, however, the spring band **220** includes an extension section **257** bent upwardly from the downwardly extending rear end section **228**. The extension section **257** includes the last linear segment **258** at the rear end of the band **220** and the last semicircular segment **259** thereof, bent upwardly about the second last linear segment **230** at an angle of approximately 110° to the plane of the linear segments **230** and **232** and their connecting semicircular segment **231**.

Referring to the spring assembly **211** as illustrated in FIG. 5, the sinuous band **220** is connected to the front rail **12** by the EK clip **21** and the back rail **13** by the EK clip **22**. In this light, the last linear segment in the extension section **257** on the rear end section **228** is held in the loop **40** of the EK clip **22** while the last linear segment **234** on the front end section **229** is retained in the loop **41** of the EK clip **21**. Each end of the band **20** is thus mounted for pivotal movement about corresponding ends linear segments **258** and **234** held in EK clip loops **40** and **41**, respectively.

When the spring band **220** is stretched between the front rail **12** and the back rail **13** in the foregoing manner, a downward torque or moment arm is introduced in the band adjacent the front trail **13** by downwardly bent end section **229** of the band, in identical fashion to the first form of spring assembly **11** hereinbefore discussed. At the same time, the downwardly bent attitude of the rear sections **228** of the band **220** introduces a downward torque or moment arm in the band adjacent the back rail **13**, albeit through the extension section **257** of the band. These opposing torques develop store resilience in the central body portion **245** to the band **220**.

As the subject lowers into relationship on the spring band assembly **211**, the front end section **229** of the band pivots about its mounting linear segment **234** and tends to further compress or develop stored resilience in the body portion **245** of the band. At the same time the actual pivot point of the rear end section **228** is displaced from the linear segment **230** to the free end linear segment **258** on the extension section **257**. Accordingly, the effective pivot axis of the rear end section **228** defined by its linear segment **230** moves linearly inward and downward of the spring band **220** in a translatory movement.

The stored resilience developed in the body portion **245** of the spring band **220** by the rear end section **228** thereof, is accordingly, increased at a substantially lesser rate than is the stored resilience developed by the rear end sections **28** and **128** of the spring bands **20** and **120** hereinbefore discussed in relation to the first two forms of the present invention. Since the more acutely bent rear end section **228** of the spring band **220** normally develops slightly greater stored resilience in the band adjacent the rear end thereof than the front end section **229**, modification of its capacity for inducing stored resilience produces a relatively softer seat than the spring assembly **111** hereinbefore discussed; a seat which on our relative scale is defined as "medium soft."

Regardless, however, bucketing in the band in the central body portion **245** is avoided, as is jackknifing of the band adjacent the back rail **13**. Extensive support is still provided in the area under the spine of the seated subject and a highly desirable rearwardly sloping contour or profile of the sinuous spring arrangement **10** is also achieved in this form of the present invention.

A fourth form of spring band assembly embodying features of the present invention is illustrated generally in FIG. 7 and, in our relative scale of firmness versus softness, provides a "soft" seat. This "soft" seat is afforded by providing a lesser rate of increase in stored resilience developed in spring band **320** adjacent both the front rail **12** and the back rail **13** of the frame **14** as a subject is seated.

The spring band **320** is illustrated in relaxed relationship in FIG. 8. The band **320** includes a rear end section **228** bent inwardly of the circle at an angle of approximately 80°–90° thereto, and a front end section bent inwardly of the circle at an angle of approximately 70°–80°. To this extent it is identical in construction to the spring band **20** hereinbefore discussed.

In distinction from the spring band **20**, but similar to the bands **120** and **220** also hereinbefore discussed, the band **329** includes an extension section **337** bent upwardly from the downwardly extending front end section **129** and an extension section **357** bent upwardly from the downwardly extending rear end section **328**. Corresponding linear segments **334** and **358** are retained in EK clip loops **41** and **40**, respectively, on the front rail **12** and back rail **13**.

As the subject lowers into seated relationship on the spring band assemblies **311**, the effective pivot axes of the front end section **329** and the rear end section **328** move linearly inward and downward of the spring band **320** in a translatory movement. Total stored resilience in the spring band **320** is developed at a lesser rate than any of the bands **20**, **120**, **320**, hereinbefore discussed, and a still softer seat, which on our relative scale is defined as "soft," is effected.

Nevertheless, the assets of the basic spring construction embodying the present invention are retained. Bucketing of the band in the central portion **345** is avoided along with jackknifing of the band adjacent the back rail **13**. The greatest amount of support is provided in the area under the spine of the seated subject where the bulk of weight is concentrated. A lesser arc is developed in the rear of the body portion **345** than in the front portion thereof, as illustrated in FIG. 7, and a highly desirable rearwardly sloping contour or profile is achieved.

Turning to FIGS. 10–14, several variations on "back rail" connections between sinuous spring hands and the back frame rail are illustrated. Each provides the back rail translation and vector thrust hereinbefore discussed in relation to the spring assemblies **211** and **311**, for example.

In FIG. 10, a variation on the first form of furniture spring arrangement illustrated in FIG. 9 is shown generally at **410**. The spring arrangement **410** includes a sinuous spring band assembly **411** mounted between the front rail (not shown) and the back rail **413** of a frame **414**. The sinuous spring band assembly **411** includes a sinuous spring band **420**, identical to that hereinbefore discussed, connected to the back rail **413** through a back connector subassembly **422** which provides enhanced lateral stability to the spring band **420** according to the present variation, in addition to providing the elicited advantages of the present invention.

The back connector subassembly **422** comprises a diverging pair of helical springs **422***a* which interconnect the sinuous spring band **420** with the back rail **413**. As will be noted, it includes a J clip **423** which encircles the end linear segment in the depending lever arm **424** of the spring band **420** and has three apertures formed therein, the outer two bracketing the inner one. The apertures receive the hook ends of the helical springs **422***a* in the manner illustrated. In a corresponding manner, the opposite hook ends of the helical springs **422***a* extend through apertures in L-clips **432** secured to the back rail **413**.

It should be recognized that the clip **423** and helicals **422***a* serve as translatory members to permit the back end of the band **420** to move down while torque is induced in it through the arm **424**. As such, a substantially "soft" seat, on our relative scale, is developed. In addition, the use of helical springs to connect the band **420** to the back rail **413** provides the additional feature of automatic adjustability of the spring assembly **410** to fit a seated person's thigh length. The best flexing of the arm **424** for the specific comfort of that weight and size sitter is achieved.

FIG. 11 illustrates yet another variation on the first form of furniture spring arrangement, as shown at **510**. The furniture spring arrangement **510** includes a sinuous spring band assembly **511** mounted between the front rail (not shown) and the back rails **513** of a seating frame **514**. The assembly **511** includes a sinuous spring band **520** identical to that hereinbefore discussed with the exception that a Z-hook **521** is provided extending directly outwardly from the last linear segment **530**. The Z-hook **521** is then connected to the back rail **513** through a back connector subassembly **522**.

When the spring band assembly **511** is stretched between the front rail (not shown) and the back rail **513**, a downward torque or moment arm is introduced in the sinuous spring band **520** adjacent the back rail **513** by virtue of the downwardly bent rear end section **528** of the spring band. At the same time, by virtue of the horizontally extending band section **529**, Z-hook **521**, and helical, the rear end of the band **520** is permitted to translate downwardly. Again, a relatively soft seat is assured by this translation and vector thrust. The "automatic adjustability" hereinbefore referred to is also this construction.

FIG. 14 illustrates, at **510***a*, a slight modification of the furniture spring arrangement variation **510** seen in FIG. 11. In the modification **510***a*, note that the Z-hook **521***a* actually "replaces" the horizontally extending band section **529** entirely. In this modification, it is the extending Z-hook **521***a*, in combination with the helical **522***a*, which permits downward translation of the spring band end to assure a soft seat.

A variation on the second form of the present invention is illustrated at **610** in FIG. 12. In this case, a back connector subassembly **622** is provided which connects the last linear segment **651** of the spring band **620** to the back rail **613** in articulated relationship. As will be seen, the back connector subassembly includes a U-shaped wire clip **623** which has a pair of loops **624** formed on its free ends for encirculing the last linear segment **651**. The base **625** of the U-shaped link **623** is retained in a standard EK clip **630**. This construction provides translation downwardly at the rear rail of the furniture frame, of course, achieving vector thrust and a relatively soft seat, albeit not as soft as when a helical is used.

FIG. 13 illustrates another variation of the second form of the present invention, as illustrated generally at **710**. In this case, the rear end **720***a* of the sinuous spring band **720** has its third and second last semicircular segments **721** and **722** bent downwardly in a plane about the fourth last linear segment **723**. The last semicircular segment **724** is bent upwardly about the second last linear segment **725** and the last linear segment is secured to the frame **713** by an EK clip **726** or the like. The action at the rear end **720***a* is similar to the action of the spring arrangement **211** illustrated in FIG. 5.

Turning now to FIG. 15 of the drawings, a spring arrangement embodying features of this invention is disclosed in its simplest form at **810**. The spring arrangement **810** comprises a spring band **820** arranged and connected between a front rail **812** and a back rail **813** according to the invention.

The band **820** is connected at its frontmost linear segment **830** by a conventional EK clip. As such, the front end **820***a* of the band **820** is free to pivot downwardly about its point of attachment with the front rail **812**.

Adjacent the back rail **813**, the band **820** is bent downwardly into a torque arm **831** about the third last linear segment **832** of the band. A horizontally extending translation arm **833** defined by the last two linear segments **835** and **836** and their enclosed semicircular segments extends to and is pivotally retained by a standard EK clip **840**.

The back end **820***b* construction of the spring band **820** provides the vector-thrust translatory movement of the band beneath the seat of the person being seated. Torque is slowly and evenly induced in the band **820** as it sinks at its rear end **820***a*, providing a luxuriously soft, yet firm seat with upthrust under the occupant as he rises.

While several embodiments described herein are at present considered to be preferred, it is understood that various modifications and improvements may be made therein, and it is intended to cover in the appended claims all such modifications and improvements as fall within the true spirit and scope of the invention.

What is desired to be claimed and secured by Letters Patent of the United States is:

1. In a spring arrangement for furniture or the like including a frame having a first rail and a second rail, the improvement in spring band assembly, comprising:

(a) a sinuous spring band,

(b) said band including a series of semicircular segments interconnecting a series of linear segments,

(c) a front portion of said band and bent downwardly from the main body portion of said band at a predetermined angle,

(d) means pivotally connecting the lowermost linear segment of said front portion to the first rail,

(e) a back portion of said band and bent downwardly from the main body portion of said band at a predetermined angle,

(f) means pivotally connecting the lowermost linear segment of said back portion to the second rail,

(g) said main body portion extending in a continuous arc between said front and back portions,

(h) the bends in said band about said linear segments which define the extremities of said front and back portions being the only bends formed in said band between adjacent semicircular segments,

(i) whereby said downwardly bent portions constitute moment arms which generate stored resilience in the main body portion to give increased lift as a subject is seated on the spring arrangement.

2. The improvement in spring band assembly of claim **1** further characterized in that:

(a) at least one of said means pivotally connecting the lowermost linear segment of the front portion to the first rail and the lowermost linear segment of the back portion to the second rail comprises a clip securing said lowermost linear segment directly to the corresponding rail.

3. The improvement in spring band assembly of claim **1** further characterized in that:

(a) at least one of said means pivotally connecting the lowermost linear segment of said front portion to the first rail and the lowermost linear segment of said back portion to the second rail comprises generally horizontal means extending from a corresponding lowermost segment to a corresponding rail.

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