March 12, 1963 N. V. RISDALL 3,080,834

FOLDABLE FURNITURE

Filed Feb. 24, 1961 2 Sheets-Sheet 1

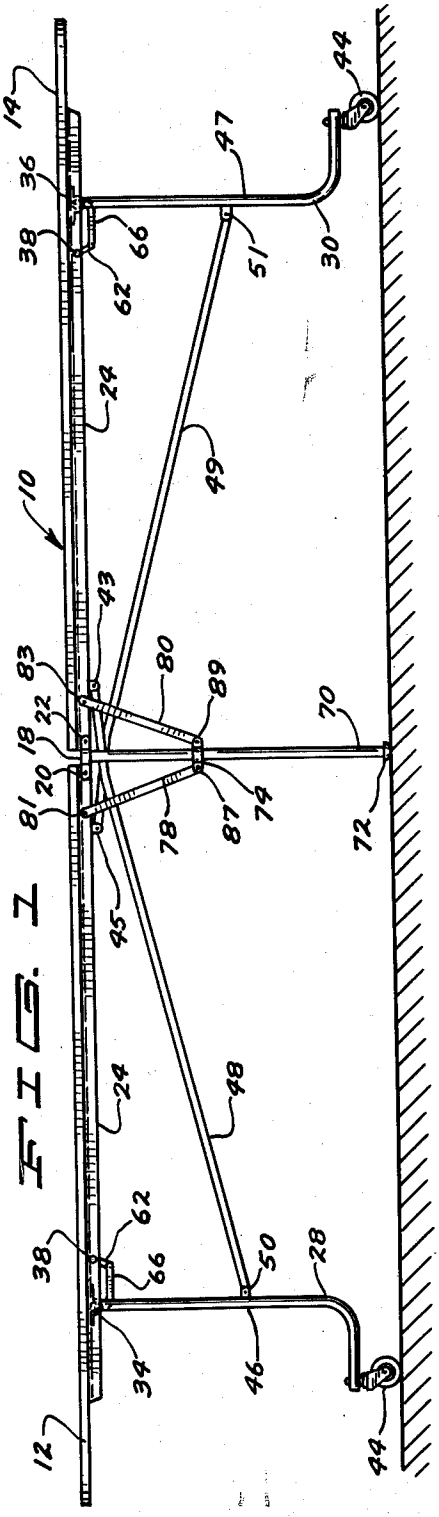

FIG. 7

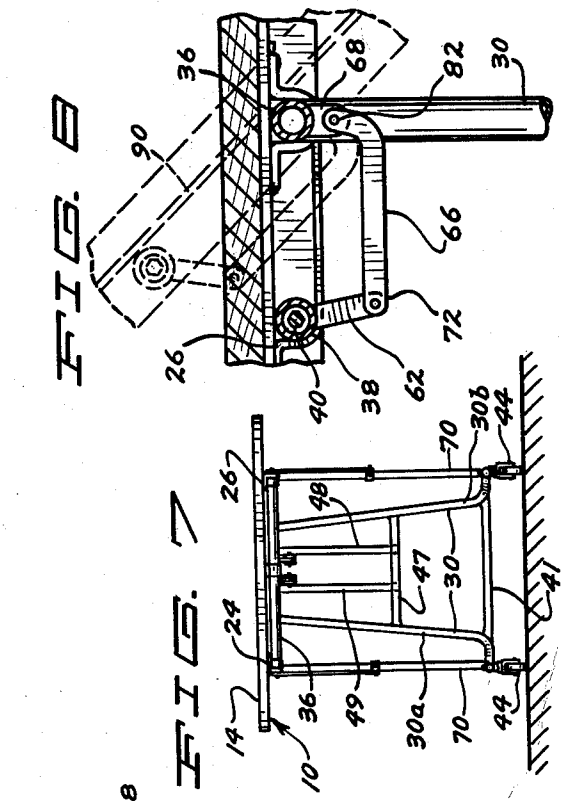

FIG. 8

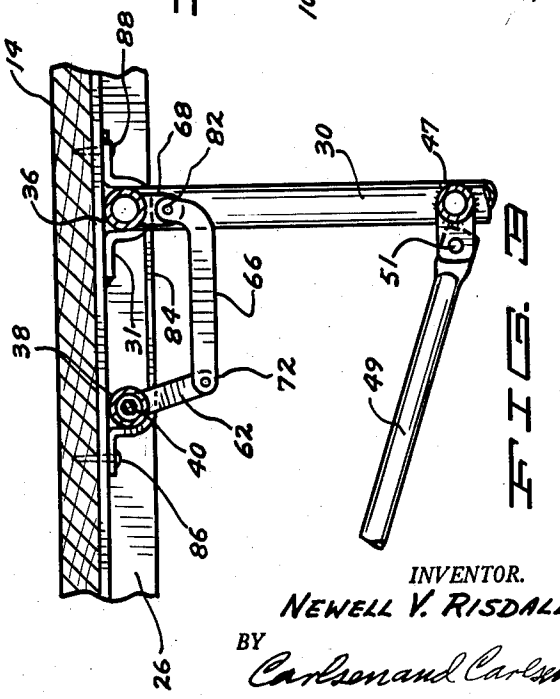

FIG. 9

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FIG. 2

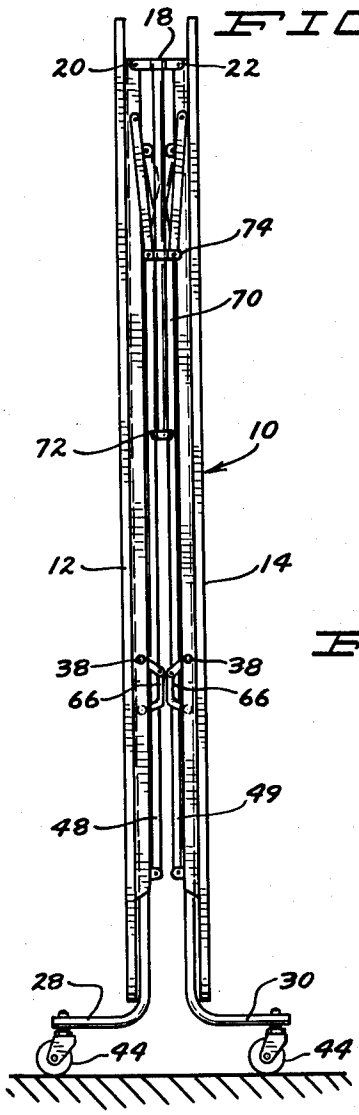


FIG. 5

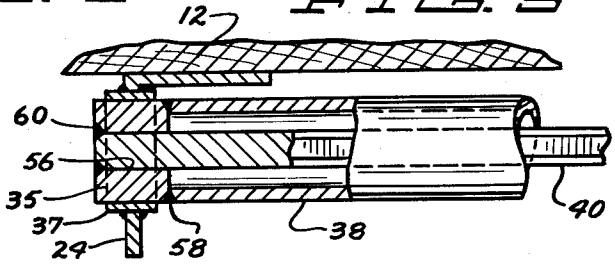


FIG. 6

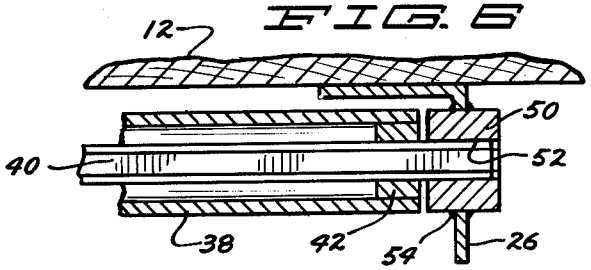
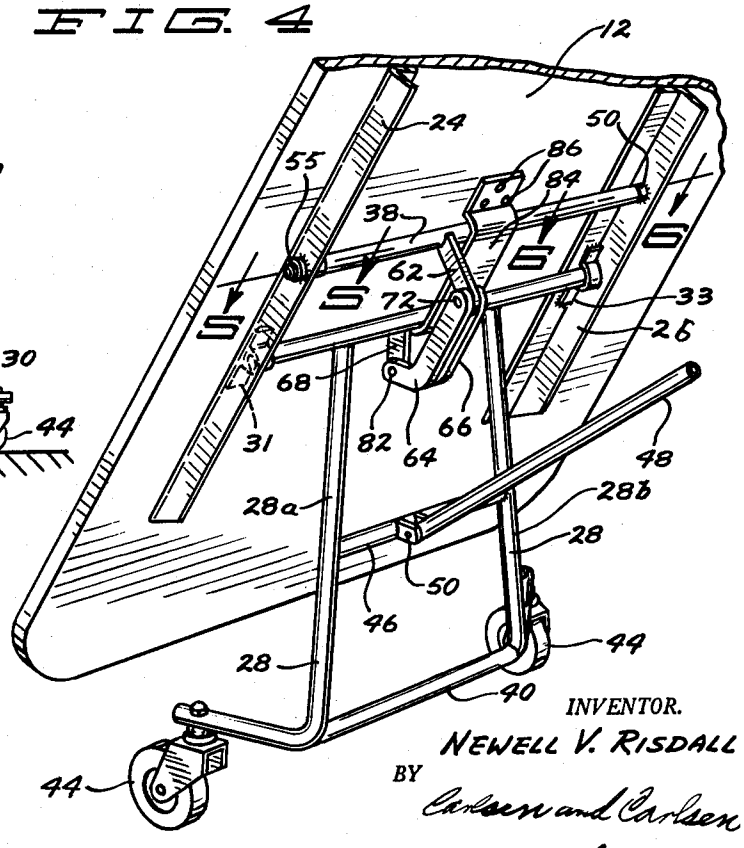


FIG. 4



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FOLDABLE FURNITURE

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5 Claims. (Cl. 108—112)

The present invention relates to foldable furniture and more particularly to apparatus for facilitating folding of relatively heavy pieces of furniture such as folding tables, benches or stages to a collapsed condition for convenient storage.

Large pieces of furniture such as benches or temporary stages used, for example, in schools or churches occupy a considerable amount of space when in use. To enable this space to be used for other purposes, it is desirable to provide that these articles be readily collapsible for convenient storage. Because of the large size and bulk of some of these articles, considerable effort is required to fold them from unfolded to the collapsed condition.

A number of foldable furniture units such as folding tables have been previously described. It has been previously shown that such tables can be provided with a spring means for assisting in folding the table to the collapsed condition.

Previous devices for facilitating folding of such articles of furniture to the collapsed position suffer from certain inherent shortcomings, require a number of additional parts and do not always provide the desired performance. Moreover, the previous units for facilitating folding of furniture to the collapsed condition are not well adapted for use in a variety of furniture items of different designs. For this reason it is necessary to design a new unit for each different article of furniture which is produced.

It is thus one object of the present invention to provide an improved unit for facilitating folding of a piece of furniture to the collapsed condition which is readily adapted for use in a variety of pieces of folding furniture of different sizes and shapes.

It is still another object of the present invention to provide an improved apparatus of the type described utilizing a torsion bar spring means wherein deflection of the torsion bar throughout a range approaching the elastic limit thereof is not required.

It is yet another object of this invention to provide an improved collapsible self-folding furniture article of the type described which is economical to manufacture, reliable in operation and exhibits good durability under conditions of actual use.

It is still another object of the present invention to provide an improved foldable furniture unit having spring means to assist in folding the unit to the collapsed position and wherein the unit will remain in the unfolded position without the requirement for a locking device to secure it in the unfolded position.

With these objects in mind, the invention broadly comprises a collapsible furniture unit divided into a plurality of pivotally connected folding members, a plurality of leg members pivotally connected to the folding members to support the unit from the floor and resilient means operatively connected between at least one pair of pivotally connected members to urge the unit to the collapsed condition. The resilient means are preferably connected between the leg members and the folding members. According to a preferred form of the invention I provide a torsion bar operatively connected between at least one of the leg members and the folding portion of the unit. The torsion bar is mounted along an axis extending parallel to and spaced from the pivot axis between the leg members and the folding member to which the leg is attached. A linkage means is operatively connected between the leg member and the torsion bar to transmit the force exerted by the torsion bar to the leg member.

These and other more detailed and specific objects will be disclosed in the course of the following specification, reference being had to the accompanying drawings, in which—

FIG. 1 is a side elevational view of a foldable table employing the present invention.

FIG. 2 is a side elevational view similar to FIG. 1 but illustrating the table in the collapsed condition.

FIG. 3 is a partial vertical sectional view of the right end of the table of FIG. 1.

FIG. 4 is a partial perspective view of the table as viewed from the underside with the table positioned between the unfolded and collapsed condition.

FIG. 5 is a partial sectional view taken along line 5—5 of FIG. 4.

FIG. 6 is a partial sectional view taken along line 6—6 of FIG. 4.

FIG. 7 is an end elevational view of the table of FIG. 1.

While the invention is illustrated in connection with folding tables, it is to be understood that the invention is not limited to such articles and may be applied to other articles of foldable furniture as well.

Referring now particularly to the drawings wherein the same reference numbers denote like parts and structural features, there is shown a collapsible table 10 according to the present invention. The table comprises a table top 10 divided into two flat rectangular portions 12 and 14. Portions 12 and 14 may be formed from wood. Each of the portions 12 and 14 is provided with suitable reinforcing members 24 and 26 such as angle irons. Members 24 and 26 are pivotally connected at the center to a centerpiece 18 by pivots 20 and 22 and are rigidly attached to each of the table top portions 12 and 14 by any convenient fastening device (not shown). Pivotally connected to the table top near the outer end of each of portions 12 and 14 are table legs designated at 28 and 30 respectively.

Table legs 28 and 30 include hinge members 34 and 36 which may be formed from metal tubing. Members 34 and 36 are accordingly pivotally connected at each end to one of reinforcing members 24 and 26. Rigidly attached to each of hinge members 34 and 36 are the leg members 28 and 30. Each leg comprises a pair of spaced apart vertically disposed metal tubes, designated 28^a, 28^b, 30^a and 30^b. Connected between the lower ends of members 28^a and 28^b and also 30^a and 30^b are horizontal brace members 40 and 41 respectively. Members 40 and 41 may also be formed from metal tubing. At the lower end of each of the leg members is provided a wheel 44.

Approximately intermediate the ends of leg members 28^a and 28^b and leg members 30^a and 30^b are provided horizontally positioned connecting members 46 and 47 respectively. Pivotally connected at one end to member 46 is a leg brace 48, while pivotally connected to connecting member 47 at one end is a leg brace 49. The other end of the brace 48 is pivotally connected to the table top

member on the opposite side of the center pivots 20 and 22 from the leg 28. Thus brace 48 is connected by a pivot 50 at one end to the leg member 28 and at the other end by pivot 43 to top portion 14. Brace 49 is mounted in a similar manner, it being pivotally connected at pivot 51 to member 47 and at the opposite end to table top portion 12 by pivot 45. It will be understood by making reference to FIGS. 1 and 2 that as the table is elevated from the unfolded position shown in FIG. 2 to the collapsed position shown in FIG. 1, the resultant relative movement between table top portions 12 and 14 will cause the legs 28 and 30 to remain in a vertical position as the table is folded due to the action of braces 48 and 49. The braces 48 and 49 may therefore be thought of as a means for maintaining the legs in a vertical position as the table is folded.

At the center of the table there is provided a central leg 70 which is rigidly connected at the upper end thereof to a centerpiece 18. The bottom of leg 70 is provided with a floor engaging portion 72. At approximately the center of leg 70 is provided a sliding collar 74. Pivotally connected at each end between collar 74 and table top members 12 and 14 are two links 78 and 80. The links 78 and 80 are accordingly pivotally attached at the upper end thereof to table top members 12 and 14 by pivots 81 and 82 respectively. The links 78 and 80 are pivotally connected at their lower ends to collar 74 by means of pivots 87 and 89. The links brace leg 70 and retain it in a vertical position as the table is folded.

As can be best seen in FIG. 4, the hinge member 34 is pivotally attached at each end to one of reinforcing members 24 and 26 by suitable brackets 31 and 33 respectively. The hinge member 36 is pivotally attached to the reinforcing members 24 and 26 of the top portion 14 by similar brackets (not shown).

Spaced centrally of each of the hinge members 34 and 36 and aligned with the pivot axis thereof is a tubular member 38 as can be seen in FIGS. 1 and 2. The tubular members 38 are connected at one end to a torsion bar member 40 which is mounted within tubular member 38.

As can be seen in FIG. 5, tubular member 38 has secured to the end thereof a cylindrical end fitting 35. Fitting 35 may be secured to tube 38 by welding as shown at 58. The fitting 35 is preferably journaled in a bushing 37 rigidly secured to member 24 and is also provided with a central opening 56 in which the end of torsion bar 40 is secured. The torsion bar 40 is secured to fitting 35 by making the torsion bar 40 and opening 56 hexagonal in cross section. In this way the end portion of torsion bar 40 passing through opening 56 is held against rotation with respect to member 35. Bar 40 may, if desired, be rigidly attached to fitting 35 by welding indicated at 60.

The opposite end of tube member 38, as shown in FIG. 6, has recessed therein a bushing 42 which allows tubular member 38 to rotate freely with respect to the end of the torsion bar 40 adjacent reinforcing member 26. The end of torsion bar 40 adjacent member 26 passes through a hexagonal opening 52 in a mounting member 50 which is in turn rigidly secured to reinforcing member 26. In this way the end of bar 40 in opening 52 is secured against rotation with respect to member 26 and also with respect to table member 12.

At approximately the center of tube 38 is rigidly secured a downwardly extending lever 62. Connected to the lower end of lever 62 by means of pivot 72 are a pair of linkage members 64 and 66. The opposite ends of members 64 and 66 are connected at pivot 82 to a lever 68 which is in turn rigidly secured to the hinge member 34. A bend 67 can be provided in each of linkage members 64 and 66 to accommodate the hinge member 36 when the table is folded to the collapsed position. The lever 62 is preferably about twice the length of lever 68.

The pair of tubes 38 and 36 at the right end of the table as shown in FIGS. 1 and 2 as well as tubes 34 and 38 at the left end of the table are retained in position at their centers by means of bracket members 84 which pass under the lower surfaces of each pair of tube members, extend upwardly on either side of the pair and are secured to the table top portion 14, as best shown in FIGS. 3 and 4. The bracket members 84 may be secured rigidly to table 10 by suitable fasteners such as screws 86 and 88. The bracket members 84 should not prevent rotation of the tubes 34, 36 and 38 but will help to prevent lateral deflection of the tubes in the event torsion bar 40 should break or be flexed excessively.

From the above description it can be seen that each torsion bar 40 is aligned with the pivot axis between the pivotally connected table members, specifically the top portionand the leg member, and is affixed at one end to the table portion and at the other end is operatively associated with the leg member through the connection with tubular member 38 and linkage members 64 and 66.

The operation of the device will now be explained. When the table 10 is in storage, it is collapsed to the folded condition shown in FIG. 2. In this condition both of torsion bar members 40 will be substantially relaxed.

When it is desired to take the table out of storage and place it in use, the table can be readily moved about on wheels 44. After the table has been moved to the place where it is to be used, the center part of the table is lowered manually until the lower end of the central leg 70 rests against the floor. As the center portion of the table is lowered, the leg members 28 and 30 are held in a vertical position by the braces 48 and 49 as explained above. Since legs 28 and 30 remain in a vertical position there results a relative pivotal movement between leg 28 and table portion 12 about the axis of hinge member 34 and a similar pivotal movement of table member 14 about the axis of hinge member 36.

As can be best seen in FIGS. 3 and 8, the relative pivotal movement of the hinge member 36 with respect to the table top portion 14 will be transmitted to the tubular member 38 by means of the linkage members 64 and 66. The same, of course, will be true of hinge member 34 and top portion 12. Thus, as the table is unfolded from the position shown in FIG. 2 to the position shown in FIGS. 1 and 3, and from the dotted line position 90 of FIG. 8 to the solid line position of FIG. 8, the top portion 14 of the table will pivot counterclockwise with respect to hinge member 36. As a result, the linkage members 64 and 66 cause the lever 62 and tubular member 38 to pivot in a clockwise direction about its own axis. As the tubular member 38 is pivoted in a clockwise direction, the end of torsion bar 40 secured to tube 38 is twisted with respect to the end thereof attached to the table. In this way energy is stored in the torsion bar.

When it is desired to collapse the table to the position shown in FIG. 2, the center portion of the table is raised manually. As will be readily apparent, a table of relatively large size and bulk for which the present invention is ideally suited would be quite difficult to lift to the collapsed position without some means of assistance. The present invention very ably provides the needed assistance.

As the center of the table is lifted from the position shown in FIG. 3 and FIG. 8 to the dotted line position 90 of FIG. 8, it can be seen that the energy stored in torsion bar member 40 will exert a counterclockwise torque on tubular member 38. This force is transmitted through lever 62 and pivot 72 to linkages 64 and 66 and finally to hinge member 36 through pivot 82. This force will, of course, tend to assist in folding the table to the collapsed position.

The invention thus provides an improved means for assisting movement of an article of furniture from the unfolded to the collapsed condition. Moreover, the present invention will not tend to raise the table to the collapsed position after the table is completely extended.

This derives from the fact that the torque exerted by the torsion bar **40** results in a force vector through the linkage members **64** and **66** which has a substantially horizontal direction. The effect is to render the tension of bar **40** less effective during the last few inches of downward movement of the table as it is being unfolded. As the table is again collapsed, the spring pressure of the torsion springs again becomes effective to assist in moving the table to the collapsed position after the first few inches of upward movement of the center of the table. Because of this tension relieving characteristic of the improved folding assisting means of the present invention it has been found that the table is stable in the unfolded position and has no tendency to move from the extended to the collapsed position. For this reason, a locking device is not required to secure the table in the unfolded or extended position.

Another advantage of the present invention results from the fact that while the table top members pivot through an arc of approximately 90° with respect to the leg members, the ends of the torsion bar move only approximately half this angular distance. This feature of the present invention will be appreciated when it is realized that the deflection limits of commercially available torsion bars of the appropriate length are approximately 105°. If the torsion bar **40** were to be subjected to a full 90° twist during collapsing of the table, it would be much more subject to fatigue, taking on a permanent set or breakage.

A still further advantage of this invention is that the torsion bar **40**, tube **38** and linkage members **64** and **66** comprise a complete package which can be applied to a variety of different foldable furniture units. Such units may include folding tables, folding stages, folding benches and other items of foldable furniture. In some of these items it may be desirable to apply the folding assist device according to the present invention while in others it may not be desirable. Thus, instead of having to design a separate mechanism for each item, the package composed of the bar, tube and linkage members may be kept in stock at the factory and used in various articles of foldable furniture of different sizes and shapes as required.

It is understood that suitable modifications may be made in the structure as disclosed, provided such modifications come within the spirit and scope of the appended claims. Having now therefore fully illustrated and described my invention, what I claim to be new and desire to protect by Letters Patent is:

1. A collapsible furniture article, comprising in combination, a plurality of foldable members, a pivotal connection between each of said members whereby said article may be folded from an extended condition to a collapsed condition, a resilient member operatively connected between a first foldable member and an adjacent foldable member to urge said article to the collapsed condition, said resilient member comprising a torsion bar, said torsion bar being spaced laterally from the pivot axis between said first foldable member and said adjacent foldable member, a tubular member, said torsion bar being mounted within said tubular member, said torsion bar being held against rotational movement at one end thereof with respect to said first foldable member, said torsion bar being held against rotation at the other end thereof with respect to said tubular member, a first lever rigidly connected to said tubular member and extending radially therefrom, a second lever rigidly connected to said adjacent foldable member, the length of said first lever being on the order of two times the length of said second lever and a linkage member pivotally connected between the free end of said first lever and the free end of said second lever.

2. A collapsible furniture article, comprising in combination, a plurality of foldable members, a pivotal connection between each of said members whereby said article may be folded from an extended condition to a collapsed condition, a resilient member operatively connected between a first foldable member and an adjacent foldable member to urge said article to the collapsed condition, said resilient member comprising a torsion bar, said torsion bar being spaced laterally from the pivot axis between said first foldable member and said adjacent foldable member, a tubular member, said torsion bar being mounted within said tubular member, said torsion bar being held against rotational movement at one end thereof with respect to said first foldable member, said torsion bar being held against rotation at the other end thereof with respect to said tubular member, a first lever rigidly connected to said tubular member and extending radially therefrom, a second lever rigidly connected to said adjacent foldable member, the length of said first lever being greater than the length of said second lever, and a linkage member pivotally connected between the free end of said first lever and the free end of said second lever.

3. A collapsible furniture article, comprising in combination, a plurality of foldable members, a pivotal connection between each of said members whereby said article may be folded from an extended condition to a collapsed condition, a resilient member operatively connected between a first foldable member and an adjacent foldable member to urge said article to the collapsed condition, said resilient member comprising a torsion bar, said torsion bar being spaced laterally from the pivot axis between said first foldable member and said adjacent foldable member, a tubular member, said torsion bar being mounted within said tubular member, said torsion bar being held against rotational movement at one end thereof with respect to said first foldable member, said torsion bar being held against rotation at the other end thereof with respect to said tubular member, a lever rigidly connected to said tubular member and extending radially therefrom, and a linkage member pivotally connected to the free end of said lever and fixed to said adjacent foldable member.

4. In a collapsible furniture article wherein a plurality of furniture members are pivotally interconnected for relative movement during folding and unfolding of said furniture article into and out of collapsed condition, the provision of torsion means defining at least one of the pivotal connections between first and second members to store energy to aid in the operation of said article, said torsion means comprising an elongate torsion bar fixedly attached in a limited area thereof to said first member, sleeve means freely surrounding said torsion bar in radially spaced relation thereto at least substantially throughout the length thereof in telescoping relation, said sleeve means being fixedly attached to said torsion bar at a point in spaced relation to the fixed attachment of said torsion bar to said first member, said second member being fixedly attached to said sleeve means intermediate the attachment of said torsion bar to said first member and the attachment of said sleeve means to said torsion bar, and means supporting said torsion means on said first member to stabilize the same during operation of said furniture article.

5. In a collapsible furniture article wherein a plurality of furniture members are pivotally interconnected for relative movement during folding and unfolding of said furniture article into and out of collapsed condition, the provision of torsion means defining at least one of the pivotal connections between first and second members to store energy to aid in the operation of said article, said torsion means comprising an elongate torsion bar extending transversely of said article and fixedly attached at one end thereof to said first member, sleeve means freely surrounding said torsion bar in radially spaced relation thereto throughout the entire length thereof in telescoping relation, one end of said sleeve means being fixedly attached to the other end of said torsion bar, said second member being fixedly attached to said sleeve means at a point substantially equidistant between the ends of said

torsion bar, and means supporting said torsion means on said first member to stabilize the same during operation of said furniture article.

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