Aug. 9, 1960 W. J. HELTON 2,947,997

FOLDING SOFA BED STRUCTURE

Filed March 6, 1957 3 Sheets-Sheet 1

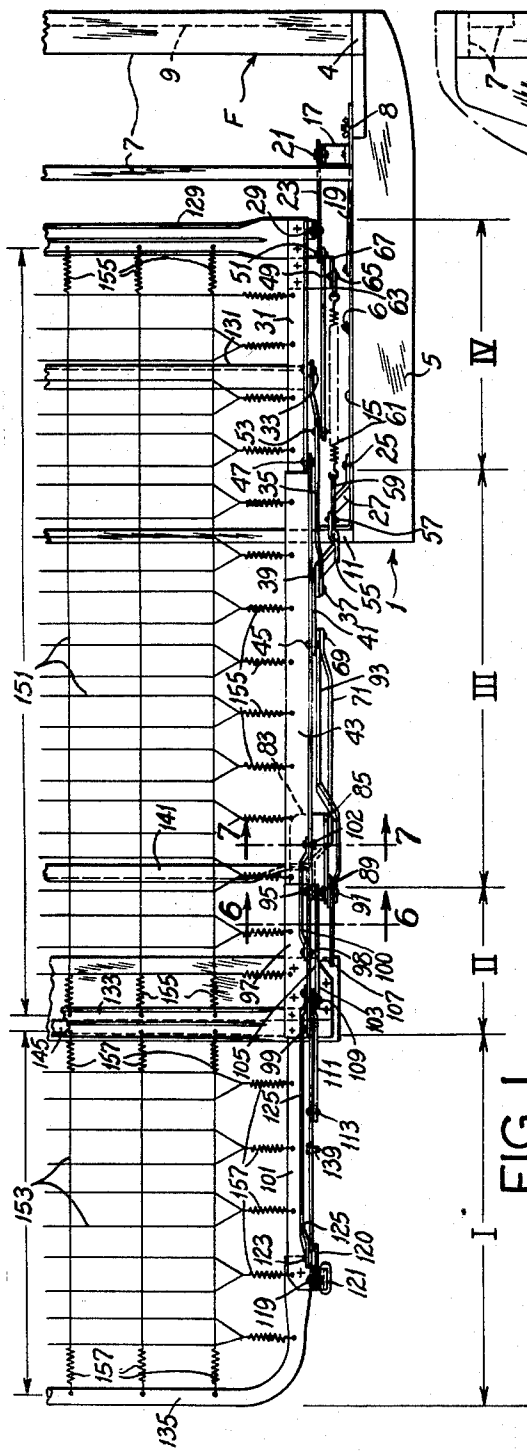


FIG. 1.

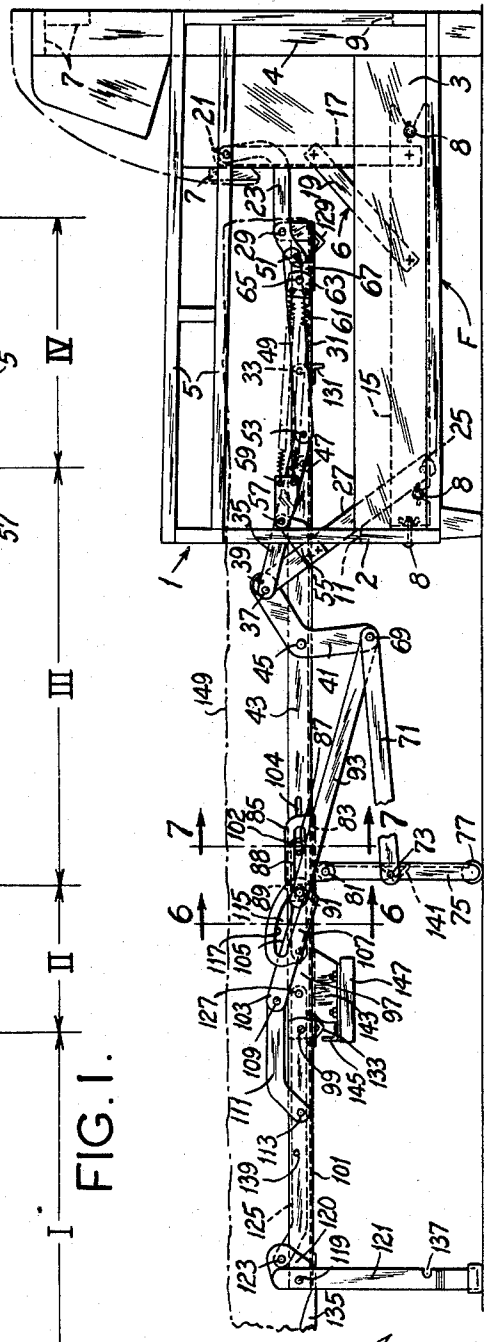


FIG. 2.

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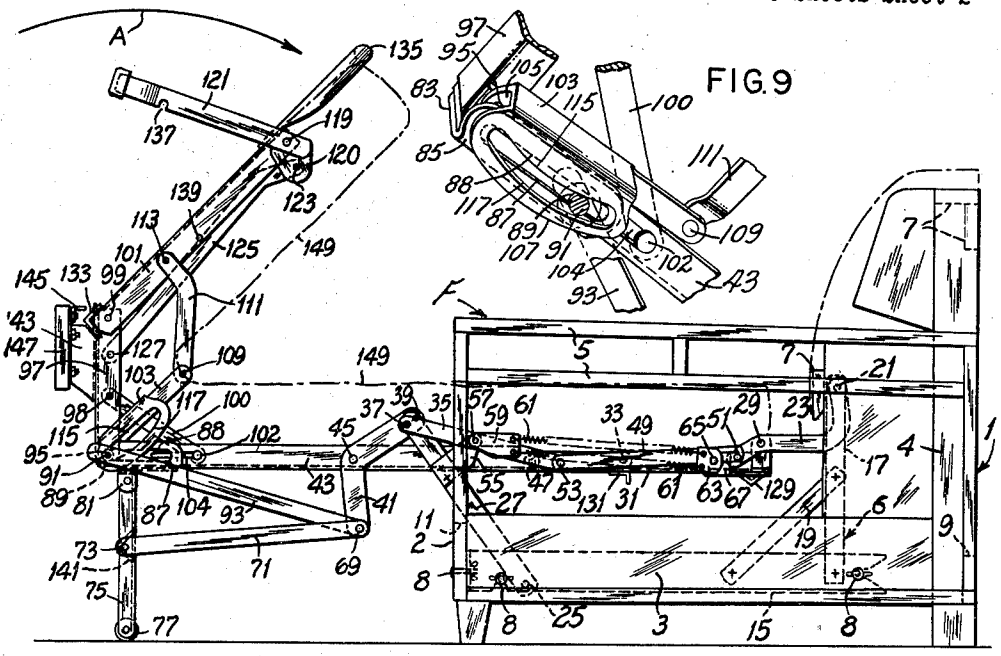


FIG. 3.

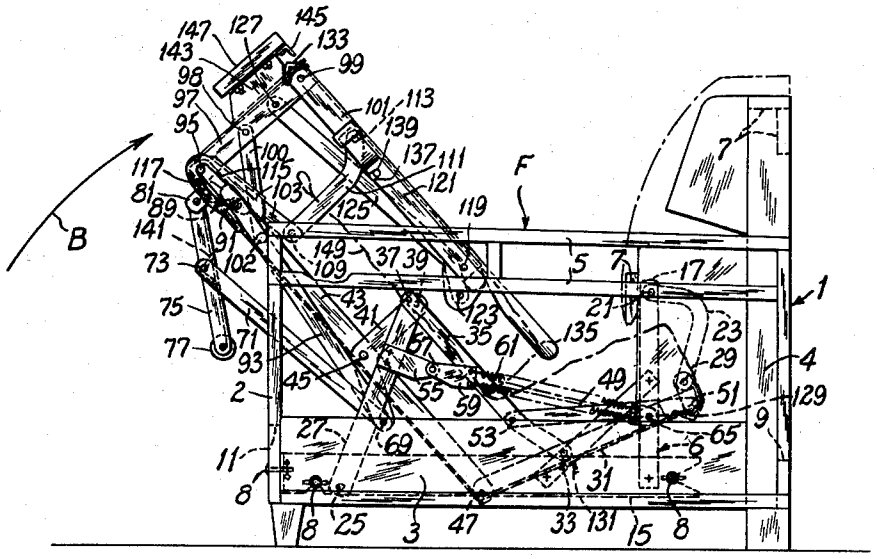


FIG. 4.

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FOLDING SOFA BED STRUCTURE

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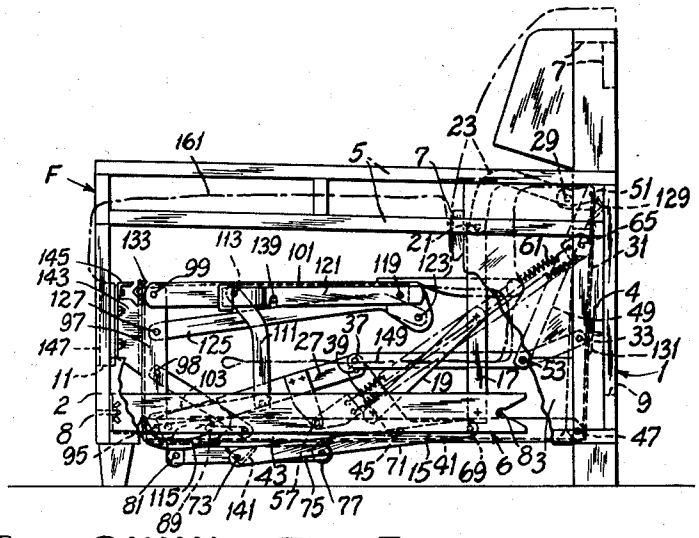


FIG. 5.

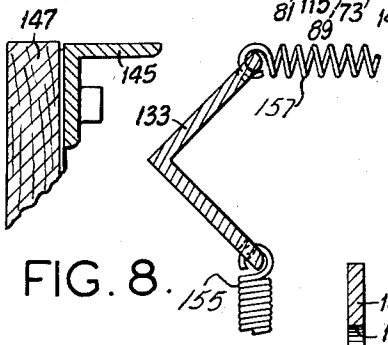


FIG. 8.

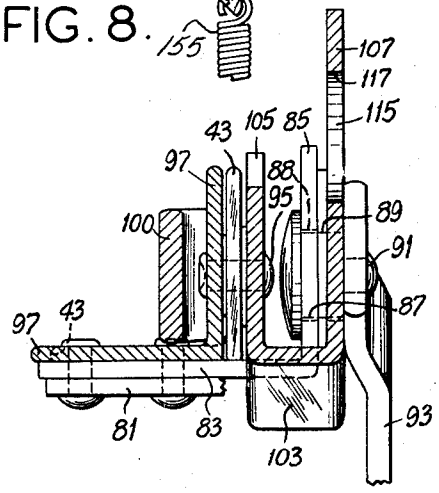


FIG. 6.

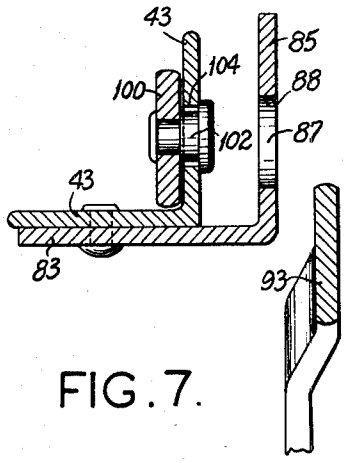


FIG. 7.

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2,947,997

FOLDING SOFA BED STRUCTURE

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Filed Mar. 6, 1957, Ser. No. 644,291

5 Claims. (Cl. 5—13)

This invention relates to a sofa bed of the class comprising a plurality of interconnected folding sections which, when unfolded in substantially horizontal alignment, form a bed, and which may be moved into folded position within a sofa frame to form a sofa.

Among the several objects of the invention may be noted the provision of a folding sofa bed having a simple and reliable linkage providing a well-balanced low-resistance extending and retractive action in moving between bed- and sofa-forming configurations; the provision of a bed of the class described in which a first or seat section is improvedly interlinked with other sections so as automatically to fold and lock a mattress in response to simple folding movement from bed to sofa formation without the requirement for any additional manual locking operation; the provision of an interlinkage which lends itself to be conveniently designed for most desirable operating characteristics for the locking action; and the provision of a bed of this class having independent fabric supports for mattress support when the device is in use as a bed, and for a sofa cushion support when the device is in use as a sofa, said supports avoiding the use of an upholstery board frame for anchoring purposes and thereby minimizing unsupported marginal cushion areas. Other objects and features will be in part apparent and in part pointed out hereinafter.

The invention accordingly comprises the elements and combinations of elements, features of construction, and arrangements of parts which will be exemplified in the structures hereinafter described, and the scope of which will be indicated in the following claims.

In the accompanying drawings, in which one of various possibe embodiments of the invention is illustrated,

Fig. 1 is a half plan view of the improved bed in unfolded bed-forming position, the usual mattress, cushions and trim being omitted;

Fig. 2 is a fragmentary right-side elevation of Fig. 1, showing in dash lines the location of a mattress and some trim;

Fig. 3 is a complete right-side elevation similar to Fig. 2, showing an intermediate step in folding the sections from bed to sofa configuration;

Fig. 4 is a view similar to Fig. 3, showing a subsequent folding step;

Fig. 5 is a view similar to Fig. 4, showing the parts folded into sofa-forming position and showing in additional dash lines the application of a sofa cushion, parts being broken away for clarity;

Fig. 6 is an enlarged detail cross section taken on lines 6—6 of Figs. 1 and 2;

Fig. 7 is an enlarged detail cross section taken on lines 7—7 of Figs. 1 and 2;

Fig. 8 is an enlarged detail vertical cross section on the longitudinal center line of the sofa showing the support of the front edge of a sofa cushion and the adjacent support of the spring fabric; and

Fig. 9 is a detail perspective of the locking mechanism

for the cushion support frame in the position shown in Fig. 4, but drawn to an enlarged scale.

Corresponding reference characters indicate corresponding parts throughout the several views of the drawings. For clarity, and unless otherwise indicated, rigid connections which are formed by equivalent rivets, weldments, bolts, screws, etc., are indicated in plan by means of small right-angular crosses. Since the construction is symmetrical, both sides of the device consisting of parts which are glove-images of one another, only one side is illustrated. It is to be understood that the description of one side serves for both.

Referring now to the drawings, there is shown in general at F the usual sofa frame, generally composed of wood and forming the foundation for the usual upholstery and trim employed. This frame F consists of side sections 1, providing supporting spans 3, uprights 2 and 4, and arm rests 5. The side sections 1 are joined by upper back-forming cross braces 7. They are also joined by lower back and front cross braces 9 and 11, respectively. The side sections 1 and the forward cross brace 11 also form the supports for two rigid metal assemblies of subframes 6. These subframes are attached to the wood frame F by means of bolts 8.

Each subframe 6 consists of angularly related bars 15 and 17, held relatively rigid by a corner brace 19. Each of these subframes supports one of a pair of lateral linkages, the linkages being transversely connected, as will appear (Fig. 1) to form a plurality of sections, namely, a bed outer end or sofa cushion-mounting upper section I, a bed fold or sofa front section II, a bed intermediate or sofa lower section III, and a bed inner or sofa rear section IV, respectively. Before describing such sections, the linkages will be described. Inasmuch as the linkages on opposite sides are identical, the description of the one will suffice for both.

Referring then to the right-side linkage, a pin 21 on fixed bar 17 forms a fixed pivot for an angularly formed first double-curved swing link 23. A second pin 25 on fixed bar 15 forms a fixed pivot for a second swing link 27. The swing link 23 carries a pin 29, forming a pivot with an angle iron side bar 31 of section IV. Bar 31 carries a pin 33 forming a pivot for one end of a curved link 35. The other end of link 35 is pinned to the upper end of swing link 27 (see pivot pin 37). The upper end of swing link 27 carries another pivot pin 39, slightly offset from pin 37, forming a pivotal connection with a bell crank 41, which in turn is pivoted at 45 to an angle iron side bar 43 of intermediate section III. The rear end of bar 43 is pivoted to the forward end of bar 31 (see pivot pin 47).

A control link 49 is at one end pivoted to the outermost end of link 23 by means of a pin 51 and at its other inner end to an intermediate pivot 53 on curved link 35. Riveted to link 27 is a lug 55, to which a rocker plate 59 is pivoted at 57. Two tension springs 61 are attached to rocker plate 59. The other ends of these springs are attached to a rocker plate 63, pivoted at 65 to an angle lug 67 rigidly attached to the bar 31.

The bell crank 41 carries a third pivot pin 69, for pivoting one end of a first drag link 71. The other end of link 71 is pivoted at 73 to a mid portion of a folding leg 75. The leg 75 carries a lower caster 77 and at its upper end is pivoted to an angle lug 81 fastened by riveting to the outer end of said bar 43 of intermediate section III. Riveted to the bottom of the bar 43 is the horizontal bottom side 83 of an angle iron, the vertical side of which forms a plate 85 (see Fig. 7). Thus plate 85 is held in rigid, spaced parallel relationship to the vertical side of the angle iron bar 43. The plate 85 is preferably straight slotted, as shown at 87, for the reception of a follower pin member 89, riveted on pivot point 91 to one end of

another drag link **93** (Fig. 6). At its other end link **93** is pivoted to the bell crank lever **41** at said pivot pin **69**.

As the bed is folded into sofa position, links **27, 35** control the position of bell crank **41** so that it turns on pivot **45** and through pin **69** forms a driving member for links **71, 93**.

Pivoted at **95** to the outer end of bar **43** is an angle iron bar **97** of fold section II. Pivots **91** and **95** are separate. They are coaxial only when the parts are in the positions shown in Figs. 1–3, 6 and 7. Pivoted at **99** to the outer end of the bar **97** is an angle iron bar **101** of outer section I. Pivoted at **98** to the bar **97** is a stop forming bar **100**. Bar **100** carries a pin **102** at its other end, which slides in a slot **104** cut into the vertical side of the bar **43** (see Fig. 7). The slots **87** and **104** are in transversely spaced vertical planes. As above remarked, pivot **95** is in concentric alignment with pin **89** when the pin is in its position corresponding to the positions of it in Figs. 2 and 3. At this time pin **102** is forward in its slot **104**. It moves to the other end of the slot in the Fig. 3 configuration.

At **103** is shown a link which is partly channel shaped, having spaced inner and outer sides **105** and **107**, respectively. The side **105** rotates on said pivot **95** on bar **43**. Its other end is pivoted at **109** to a link **111**, the latter at its outer end being pivoted at **113** on the bar **101** of outer section I. Pivot **113** is at an intermediate point on bar **101**.

In the outer side **107** of the link **103** is a slot **115** which preferably, though not necessarily, is curved on one side **117**, as shown. One end of this slot has the same radius of curvature as, and is concentric with the pin **89**, when the parts are in the positions shown in Figs. 2, 3 and 6.

Pivoted at **119** at the outer end of the bar **101** is a folding leg **121**. The upper end of this leg is provided with a fixed lug **120**, pivoted at **123** to a link **125**. The other end of link **125** is pivoted at **127** to the bar **97**. Motion of leg **121** is limited by engagement of a notch **137** in it with pin **139**.

Plate **85** and link **103** have relative angular motion about pin **89** when they move from the Figure 2 position to the Figure 3 position and vice versa. Thereafter as the front board **147** is lifted and the parts moved from Figure 3 position to Figure 4 position, drag link **93**, actuated by bell crank **41**, moves pin **89** to the right, thus locking sections I, II, and III against relative angular movement. If the folding mattress **149** offers resistance to the latter, the edges **88** and **117** of slots **87** and **115** act as cams and pin **89** forces the slotted parts into substantial alignment which forces section I into parallel relation with section III, as well as locking these parts against unfolding until pin **89** is again moved to the left by bell crank **41** and link **93**.

There is a pair of linkages such as above described, one on each side of the sofa bed. Their bars, links and levers are in pairs and operate in parallel by reason of the following cross connections between the linkages. Starting with the side bars **31**, these are cross connected by means of riveted cross braces **129** and **131**, thus establishing inner section IV as a rigid assembly. There are no cross braces connecting the bars **43** but they will be referred to as the intermediate section III because they are sufficiently braced by adjacent sections and by reason of cross brace **141** connecting the folding legs **75** of this section III. The short bars **97** are joined by a riveted cross brace **133**. At the outer end of the bars **101** is welded a curved cross brace **135**.

Riveted to bars **97** of fold section II are short Z-shaped brackets **143**. These brackets rigidly support an angle iron cross member **145**. A front board **147**, to which upholstery may be secured, is fastened at opposite ends to brackets **143** and at intermediate intervals to cross member **145**. When the sections are in sofa-forming position (Figures 5, 8) the horizontal flange of member **145** acts as a space filler and cushion support in the gap between board **147** and cross brace **133**. Member **145** and brackets **143** support board **147** independently of any connection with cross brace **133** which has its legs disposed diagonally of the general plane of front section II. When the sections are in sofa-forming position (Figures 5, 8) the outer edge of the upwardly extending leg of cross brace **133**, to which fabric **151** is attached, is no higher than the general plane of the fabric while the remainder of the angle depends from the fabric plane and is below the level of the horizontal leg of front board angle **145**. When the sections are in co-planar bed-forming position (Figure 2) the outer corner of angle iron cross brace **133** points downwardly and the entire angle is below the general plane of fabrics **151, 153**. At each end of cross brace **133** its legs are spread into a common-plane, flat terminal riveted to the adjacent side bar **47** of front section II.

A mattress is shown in dotted lines at numeral **149** in Figs. 2–5. The mattress is supported by two separate sections of articulated flexible wire fabric. One section is numbered **151** and the other section **153** (Fig. 1). The section **151** is supported across the bed in sections II, III and IV. This is accomplished as to section **151** by helical springs, or so-called helicals **155** hooked laterally in openings in bars **31, 43** and **97** and endwise in openings in cross braces **129, 133**. The section **153** is supported in outer section I by coil springs or helicals **157**, which are laterally hooked in openings in bars **101** and at their outer ends are hooked into openings formed in the cross braces **133, 135**. Movement of bed outer section I carrying the section **153** relative to cross brace **133** of fold section II causes some relative movement of the margin of the fabric section **153** adjacent to brace **133**. This is compensated by stretching of adjacent ones of the springs **157**.

Operation is as follows, starting with the bed-forming configuration of parts shown in Figs. 1 and 2 and speaking in the plural in regard to both side linkages:

The operator grasps the endwise cross brace **135** and moves it archwise (see dart A, Fig. 3) in a direction toward the frame F, which hinges sections I and II relative to section III and brings the parts into the position shown in Fig. 3, wherein several events have occurred. First, section II has rotated on the pivots **95** connecting it with section III. The pins **102** of bars **100** have moved to the inner ends of the slots **104**, thus stopping section II in the vertical position relative to section III shown in Fig. 3. During this movement section I has rotated forward relative to section II, pivoting at **99**. At the same time, legs **121** have been angled partially inward toward the bars **101**, because of the thrusting action of link **125** between its pivots **123** and **127**. The action thus far described has only partially folded the mattress, and has involved little reaction on the hands of the operator. Any further folding action requires a substantial mattress folding force which it is preferable not to supply by further manual pressure on brace **135**.

Therefore, the next step of the operation is to grasp the bottom of the now raised and accessible upholstery board **147** and lift it archwise from the Fig. 3 position toward the Fig. 4 position (see dart B, Fig. 4). During this step the following events occur automatically: First, the original straight-line relationship between the pairs of bars **31** and **43** in Fig. 3 is broken at the pivot points **47** (Fig. 4) between sections III and IV. Then, by reason of the constrained-motion relationship between pairs of bars **31, 43**, upper legs of bell cranks **41**, and links **35**, the bell cranks **41** rotate to pull upon drag links **71** and **93**. Drag links **71** then start to pull and fold in the legs **75**. At this time, the drag links **93** pull the pins **89** along the slots **87** in the plates **85** which are attached to bars **43**. At the beginning of this movement (as shown in Fig. 3) the slots **115** in links **103** are at an angle to the slots **87**. Consequently, the pins **89** in their constrained movements forward along slots **87**, tend to force the slots **115** into general alignment as the Fig. 4 position is reached. In other words the pivots **109** are drawn down toward bars **43**. This action is transmitted

through links 111 to bars 101, and consequently to the entire section I which presses down in a folding direction upon the mattress. This closing and mattress folding action of section I relative to section III requires no assistance by pressure on bar 135, and responds only to pressure on the upholstery board 147.

Another action that occurs between the Fig. 3 and Fig. 4 positions of parts is that the links 125 further rotate legs 121 into positions wherein the notches 137 engage the pins 139, thus limiting the infolding of said legs.

Figure 4 shows the parts in a temporary intermediate folding (or unfolding) position and this figure does not necessarily indicate a dwell in the folding operation. It does indicate a position when the outer end of link 27 is no longer rising but has moved past a point vertically above its pivot 25 and is descending. In this position the left hand two-thirds of the mattress has been doubled on itself and the overlying portions have been squeezed toward each other and framing sections I and III are locked against movement away from each other by the spacing of pin 89 in the right hand portions of slots 87 and 115 in plate 85 and link 103. The folded end of section I is so held that, with continued inward movement of the folded sections I and III, cross brace 135 will pass under the lower back cross brace 7. There remains a final folding and squeezing action as the operator pushes the footboard 147 downwardly and the sections move to the position shown in Figure 5, where pin 89 has shifted further toward the right hand ends of slots 87 and 115 in plate 85 and link 103. The weight of the parts after passing the Fig. 4 position (approximately) tends to carry them toward their final Fig. 5 position, and in order partially to counterbalance this action for convenient subsequent unfolding, the springs 61 have been caused by the linkage to stretch, exerting the required partial counterbalancing action, though not enough in view of friction to return the sections from the sofa-forming configuration of Fig. 5, without some manual assistance. A final downward push on the upholstery board 147 causes the configuration of Fig. 5 to be reached which is maintained by gravity.

Unfolding is accomplished by lightly lifting up on the upholstery board 147 and drawing it forward. This action is aided by the partially counterbalancing tension in the springs 61. Then the parts are brought out through the Figs. 4 and 3 positions to the position of Figs. 1 and 2. In passing from the Fig. 4 to the Fig. 3 position, the pins 89 return to the forward ends of the aligned slots 87, 115, thus permitting plates 85 and 107 to angle apart. Then the braces 135 are grasped to rotate sections I and II into the bed-forming configuration of Figs. 1 and 2. During this movement, pins 102 move forward along slots 104. Sections I and II are held coplanar by contact between the ends of bars 43 and 97 adjacent pivot 95.

In the Fig. 5 sofa position, the section 153 is uppermost and is adapted to receive a cushion 161, shown in dotted lines. Therefore, section I, which contains wire fabric section 153, may be called a cushion section. The forward edge of the cushion 161 rests upon the top of the filler bar 145 of upholstery board 147. Since section 153 does not extend beyond cross brace 133, a space would be left between cross brace 133 and top of the upholstery section 147, except for the fact that the space filler bar 145, carried on brackets 143, has been introduced in position in this space, so as to form said support for the marginal portions of the cushion spanning the space.

From the above it will be seen that the invention provides several advantages:

First, movement of the mattress, from the unfolded position shown in Fig. 2 to the folded position shown in Figs. 4 and 5, is brought about by locking means which is automatic in the sense that locking action is responsive simply to the operator's action in folding the sections I, II, III and IV from the bed position (Fig. 2) to the sofa

position (Fig. 5). No additional manual operation for locking purposes is required, aside from this folding movement.

Secondly, sections I and III actuate the locking means through the permanently secured pinned section II and the permanently pinned linkage 103, 111 which is constrained as to movement. This eliminates operating difficulties arising from looseness of latches often used to effect manual locking operation, particularly latches and the like that require movements in addition to folding and unfolding movements of the bed sections. Thus it is not necessary to press down upon section I in the Fig. 3 position, as would be the case if the additional latching operation were required. The automatic folding operation afforded by the slotted locking means 85, 107 avoids this necessity for an additional locking operation. Moreover, no significant resistance to smooth action is encountered by reason of the automatic latching action during the infolding or unfolding movements of sections I, II, III, IV. One reason for this smooth action will be seen from Fig. 4. This figure illustrates the final locking action. This final locking action has brought to bear on it the gravitating force of the parts as they move from the Fig. 4 to the Fig. 5 position. This reduces the required pushing effort on board 147 during final stages of folding. The characteristics of the locking action may readily be modified in design by control of the shapes of the slots 115 and 87. In the example given, the edge 88 of slot 87 is straight and lower edge 117 of slot 115 is slightly curved, but it will be understood that other curvatures may be used or both slots may be straight. Moreover, there is an absence of any lost motion in the locking action, since pin 89 is effective as an operating wedge throughout its traverse in slots 87 and 115 in order to bring about locking.

Another advantage of the invention is in the independence of the two wire fabric supports 151 and 153 relative to each other and to the upholstery board and filler strip. This avoids wire fabric spring connections with the upholstery board or its supporting structure and minimizes the wire fabric compensating stretch required in opening and closing movements.

In view of the above, it will be seen that the several objects of the invention are achieved and other advantageous results attained.

As various changes could be made in the above constructions without departing from the scope of the invention, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

I claim:

1. A folding sofa bed comprising first, second, third and fourth pinned folding sections, a locking mechanism between said first and third sections including a cam link rotatable about the pin between the second and third sections, a first cam-forming portion affixed to said link, a connecting link between said cam link and the first section, a second cam-forming portion affixed to the third section, a member slidable between said cam-forming portions, a lever pivoted to the third section, linkage means adapted to move said lever in response to relative movements between the third and fourth sections, and a drag link connecting said lever with said slidable member, said lever and drag link being adapted in response to action of said linkage upon relative movements between the third and fourth sections to drive said slidable member between said cam-forming portions, said cam link through said connecting link positively driving said first section toward the third section.

2. A sofa bed made according to claim 1, including at least one leg pivoted to each of the first and third sections, a link pivoted to the leg on the first section and pivoted to the second section and adapted to fold said leg inward upon locking action, at least one leg pivoted to the third section, and a drag link pivoted to

said lever and to said last-named leg adapted to pull said last-named leg inward toward the third section upon locking movement.

3. A mattress folding and locking mechanism for use in sofa beds having first, second, third and fourth adjacently pin jointed foldable sections articulated with a frame; comprising a first cam member pivoted at the pin joint between the second and third sections, its outline extending to a point opposite said pin joint, a second cam member affixed to the third section, its outline also extending to a point opposite said pin joint, a follower movable along both cam members from the point opposite said pin joint, a driving linkage connected with said follower, said linkage being articulated between the pivoted third and fourth sections and adapted in response to relative movements between said third and fourth sections to move said follower away from a position on the second cam member opposite the pin joint located between the second and third sections, and a driving link joining the first cam member with the first section.

4. A mattress folding and locking mechanism for use in sofa beds having first, second, third and fourth adjacently pin jointed foldable sections articulated with a frame; comprising a first slotted member pivoted at the pin joint between the second and third sections, its slot extending to a point opposite said pin joint, a second slotted member affixed to the third section, its slot also extending to a point opposite said pin joint, a follower movable in both slots from the point opposite the pin joint, links pivoted to each other and to said follower and movable by relative pivoting of the third and fourth sections to move said follower along said slots to shift said slotted members and the corresponding sections relative to each other, and a driving link connecting the first slotted member with the first section and responsive to relative movements between the first and second sections to rotate said first slotted member around the pin joint between the second and third sections, said first slotted member also acting through said link to move the first section relative to the third section, whereby upon initial folding movements of the first and second sections from coplanar positions the first slotted member is brought into an angular position relative to the second slotted member such that upon infolding movements of the third and fourth sections from coplanar positions said follower will be drawn away from the pivot point between the second and third sections to angle said slots toward one another and draw the first section toward the third section.

5. In a folding sofa bed comprising first, second, third and fourth sections arranged successively end to end with pinned connections between adjacent ends of the sections, an elongated member swinging about the pinned connection between the second and third sections and having an elongated slot, there being an elongated slot in the outer end portion of the third section, a link from the swinging end of said member to a point on the first section spaced from its pinned connection to the second section, a lever fulcrumed on the third section having a link connection to the fourth section which shifts the lever when the third and fourth sections move relatively about their pinned connection, a drag link connecting said lever to a pin and drawing said pin along said slots from the pivoted end of said member toward its opposite end to lock the first and third sections against relative angular movement, and to positively thrust the first section toward the third section, when the outer end of the bed is folded, said lever and drag link moving said pin in the opposite direction when the bed is unfolded.

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