Dec. 17, 1968 L. POKORNY, JR 3,416,168

SOFA-BED ASSEMBLY

Filed March 21, 1967 3 Sheets-Sheet 1

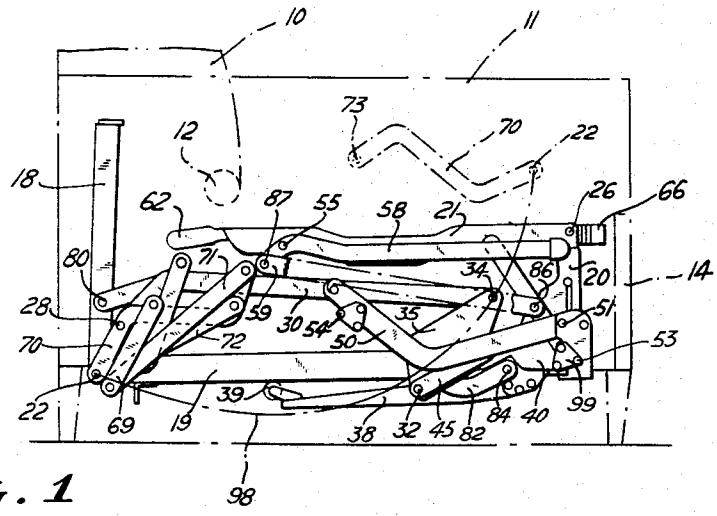
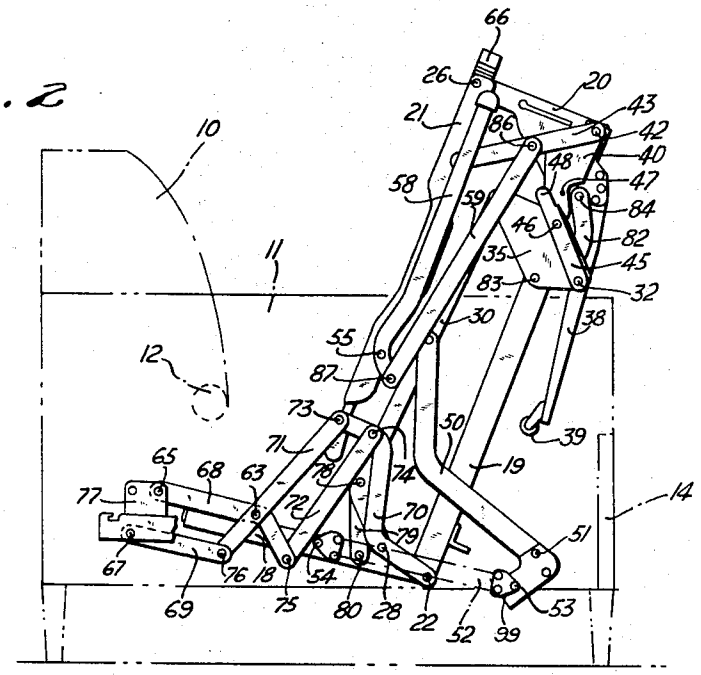


FIG. 1

FIG. 2



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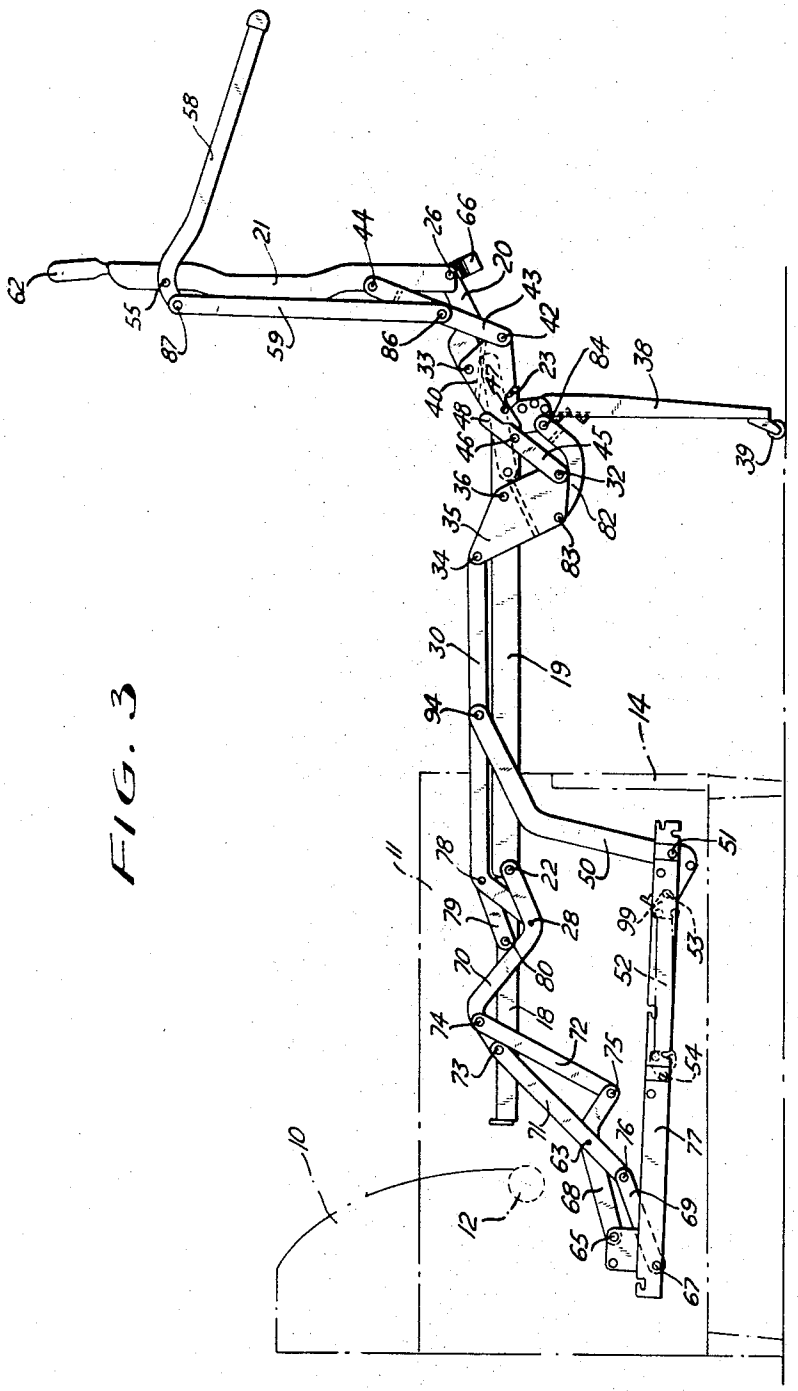


FIG. 3

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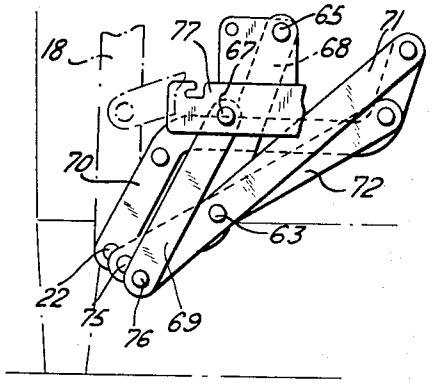


FIG. 4

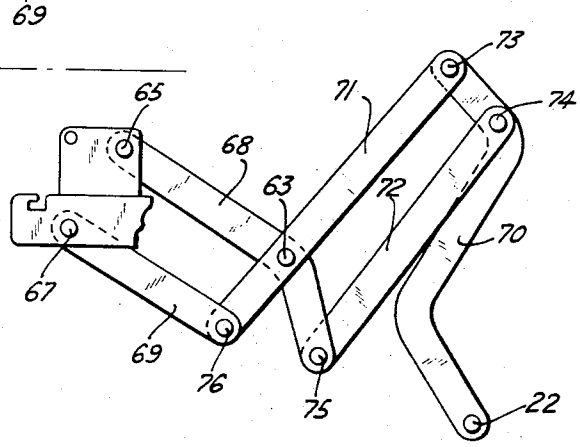


FIG. 5

FIG. 6

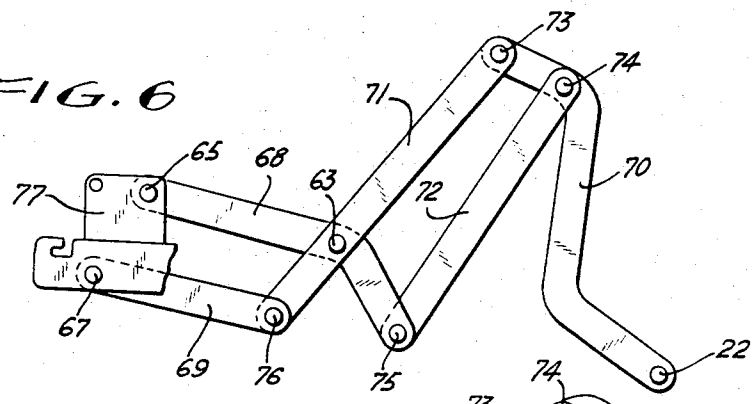
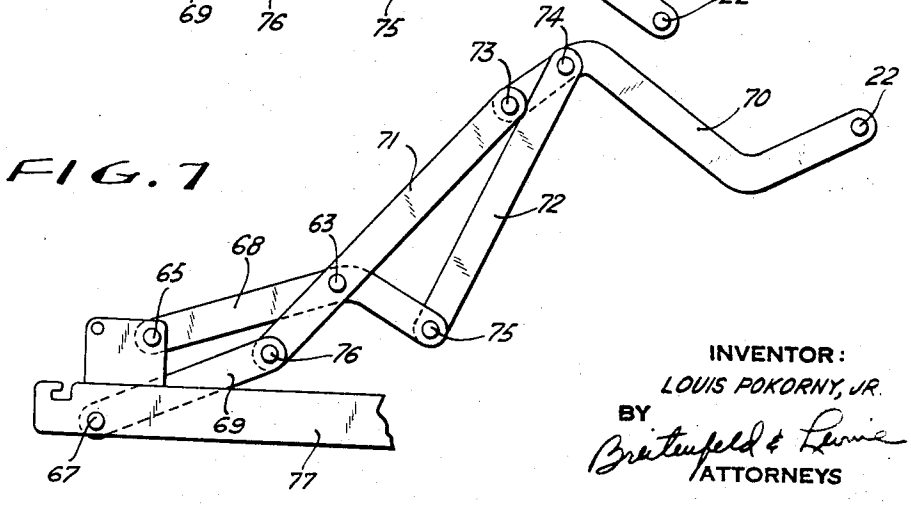


FIG. 7



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3,416,168

SOFA-BED ASSEMBLY

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Filed Mar. 21, 1967, Ser. No. 624,847
6 Claims. (Cl. 5—13)

ABSTRACT OF THE DISCLOSURE

Sofa-bed mechanism comprising four sections pivoted to one another in succession and foldable between collapsed sofa position and extended bed position. Support linkage movably supports mechanism between opposed side walls of sofa body, and support linkage arranged in its entirety below back of sofa when mechanism is in collapsed condition, so that sofa back can be made relatively narrow.

This invention relates generally to sofa-beds, and has particular reference to an improved foldable and refoldable mechanism and an improved mode of association of such an articulated mechanism with a sofa body.

The type of sofa-bed mechanism with which the invention is concerned comprises sections that are pivoted to one another in succession and are foldable between a collapsed sofa position and an extended bed position. The sections include two which lie in superposed horizontal planes when the structure is collapsed and in horizontal alignment when the mechanism is extended; they may be conveniently designated upper and lower horizontal sections. Between them, at the front of the sofa, is a front vertical section; and at the rear of the lower horizontal section it is pivotally joined to a rear vertical section, the word "vertical" signifying that in the collapsed or folded condition of the mechanism these sections lie in substantially vertical planes. Connecting linkages support the mechanism between the opposed side walls of a rigid sofa body which includes a front board and a back structure. The back is usually made hollow to accommodate the rearmost part of the mechanism, i.e., the rear vertical section, when it is in its fully folded condition. Helping to rigidify the sofa body is a crosspiece extending between the side walls at the base of the back structure.

My copending application, Ser. No. 415,050, filed Dec. 1, 1964 now U.S. Patent No. 3,321,777, shows an example of this general kind of assembly. In its extended condition the mechanism stretches forwardly from the sofa body to define four alinged bed-defining sections. A mattress is generally coextensive with the mechanism and foldable and unfoldable with it. The linkage system interconnects the sections in such a way that the mechanism is constrained to fold and unfold in accordance with a predetermined pattern of movement.

In the above-identified copending application, reference is made to the use of a unitary front board on the sofa. This necessitates the use of a linkage arrangement able to move the mechanism so that it "ducks under" the rear crosspiece and "jumps over" the relatively high front board. The present invention also deals with a linkage arrangement having these capabilities.

Furthermore, in the past, the hollow back of the sofa body has been made relatively deep to enable it to accommodate both the rear vertical section of the mechanism and the rear portion of the supporting linkage when the mechanism is in collapsed condition. Under some circumstances, particularly when it is desired to give the sofa a lighter looking, more modern styling, it is desirable to make the sofa back as shallow as possible.

It is therefore an object of the invention to provide a sofa-bed mechanism having a supporting linkage capable of moving the mechanism according to the predetermined pattern referred to above, but in which the linkage is disposed below, rather than within, the sofa back when the mechanism is in its collapsed condition.

The preferred way of achieving these objects and the other advantages and benefits hereinafter to be pointed out is illustrated in the accompanying drawings, in which:

FIG. 1 is a side view of the assembly with the near side of the sofa body omitted to reveal the mechanism within it, the mechanism being shown in its fully collapsed sofa-defining condition, and parts of the sofa body being shown only schematically;

FIG. 2 is a view similar to FIG. 1, with the mechanism in a partially withdrawn position relative to the sofa body;

FIG. 3 is a view similar to FIG. 2 showing the mechanism at a further stage of the unfolding procedure; and

FIGS. 4, 5, 6, and 7 are views, on an enlarged scale, showing successive positions of the rear supporting linkage during the unfolding procedure.

The sofa body shown in FIGS. 1–3 is schematically depicted because its structural and upholstery features are not material to an understanding of the invention, except for the presence of opposed side walls **11**, an upholstered back **10**, a crosspiece **12** at the base of the back a little above the level of the collapsed mechanism, and a one-piece immovable front board **14** extending along the entire length of the sofa. The board **14**, as best seen in FIG. 1 has a height about equal to the housed foldable-frame mechanism when in its completely folded condition.

The back **10** of the sofa body is hollow, and affords space for the rearward part of the mechanism, and in conventional sofa-beds, for its anchorage to the opposed sides **11**. However, according to this invention, the mechanism is anchored to the sides **11** of the sofa body at a point below the back **10**.

The sofa-bed mechanism comprises four sections pivoted to one another in succession, pivotal articulations between them, and a linkage for mounting the sectional unit in housing condition within the sofa body. In the fully folded condition the sections assume the relative positions shown in full lines in FIG. 1. The position assumed by one element of the supporting linkage when the mechanism is in its extended bed position, as well as the path of movement of this element, is shown in broken lines. It will be understood that these sections extend for substantially the full length of the sofa from one side **11** to the other, and that the pivotal anchorages of the mechanism to the sofa body are provided in duplicate, one at each side.

In the present mechanism, the sections comprise a rear section **18** pivoted at its lower end **22** (as viewed in FIG. 1) to the lower horizontal section **19**. The latter is pivoted at **23** (FIG. 3) to the front vertical section **20**, and the latter is pivoted to the upper horizontal section **21** at **26**. These pivotal connections permit the sections to lie in extended alignment when the mechanism is unfolded to its full extent, thus defining a bed. Each of the bed sections is preferably formed of opposed side rails connected at appropriate regions (as is well known) by braces extending parallel to the front board **14**. The side rails are preferably angle members each of which has a horizontal flange and a vertical flange when the mechanism is extended into bed-defining condition. The rear end of the rear section **18** may also be an angle member. The free end of the upper horizontal section **21** preferably consists of a tubular member **62** in the form of a U having short arms.

The mechanism is mounted in the supporting sofa body (i.e., anchored to the side walls **11**) by a linkage which

is independent of the rearmost section **18**, and engages with the lower horizontal section **19** at the pivot **22**. It consists of a front S-shaped link **70**, a pair of intermediate links **71** and **72**, and a pair of rear links **68** and **69** (see FIGS. 4–7). The terms "front," "intermediate," and "rear," refer to the relative positions of the links when the mechanism is extended as shown in FIG. 3 and 7. The link **71** is pivoted at **73** to the rear end of the link **70**, and the link **72** is pivoted to the link **70** at a point **74** spaced from the pivot point **73** and near the rearward bend in link **70**. The forward ends of the links **68** and **69** are pivoted to the rearward ends of the links **72** and **71**, respectively, at **75** and **76**. The rearward ends of the links **68** and **69** are pivoted at **65** and **67**, respectively to a bracket **77** fixed to the side **11** of the sofa body. At a point between its ends, the rear link **68** is pivoted at **63** to a point between the ends of intermediate link **71**, thus creating a scissors-like connection between the two links.

Pivoted to the link **70**, near its front end, is an actuating link **30**. The pivot **28** engages the rear end of the link **30**. From a pivot point **78** just forward of the pivot **28** a link **79** extends from the link **30** to the pivot **80** on the bed section **18**. The link **79** is also an actuating link, serving to press rearwardly on the pivot **80** when the mechanism is unfolded (see FIGS. 2 and 3), to swing the section **18** into horizontal alignment with the others to define the bed.

The front end of the actuating link **30** is pivotally connected at **34** to one arm of a lever **35** medially fulcrumed at **36** on the lower horizontal section **19**. (The pivot **36** is visible only in FIG. 3.) The lever's other arm extends from the fulcrum **36** to the pivot **32** articulating the lever **35** to the rear end of a connecting link **45**. The latter is pivoted at **46** to a second lever **40** which is medially fulcrumed at **33** on a fixed bracket on the front vertical bed section **20**. (The fulcrum **33** is visible only in FIG. 3.)

The second lever **40** is of the bellcrank variety and its forwardly extending arm extends from the fulcrum **33** to the pivot **42** at which a link **43** is connected. This link extends to the upper horizontal section **21** and is pivoted to it at **44**.

The link **45** constitutes a collapsible articulation between the first and second levers **35** and **40**. It has an extension **48** beyond the pivot **46** which at some times abuts against the pin or abutment **47** carried by lever **40**, and at others it moves away from this pin. As pointed out in the above-identified copending application, as a result of the cooperation between link **45** and lever **35**, the intermediate leg **38** is allowed to jump over the front board **14** and assume an operative support position on the floor before any further unfolding of the mechanism can be effected. Similarly, during the refolding of the mechanism the parts can be adjusted from the fully extended condition to the compacted condition wherein sections **19** and **21** lie in superposed horizontal planes without lifting the leg **38**. Thus any instability of the sofa during these maneuvers, tending to topple the entire structure forwardly, is prevented.

The leg **38** is swung between a retracted position beneath the lower horizontal section **19** (FIGS. 1 and 2) and its vertical operative position (FIG. 3) by means of an actuating link **82** extending from a pivot **83** on the lever **35** to a pivot **84** on the leg **38**. The leg is pivoted at its upper end to the lower horizontal section **19**, just rearward of the pivotal connection **23** between sections **19** and **20**. A caster **39** is preferably provided on the free end of the leg **38**.

Before describing the operation of the mechanism, other parts of the linkage system should be described.

The front leg **58**, pivoted to the upper horizontal section **21** at **55**, is automatically swung between the fully operative position wherein it rests on the floor and the fully retracted position of FIGS. 1 and 2 by a link **59** extending from it to the link **43**. The link **59** is pivoted to the actuating link **43** at **86** and to the leg **58** at **87**.

The adjustment of the compacted mechanism between the fully housed position of FIG, 1 and the partially extended position of FIG. 3 is facilitated by the elevator-arm **50** and the parts associated with it. The arm **50** is pivotally supported by the bracket **77** fixed to the sofa body at pivot point **51**. The lower end of the elevator arm **50** is pivotally connected at **53** to the front end of a tension plate **99** whose rear end is secured to coiled tension springs **52**, the rear ends of the latter being anchored to the bracket **77** at **54**. The upper end of the elevator arm is pivoted at **94** to the actuating link **30**.

In the completely housed condition of the mechanism, as shown in FIG. 1 the springs **52** are in a tensioned condition pulling rearwardly at **53** upon the lower end of the elevator arm **50**. The urgence toward swinging the elevator arm **50** upward, i.e., in a clockwise direction as shown in the drawings, is counteracted by the weight of the mechanism. During the initial stages of unfolding movement the springs **52** thus counterbalance this weight and make it easier for the user to lift the mechanism upward and forwardly toward the position of FIG. 2. Similarly, during the refolding operation the springs **52** facilitate the return movement of the parts.

The operation of the mechanism is as follows: with the mechanism in the compacted condition of FIG. 1, the handle member **66** is grasped to initiate an upward forward movement of the mechanism as a whole. Aiding in this movement are the springs **52**. During the transition from FIG. 1 to FIG. 2, i.e., from FIG. 4 to FIG. 6, the pivot point **75** at the free end of rear link **68** is constrained to move in a circular path around the fixed pivot **65**, and the pivot point **76** at the free end of rear link **69** is constrained to move in a circular path around the fixed pivot **67**. This movement causes the intermediate links **71** and **72** to swing from their overlapping relationship, shown in FIGS. 1 and 4, to a position in which they are spaced apart and generally parallel, as shown in FIGS. 2, 5 and 6. In consequence, the front link **70** is translated forwardly and simultaneously rotated through about 90°, so that its forward end moves through an arcuate path along the bottom of the sofa, as indicated by the broken line **98** in FIG. 1.

There is little change in the general relationship of parts during the movement from the condition of FIG. 1 to that of FIG. 2. It should be noted, however, that supporting linkage **70**, **71**, **72**, **68**, **69** has guided the rear vertical section **18** downwardly and forwardly beneath the crosspiece **12**. At the same time the bundle of parts has been canted upward at the front to a relatively steep angularity which will presently allow the leg **38** to jump over the fixed front board **14** without interference.

As the elevator arm continues its clockwise movement, the actuating link **30** is caused to move rearward with respect to the section **19**, and the effect of this is to press rearwardly upon the link **79** thereby bringing the rear section **18** upward into alignment with the section **19**. Also activated by the link **30** is the lever **35** which is moved into a counter-clockwise direction thereby compelling the leg **38** to swing downward to the operative position shown in FIG. 3. At the same time, the support linkage moves to the position of FIG. 7 wherein the front link **70** assumes a generally horizontal disposition, shown in broken lines in FIG. 1. It will be seen from the path **98**, therefore, that after causing the pivot connection **22** to initially move along the bottom of the sofa body, the support linkage finally permits the pivot **22** to rise suddenly to its ultimate position in the extended condition of the mechanism. During the movement between the FIG. 2 condition and the time caster **39** touches the floor, the rotative movement of lever **35** is ineffective to bring about any swinging movement of the lever **40**, as a result of which the sections **19**, **20** and **21** of the mechanism remain in a compacted condition until a lifting force is applied to the upper horizontal section **21**. A rotation of this section through the position of FIG. 3 ultimately

brings about an alignment of all the bed-defining sections and lowers the front leg **58**.

The abutment between the link extension **48** on link **45** and the pin or stop **47** on lever **40** in the fully folded and fully unfolded conditions serves to prevent the levers **35** and **40** from moving beyond the ranges prescribed for them.

The operation takes place in reverse during the refolding of the mechanism. During refolding the leg **38** jumps clear of the front board, and the mechanism ducks under the crosspiece **12**, ultimately bringing the rear bed section **18** into the upright disposition within the hollow back structure **10**, and the supporting linkage into folded condition beneath the plane of the upper surface of the upper horizontal section **21**, and hence beneath the sofa back **10**.

The invention thus affords a sofa-bed assembly in which the style requirements of a relatively shallow permanent sofa back, and an uninterrupted unitary front board, can be complied with in a practicable economically feasible manner and without sacrifice of simplicity, reliability, ease of manipulation, or comfort in either the sofa or the bed condition of the device.

It will be understood that many of the details shown may be modified by those skilled in the art without necessarily departing from the spirit and scope of the invention as expressed in the appended claims.

What is claimed is:

1. In a sofa-bed assembly arranged in a sofa body, a mechanism comprising four pivoted sections including in succession a rear vertical section, a lower horizontal section, a front vertical section, and an upper horizontal section, said sections being foldable between a collapsed sofa position in which the lower and upper horizontal sections lie in superposed parallel relation, and an extended bed position in which said sections lie in horizontal alignment, and a supporting linkage pivotally connecting said mechanism to said sofa body, said supporting linkage being connected to said mechanism in the region of the pivot connection between said rear and lower horizontal sections, and said supporting linkage being located in its entirety below the plane containing the upper surface of said upper horizontal section when said mechanism is in the collapsed sofa position, whereby when said mechanism is in the collapsed sofa position the only

portion of said entire assembly which extends above the plane containing the upper surface of said upper horizontal section is said rear vertical section.

2. A sofa-bed mechanism as defined in claim **1** wherein said supporting linkage includes a front link pivoted at one end to said mechanism, a pair of links pivoted together in a scissors relationship, the rear ends of said link pair being pivotally connected to said sofa body, and the front ends of said link pair being pivotally connected to said front link near its other end.

3. A sofa-bed mechanism as defined in claim **1** wherein said supporting linkage includes a front link pivoted at one end to said mechanism, first and second intermediate links, said first intermediate link being pivoted to the other end of said front link, and said second intermediate link being pivoted to said front link at a point spaced from said other end, and first and second rear links pivoted to said sofa body, each of said rear links being pivoted to one of said intermediate links.

4. A sofa-bed mechanism as defined in claim **3** wherein said front link is provided with a bend near its other end, said intermediate links both being connected to the portion of said front link between its other end and said bent region.

5. A sofa-bed mechanism as defined in claim **3** wherein one of said intermediate links is pivoted at a point between its ends to a point between the ends of one of said rear links.

6. A sofa-bed mechanism as defined in claim **5** wherein said intermediate link pivoted between its ends is said first intermediate link, and said rear link pivoted between its ends is pivoted to said second intermediate link.

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U.S. Cl. X.R.

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