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Filed July 7. 1961

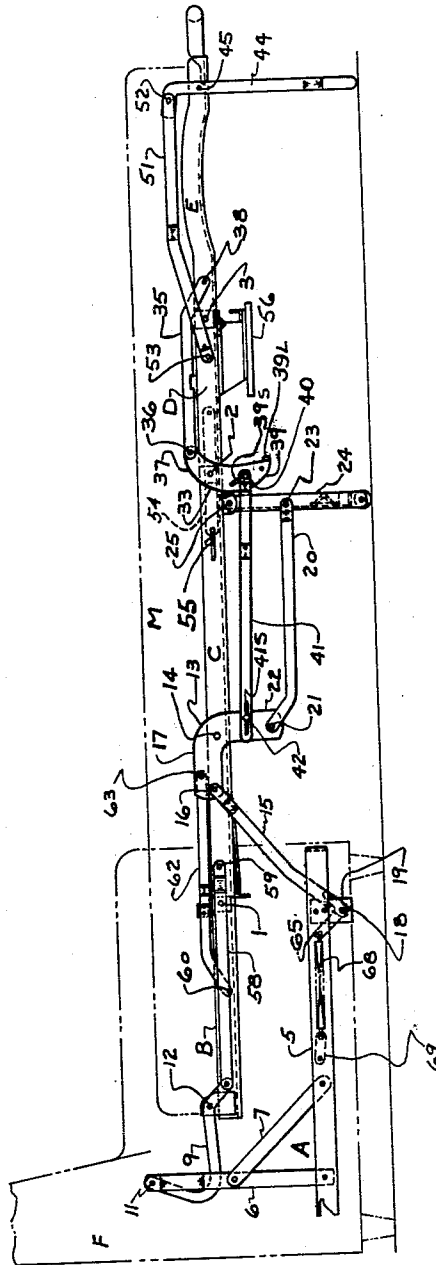
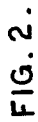


FIG. 1:

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FOLDING SOFA BED STRUCTURE

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FIG. 3.

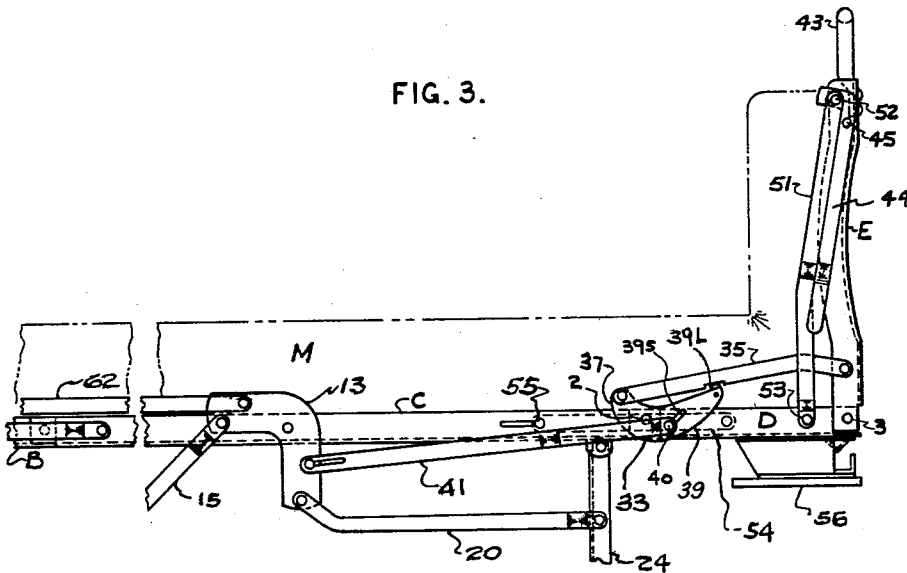
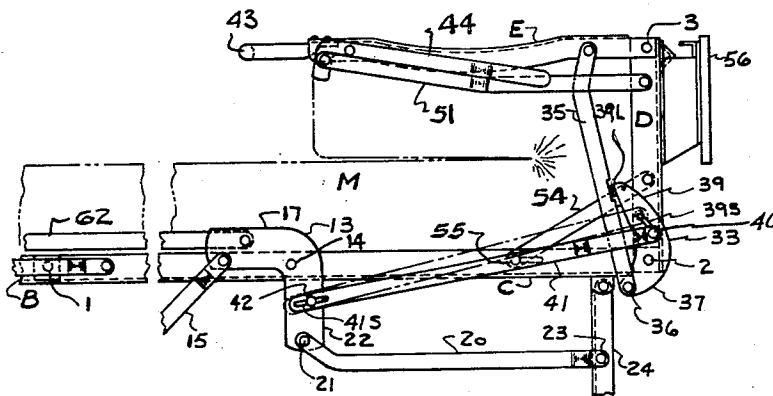


FIG. 4.



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FOLDING SOFA BED STRUCTURE

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8 Claims. (Cl. 5-13)

The invention relates to a folding metal frame adapted for a sofa bed and usually applied to or installed in a stationary wooden frame which is upholstered but forms no part of the mechanism of the present invention frequently made and sold by one manufacturer to another for assembly with the stationary frame to which the upholstery is applied.

The general object of the invention is the easing of the effort required to close up and to open out the sofa bed, particularly when it is fitted with a mattress and other bedding which resist folding and unfolding because of their weight and inherent resilience. This general object is attained by the use of linkage and leverage elements whereby the effective lengths of the lever arms are varied during the folding and unfolding operations to provide increased leverage with short movement when work effort is greater and to decrease the leverage when the work effort is less but more movement is desired.

In the accompanying drawings illustrating a selected embodiment of the invention:

FIGURE 1 is a side elevation of a folding sofa bed including the stationary frame to which upholstery is applied, the framing being shown unfolded to a coplanar bed-forming position.

FIGURE 2 is a top view of one side of the metal framing shown in FIGURE 1.

FIGURE 3 is a view on a larger scale of the outer end of the framing shown in FIGURE 1 but in the position assumed during initial folding operation.

FIGURE 4 is a similar view of the same parts shown in a position during a further folding operation.

FIGURE 5 illustrates the parts in a position assumed during an ensuing folding operation.

FIGURE 6 shows the parts when completely folded.

The folding metal frame includes an inner stationary rectangular section A at each side of the sofa bed, fixed to a wooden frame F, and a series of generally rectangular folding sections identified by their side bars B, C, D, E arranged end to end and pivotally connected at 1, 2, 3, successively. The side bars are duplicated at the opposite side of the frame. Suitable cross members connect the side bars but will be identified only as necessary. Side bars B define a rear or head frame section; side bars C define a main intermediate frame section; side bars D define a short intermediate frame section; and side bars E define a front or foot frame section.

Stationary section A comprises a main horizontal member 5 fixed to frame F, an upright member 6 and a diagonal 7 riveted to members 5 and 6. An arcuate link 9 is suspended by a pivot pin 11 from the upper end of member 6 and pivotally supports the inner end of side bar B at 12.

A bell crank 13 is fulcrumed by a pin 14 near its elbow to side bar C. One end of an anchor link 15 is pivoted at 16 to the horizontal arm 17 (FIGURE 1) of the bell crank. The other end of link 15 is pivoted at 18 to mem-

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ber 5. One end of a link 20 is pivoted at 21 to arm 22 of the bell crank. The other end of link 20 is pivoted at 23 to a folding leg 24, hinged at 25 to side bar C. Links 9 and 15 form parts of a swing linkage by which bar B is retracted from the advanced positions shown in FIGS. 1-4 to the position shown in FIGS. 5, 6.

A smaller bell crank 33 is fulcrumed by pin 2 near its elbow to the adjacent ends of side bars C and D. One end of an anchor link 35 is pivoted at 36 to the upper arm 37 (FIGURE 1) of bell crank 33. The other end of link 35 is pivoted at 38 to side bar E near but spaced from its inner end. The other arm 39 of bell crank 33 is slotted at 39S to slidably receive a pin 40 on one end of a link 41 the other end of which is slotted at 41S to slidably receive a pin 42 on arm 22 of bell crank 13.

Bell cranks 13 and 33 and associated anchors and linkage control the action of bars or sections B, C, D, E as the latter are folded and unfolded and the slots 39S and 41S provide lost motion in the bell crank linkage during certain periods of the folding and unfolding operations as detailed below. The novelty of the structure resides in the construction, arrangement and assembly of bell cranks 13, 33 and the combination of their successive lost motion link and leverage action in association with the other parts and the frame bars A, B, C, D, E.

To fold the opened bed (FIGURE 1) into a sofa (FIGURE 6), the operator first lifts the forward cross bar 43 of foot frame E about pivot 3 to the position of FIGURE 3 whereby the mattress is initially bent, before substantial inward movement and compression takes place, and the ensuing substantial movement and compression is effected by a leverage which reduces the manual effort required. The initial movement is limited by the engagement (FIGURE 3) of end leg 44, pivoted at 45 on bar E, and link 51, pivoted at 52 to leg 44 and at 53 to bar D, so that continued anticlockwise rotation of E about 3 is prevented. During this initial movement link 35 has freely rotated bell crank 33 anticlockwise and arm 39 swings to the right and upwardly to a substantially horizontal position and slot 39S moves relative to pin 40 to seat the latter against the inner end of the slot instead of against the outer end of the slot as seen in FIGURE 1. During this movement link 41 slides along pin 42 without affecting bell crank 13.

Upon further manual pressure to the left on the outer end of bar E, the latter and bar D move as a unit about pivot 2 to approximately the position shown in FIGURE 4 although the resilience of the mattress yieldingly resists the latter portion of such movement. During the latter portion of the movement, arm 39 and slot 39S are inclined upwardly and to the left and an end lip 39L on the bell crank opposes link 35. The operator now lifts upholstery board 56 and the outer end of bar C and the fulcrum 14 for bell crank 13. Link 15, anchoring the end of bell crank arm 17 to stationary bar 5, and link 62 connecting the same end of bell crank arm 17 to bar B cause the outer end of bell crank arm 17 to rotate clockwise on its pivot as the pivotally connected ends of bars B and C descend (FIGURES 5, 6). During this movement, link 15, swinging anticlockwise about its stationary pivot 18, swings bell crank 13 clockwise and pin 42 moves freely in slot 41S until it engages the outer end of the slot and then link 41, through pin 40, positively pulls against the side of slot 39S in

bell crank 37 at an angle of approximately 90° to the axis of the arm through fulcrum 2 and shifts pin 40 to the top or outer end of slot 39S and further shifts bars C, D and E as a unit inwardly and downwardly. At this time the effective length of bell crank power arm 39 (from fulcrum 2 perpendicularly to pin 40) is greater than the effective length of the bell crank work arm 37 (from pivot 2 perpendicularly to lever 35). As link 15 moves past the vertical, bell crank 13 is further rotated clockwise on its pivot and, through link 41, rotates bell crank 39 anticlockwise which, through link 35, completes final compression of the mattress by bringing bar E substantially parallel to bar C. During this final compression, taking place after link 15 moves past the vertical, the weight of the parts and mattress helps to overcome the resistance of the mattress to folding compression.

Strut 54 pivoted on bar D has a pin and slot connection 55 to bar C and limits the anticlockwise movement of bars D and E about pivot 2 to the 90° angle (shown in FIGURE 4). Lip 39L on bell crank arm 39 engages anchor link 35 and limits anticlockwise rotation of the bell crank on bar D. The mattress M is folded and compressed with little effort by the operator due to the advantage of leaning his weight against the upholstery board and the rotation of bell crank 13 about fulcrum 14 by anchor links 15 and 62, which increases the effective length of the bell crank power arm 17 and decreases the effective length of the bell crank load arm 22 which, through link 41, pulls on arm 39 of bell crank 33 at the outer end of slot 39S, thus increasing the effective length of arm 39, and its pull on bar E by link 35 is through arm 37, the effective length of which has been decreased until it is only the perpendicular to link 35 through pivot 2. The weight of the mattress and bedding also contributes to the ease of this latter movement.

During the latter part of the movement from the FIGURE 5 position to the FIGURE 6 position the anticlockwise rotation of link 15 about its pivot 16 shifts a bracket 65, fixed on the lower end of the link, to the right and thereby tenses a coil spring 68 which, in its final position, approaches parallelism with link 15 and does not materially affect the mechanism.

To unfold the sofa (FIGURE 6) to form a bed, the operator, assisted by spring 68, lifts upholstery board 56 and the forward end of link 15 and the parts move to the FIGURE 5 position. Then gravity and easy downward manual thrust on the board moves the parts to the FIGURE 4 position. This movement also rotates bell crank 13 to move its pin 42 away from the lower end of slot 41S releasing the positive lock on link 41, bell crank 33 and bars D, E. The operator now lifts upwardly and outwardly on cross bar 43 of bar E, being assisted by the resilience of mattress M, and swings bars D and E into full open position.

The pin and slot connections between the main operating link 41 and the associated bell crank levers 13, 33 provide lost motion at both ends of the link, but at different times according to the inclination of the slots. When the link is to transfer pull or thrust from bell crank 13 to bell crank 33, slot 39S is disposed nearly transversely of the link so that the pin positively engages a side of the slot. At other times the slot is disposed lengthwise or at an acute angle to the link and the pin may slide along the slot. This feature together with the changes in the effective lengths of the bell crank levers contribute to the easy action which is present both in folding and unfolding operation. In moving to sofa position, the final mattress-folding action is delayed until after the upholstery board and foot section are moving downwardly and rearwardly and the operator can push inwardly and downwardly on upholstery board 56.

The details of the structure may be varied without departing from the spirit of the invention and the exclusive use of modifications coming within the scope of the claims is contemplated.

What is claimed is:

1. In a folding sofa bed structure including a stationary frame, a folding frame suspended therefrom for projecting and retracting movement relative to the stationary frame, and comprising a head section, a main intermediate folding frame section, a relatively short intermediate frame section, and a frame front end foot section, said sections being arranged end to end with adjacent ends pivotally connected for selective unfolding projecting movement to a coplanar bed-forming position and for folding retracting movement to a folded position in which the foot section is turned upside down above the main intermediate section but is spaced therefrom by the short intermediate section to provide for a folded mattress between the main intermediate section and the foot section, there being link and pin mechanism between the foot section and the main intermediate section whereby the foot section is positively moved toward the main section as the foot section and short intermediate section are swung upwardly and inwardly during folding of the bed, said mechanism being characterized by upright bell crank levers fulcrumed at spaced points on the main intermediate section, a link interconnecting said levers and having an elongated slot at one end receiving a pin on one arm of one of said levers, a pin at the other end of said link received in a slot in one arm of the other of said levers, and individual anchor links between the other arms of said levers and said head section and foot section respectively whereby the unanchored arm of the lever anchored to the head section exerts pull through said link on the unanchored arm of the other lever as the head section is retracted but said levers may rotate relative to each other during initial folding of frame sections while the head section is stationary.

2. A folding sofa bed structure according to claim 1 in which the slot in the arm of the foot section connected bell crank lever is disposed substantially diagonally of the length of the interconnecting link when the folding frame sections are in bed-forming position, to provide for movement of the interconnecting link along the arm, and is disposed substantially transversely of the length of the interconnecting link as the intermediate and front frame sections approach said folded position to provide for positive pull of the interconnecting link on a lever arm in a direction at approximately 90° to the arm axis through the lever fulcrum.

3. A folding sofa bed structure according to claim 1 in which the slot in the link connecting the bell crank levers is disposed substantially transversely of the lever arm to which it is pinned when the frames are in bed position, to accommodate relative movement of such arm, and is disposed substantially lengthwise of said arm as said frame sections approach folded position to positively seat the pin at one end of the slot after predetermined lost motion.

4. A folding sofa bed structure according to claim 1 in which the slotted arm of the foot section connected bell crank lever is disposed diagonally of the interconnecting link when the folding frame sections are in bed-forming position and is disposed substantially transversely of the length of the interconnecting link as said frame sections approach folded position and the link connecting the bell crank levers is disposed substantially transversely of the lever arm to which it is pinned when the frames are in bed position and is disposed substantially lengthwise of said arm as said frame sections approach folded position.

5. A folding sofa bed according to claim 1 in which the ratio between the effective lengths of the arms is changed as the end section and short intermediate section are swung about their pivotal connections to each other and to the main intermediate section, and the leverage of the pulling bell crank lever on the pulled bell crank lever is increased as the foot section, short intermediate sec-

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tion and main intermediate section approach their folded position.

6. A folding sofa bed according to claim 1 in which the anchor of the pulling bell crank lever to the head section is a link secured to the mid-portion of the head section, and the anchor of the pulled bell crank lever to the foot section is a link secured to the foot section near the pivotal connection of the latter to the short intermediate section and the lever arm connected to each anchor is at its most effective length during the later movements of the frames to folded position. 10

7. A folding sofa bed structure according to claim 1 which includes a spring anchored to the stationary frame and operatively connected to the anchored arm of the first-mentioned bell crank lever, said spring being flexed when the frames are moved to their coplanar and 15

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folded position and assisting in the movement of the frames to intermediate positions.

8. A folding sofa bed structure according to claim 1 which includes a spring anchored to the stationary frame and operatively connected to the anchored arm of the first-mentioned bell crank lever, said spring being flexed when the frames are moved to a folded sofa-forming position and assisting in the early movement of the frames toward an unfolded position.

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