April 25, 1967 P. S. FLETCHER 3,316,015

RECLINING CHAIR OF THE MULTIPLE MOVEMENT TYPE

Original Filed March 18, 1964 4 Sheets-Sheet 1

FIG. 1.

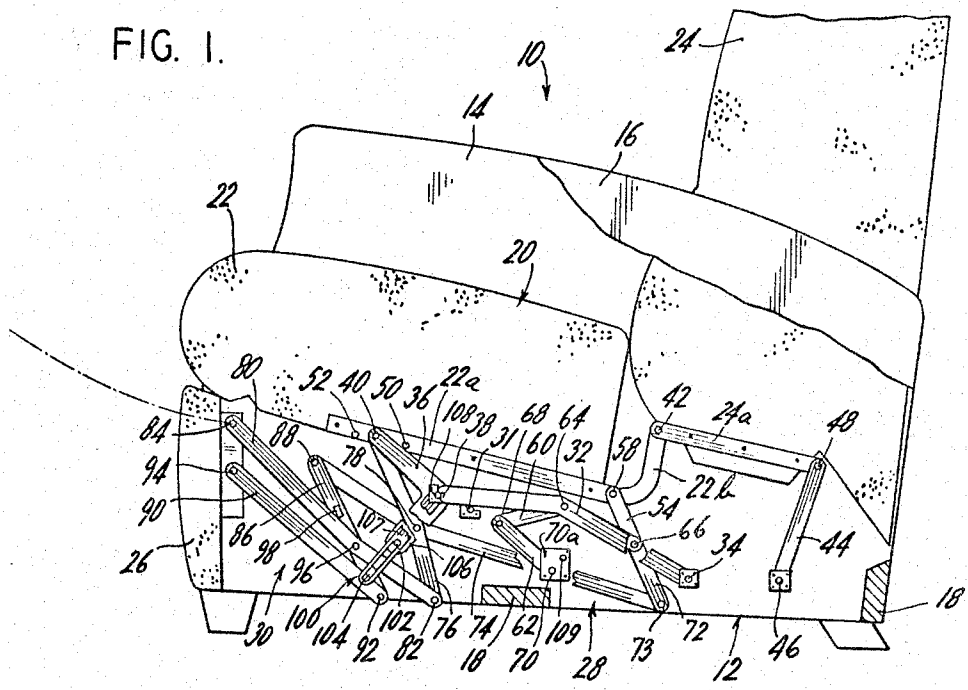
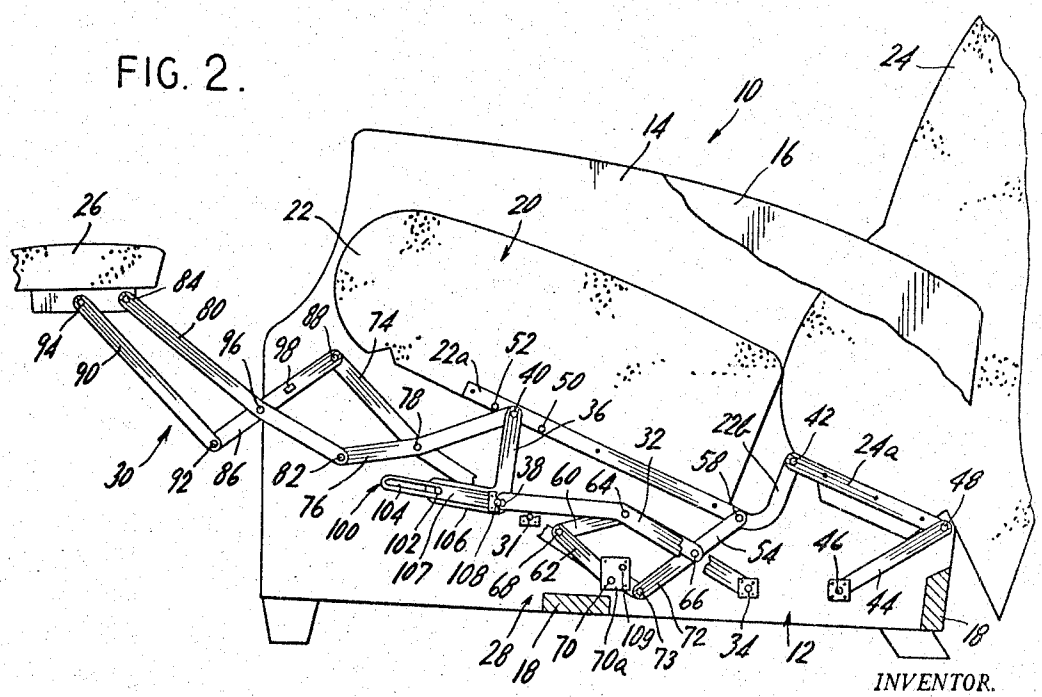


FIG. 2.



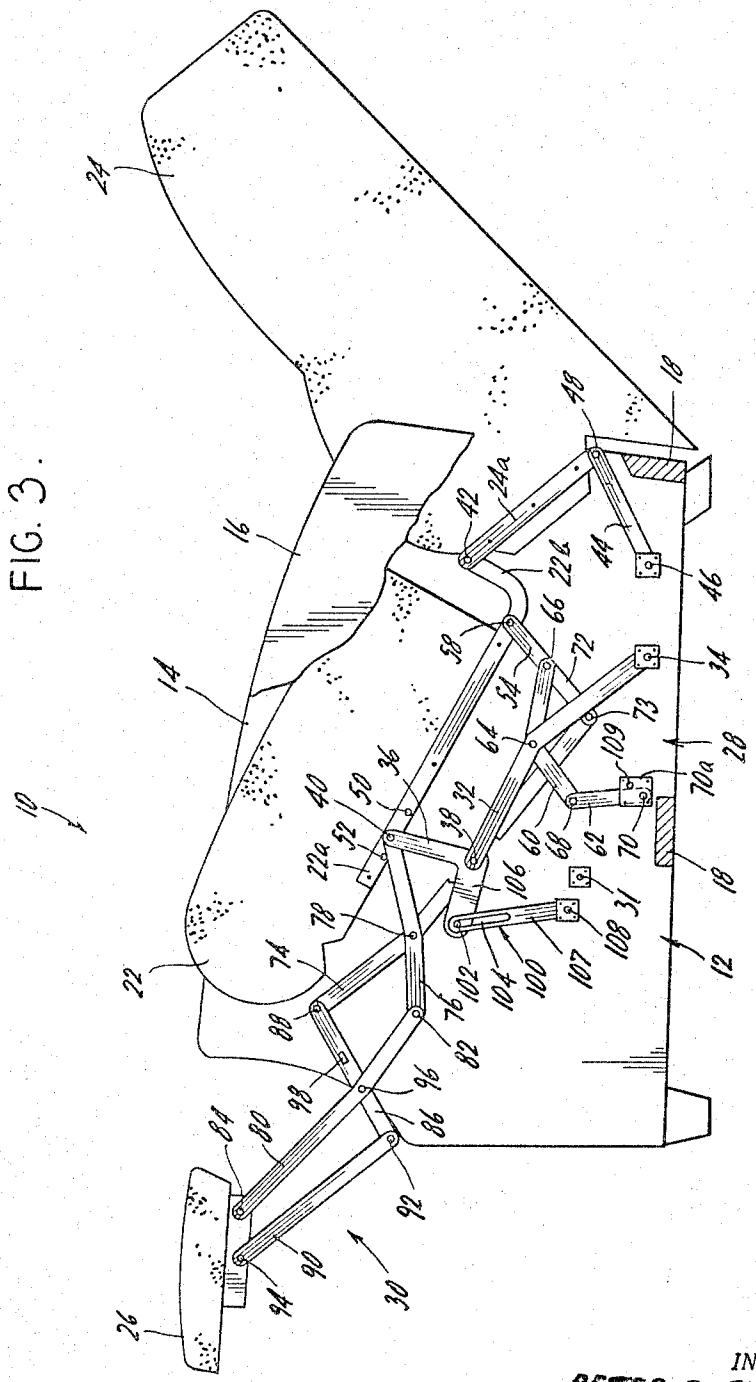
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RECLINING CHAIR OF THE MULTIPLE MOVEMENT TYPE

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FIG. 3.



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FIG. 4.

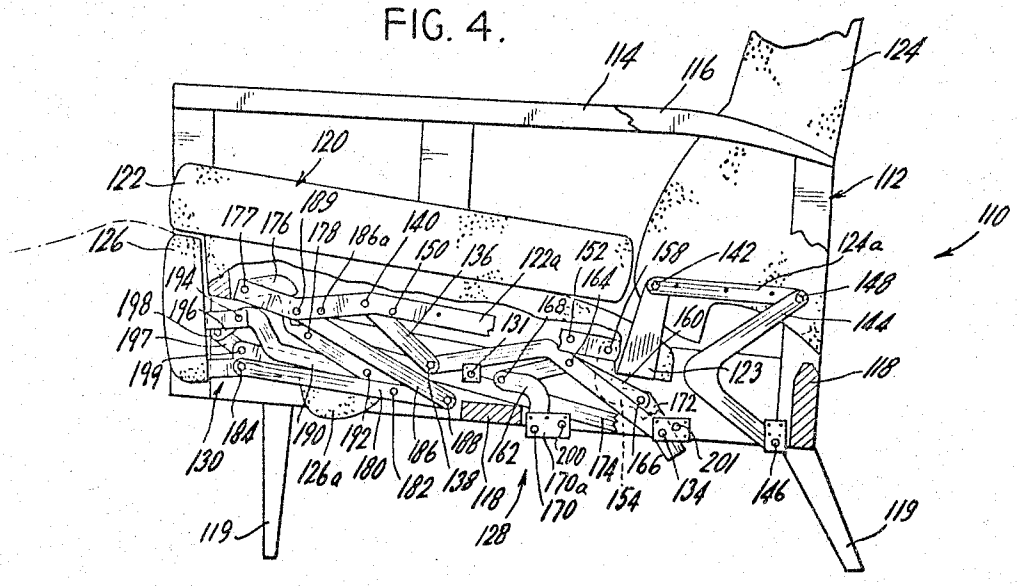
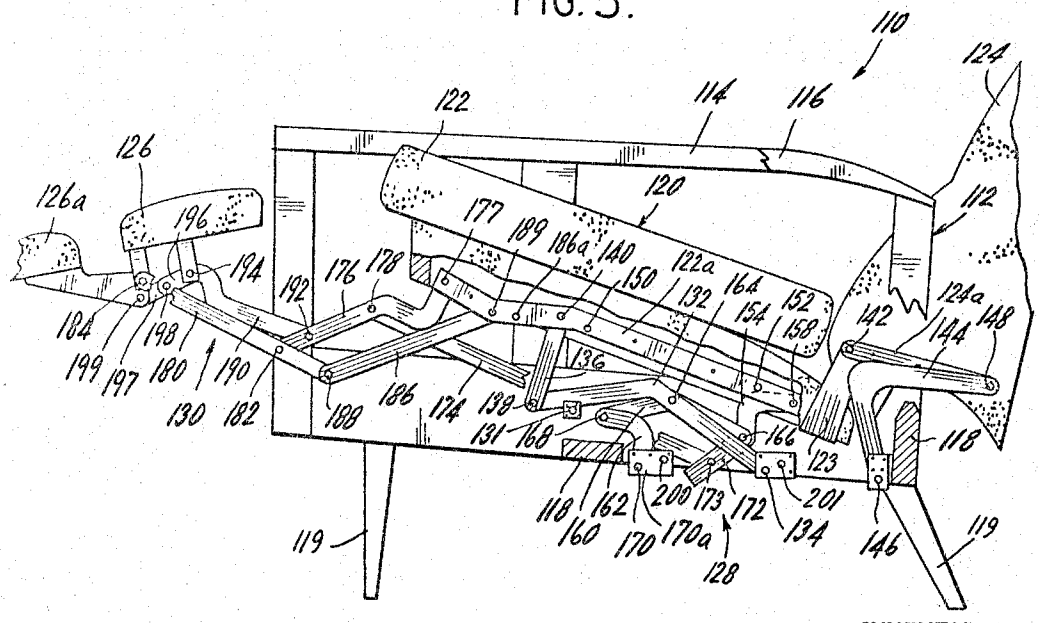


FIG. 5.



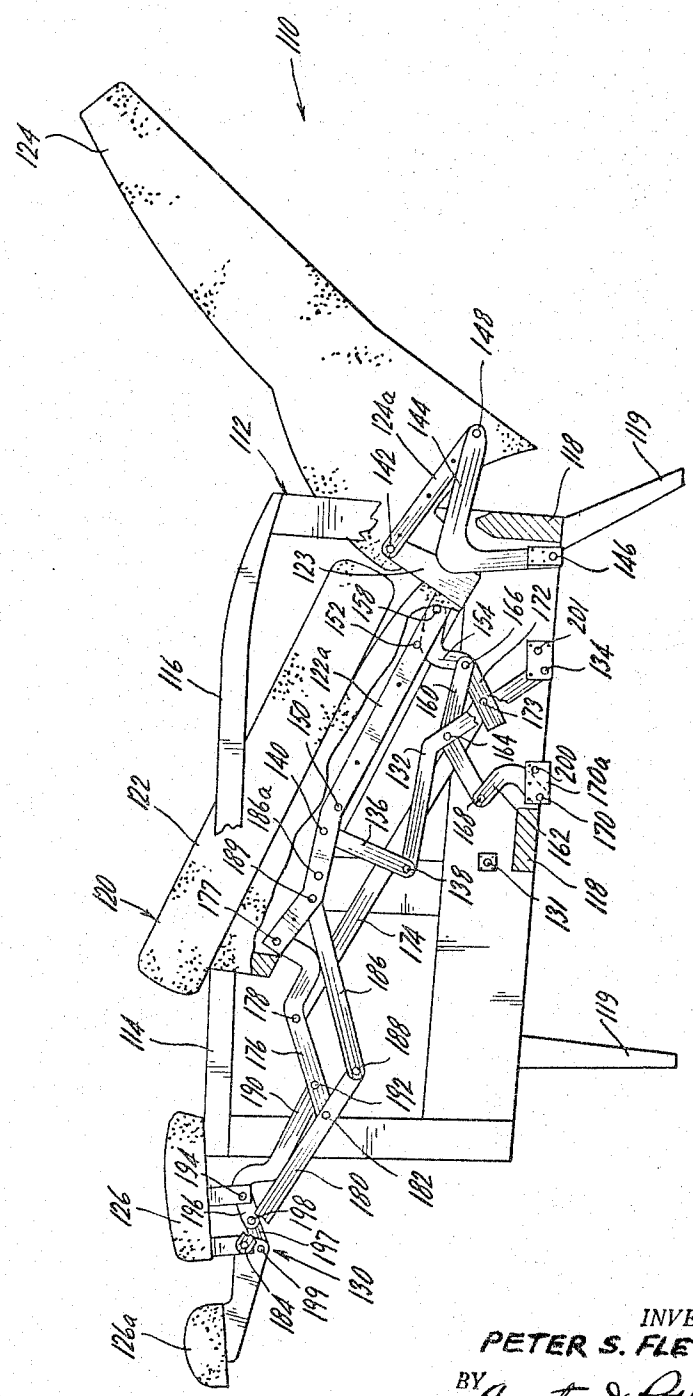
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RECLINING CHAIR OF THE MULTIPLE MOVEMENT TYPE

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FIG. 6.



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United States Patent Office 3,316,015 Patented Apr. 25, 1967

3,316,015
RECLINING CHAIR OF THE MULTIPLE MOVEMENT TYPE

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Original application Mar. 18, 1964, Ser. No. 352,891. Divided and this application Feb. 24, 1966, Ser. No. 529,788

5 Claims. (Cl. 297—89)

The present invention relates generally to reclining chairs and specifically to a lounger-type of reclining chair which has a built-in, positive, and self-acting tendency for the seat and back-rest to assume its upright sitting position, with the leg-rest completely collapsed, when the seat and back-rest are near that position and when the chair is either occupied or unoccupied. This is a division of my co-pending application Ser. No. 352,891, entitled, Reclining Chair of the Multiple Movement Type filed on Mar. 18, 1964, now abandoned.

One of the flaws of many of the commercially available reclining chairs is the undesirable propensity of the leg-rest of the chair to assume a less than fully collapsed position and of the body-supporting unit to assume a position slightly rearwardly of the upright sitting position. This results in an unkempt appearance since the leg-rest hangs downwardly from its design position at or under the front of the seat of the chair.

This well-defined principle of physics that systems tend to assume a position of equilibrium with their centers of gravity at the lowest possible point is, of course, fully applicable to the reclining chair art. Specifically, where the center of gravity of the moving elements of the reclining chair, that is, the seat and the back-rest, is at a point which is rearwardly of the point in space about which the seat and back-rest will have no tendency to rotate forwardly about that pivot point and, therefore, will not have a tendency to assume its upright sitting position. In this case, the chair will be relatively easy to operate, but the seat and back-rest will not move to the extreme of the upright sitting position and the weight of the leg-rest and its associated links will have a tendency to cause the leg-rest to hang downwardly from its fully collapsed position. Conversely, when the center of gravity of the seat and back-rest system is forwardly of the point in space which is the center of rotation of the system, the system will tend to move forwardly and downwardly to reach the point of least energy. Normally, when the chair is in the upright position or close thereto, the center of gravity of the moving system with a chair occupant is forwardly of the center of gravity of that same system without the chair occupant. This is clear since most of the chair occupant's weight is resting upon the seat rather than the back-rest. Accordingly, in almost all reclining chairs, when the chair occupant gets up, the center of gravity of the seat and back-rest system moves still further rearwardly with respect to the point of rotation of the moving system thus tending to make the seat and back-rest system rotate rearwardly away from the fully closed, upright sitting position.

This tendency may be overcome by a number of corrective devices. Obviously, the provision of a tension spring to bias the seat and back-rest in a forwardly direction could be utilized. However, this expedient is undesirable since the bias force of the spring must be overcome in order to move the seat and back-rest system from the upright sitting position into either the intermediate, tilted sitting position or the fully reclined position. A second possibility is to build a sufficient amount of friction into the mounting linkage such that the mere weight of the unoccupied seat and back-rest is insufficient to move

that system rearwardly. This expedient too has severe disadvantages in that it adds a further force which must be overcome in order to operate the chair. Furthermore, it provides no positive means to close the chair but merely adds friction to keep the chair from opening. In addition, there is a basic flaw in any mechanical addition to a system since the additional means provides an additional possible point of malfunction and such additions often provide adverse effects in addition to their desirable effects.

By far the most satisfactory method of solving this problem is the positioning of the center of gravity of the seat and back-rest system at a point where the natural tendency of the unoccupied chair is to assume the upright sitting position rather than the intermediate, tilted sitting position, i.e., where gravity causes the unit to fall into rather than fall out of the upright sitting position. However, this solution of the problem also has disadvantages. Specifically, if the center of gravity is forwardly of the center of rotation of the seat and back-rest system when the chair is unoccupied, the center of gravity will automatically move still further forwardly when the chair occupant sits on the seat. Since in the normal reclining chair there is a slight upward movement of the seat as it begins the first movement phase, the forward movement of the center of gravity will increase the difficulty of moving the seat and back-rest out of the upright sitting position since more of the occupant's weight will have to be lifted initially. Thus, although such an arrangement solves the problem of the chair moving out of the fully closed, upright sitting position or not assuming that position when the chair occupant gets up, a new problem of hard operation is created. It is desirable in a reclining chair to provide both the features of easy operation and an inherent tendency of the chair to assume the upright sitting position with the leg-rest in its fully retracted or folded state.

Accordingly, it is generally the object of the present invention to provide a reclining chair of the lounger type which obviates one or more of the disadvantages existing in the prior art chair. Specifically, it is an object of the present invention to provide a reclining chair of the lounger type which is both easy to operate and which inherently has a tendency to assume an upright sitting position when the chair is unoccupied.

It is further within the contemplation of the present invention to provide a reclining chair wherein the arrangement of the mounting linkage for the seat and back-rest system is such that the chair has an inherent tendency to assume the upright sitting position when that system is close to the upright sitting position.

In accordance with one illustrative embodiment of the present invention there is provided a reclining chair comprising a frame and body-supporting means including a seat and back-rest mounted on the frame for movement through a first movement phase from an upright sitting position to an intermediate, tilted sitting position. During the first movement phase, the included angle between the seat and the back-rest remains substantially uniform. The body-supporting unit thereafter moves through a second movement phase from the intermediate, tilted sitting position to a fully reclined position with the angle between the seat and back-rest increasing. Means are provided to mount the seat and back-rest on the frame for guided movement as recited. The mounting means includes a carrier link pivotally mounted on the frame at a carrier link pivot, a front guide link pivotally connected to the carrier link at a front pivotal mount and pivotally connected to the seat at a front guide link pivot and a back-rest guide link pivotally mounted at one end on the frame at a rear pivotal mount and pivotally connected at its opposite or upper end to the back-rest at a back-rest pivot. The seat and back-rest are pivotally connected together at a point spaced forwardly from the back-rest

pivot. The front guide link and the back-rest guide link both pivot rearwardly about the front and rear pivotal mounts, respectively, during the first movement phase to transport the seat and back-rest rearwardly, substantially no change taking place in the included angle therebetween. A first holding link is pivotally connected to the body-supporting means at a point rearwardly of the front guide link pivot and forwardly of the seat-back-rest pivot which holding link moves during the first movement phase to substantially maintain the angle between the seat and the back-rest. Second movement links include a bell crank lever which is pivotally connected to the carrier link at a first pivot and is connected at one of its ends to the first holding link at a second pivot. The second movement links also include a second holding link pivotally connected to the other end of the bell crank lever at a third pivot and pivotally mounted on the frame at a second movement holding pivot. The second movement links move with respect to each other and with respect to the frame during the second movement phase to open up the angle between the seat and the back-rest. Appropriate stop means are provided to define the upright sitting position and the fully reclined position. In addition, a leg-rest and leg-rest mounting linkage is provided to mount the leg-rest for movement upwardly and outwardly with respect to the seat in response to initial movement of the seat and back-rest during the first movement phase.

The above brief description, as well as further objects, features and advantages of the present invention, will be best appreciated by reference to the following detailed description of one presently preferred embodiment, when taken in conjunction with the accompanying drawings, wherein:

FIG. 1 is a side elevational view, with portions broken away for purposes of illustration, showing one presently preferred embodiment of the present invention with the chair being depicted in the upright sitting position and with the leg-rest shown in its corresponding fully collapsed position;

FIG. 2 is a view similar to that of FIG. 1 but showing the chair in its intermediate, tilted sitting position;

FIG. 3 is a view similar to FIG. 1 but showing the chair in its fully reclined position;

FIG. 4 is a side elevational view, with portions broken away for purposes of illustration, of another preferred embodiment of the present invention with the chair being depicted in the upright sitting position and with the leg-rest shown in its corresponding fully collapsed position, the leg-rest in this embodiment being of the folded type;

FIG. 5 is a view similar to that of FIG. 4 but showing the chair in its intermediate, tilted sitting position; and

FIG. 6 is a view similar to FIG. 5 but showing the chair in its fully reclined position.

In FIGS. 1, 2 and 3 of the drawings there is shown a reclining chair, generally designated by the numeral **10**, which is illustrative of the present invention. The reclining chair **10** includes a support or frame **12** having conventional arms or side rails, **14**, **16** which are structurally joined together by appropriate cross braces **18**. A body-supporting unit, generally designated by the numeral **20**, is mounted for movement within the frame **12** and includes a seat **22** and back-rest **24** which are pivotally interconnected as will be described below. A leg-rest **26** is mounted on the chair **10** and has a movement associated with the movement of the body-supporting unit.

The seat **22** and back-rest **24** are supported within the frame **12** by an appropriate mounting linkage **28** for movement through a first movement phase from the upright sitting position illustrated in FIG. 1 to the intermediate, tilted sitting position as illustrated in FIG. 2. During the first-movement phase the seat and back-rest translate and rotate somewhat rearwardly with the angle between the seat and back-rest remaining substantially fixed. The seat **22** and back-rest **24** may then move through a second movement phase to the fully reclined

position as illustrated in FIG. 3 during which the angle between the seat and back-rest is increased to provide a position for more complete relaxation.

The leg-rest **26** is mounted on the chair **10** by means of a leg-rest mounting linkage **30**. The leg-rest moves from its position beneath the forward end of the seat **22**, as shown in FIG. 1, to its extended leg-supporting position, as shown in FIGS. 2 and 3, in response to movement of the seat **22** through the first movement phase. As will be seen by comparing FIGS. 2 and 3, the leg-rest **26** maintains its extended leg-supporting position during the second movement phase.

The mounting means **28** for the body-supporting unit **20** includes a carrier link **32** which is mounted on the frame **12** on a carrier link pivot **34** and rests on a stop **31** on the frame **12** when the seat **22** and back-rest **24** are in the upright sitting position and the intermediate, tilted sitting position. A front guide link **36** is pivotally mounted at a front pivotal mount **38** on the forward end of the carrier link **32** and is pivotally connected to the seat **22** at a front guide link pivot **40**. The front guide link pivot **40** is formed on a mounting strap **22***a* conveniently secured along the lower edge of the seat **22**. The mounting strap **22***a* extends rearwardly of the seat **22** through an upward extension **22***b* and terminates at a seat-back-rest pivot **42**, at which location the seat **22** is pivotally joined to the back-rest **24**. A back-rest mounting strap **24***a* is conveniently secured to the back-rest **24** and the seat-back-rest pivot **42** is formed at the forward end thereof. A back-rest guide link **44** is secured at its lower end to the frame **12** at a rear pivotal mount **46** and is connected to the back-rest **24** at the rear end of the back-rest strap **24***a* at the back-rest pivot **48**.

As may be seen by comparing FIGS. 1 and 2, the body-supporting unit **20** is guided through the first movement phase by the rearward rotation of the front guide link **36** about the front pivotal mount **38** and the back-rest guide link **44** about the rear pivotal mount **46**. A stop **50** on the seat strap **22***a* engages the front guide link **36** to support the weight of the chair occupant in the upright sitting position and a second stop **52**, also on the seat strap **22***a*, engages one of the links of the leg-rest mounting linkage to halt rotation of the front guide link **36** and to define the intermediate, tilted sitting position.

The angle between the seat **22** and the back-rest **24** is maintained substantially uniform during the first movement phase by the operation of a first holding link **54**. The first holding link **54** is pivotally connected to the seat **22** at a pivot point **58** spaced rearwardly of the front guide link pivot **40**. The effect of the first holding link **54** is to serve as a stop during the first movement phase to maintain a substantially constant angle between the seat **22** and back-rest **24**, as will be described below.

Second movement links are provided which include a bell crank lever **60** and a second holding link **62**. The bell crank lever **60** has the normal three pivot points and is connected at the first pivot **64** intermediate its ends to the carrier link **32**. The bell crank lever **60** is pivotally connected to the first holding link **54** at a second pivot point **66** and is connected to the second movement link **62** at the third pivot point **68**. The second holding link **62** is pivotally mounted on the frame **12** at the second movement holding pivot **70** which is conveniently provided on a mounting plate **70***a* secured to the support **12**. As will be seen by comparing FIGS. 1 and 2, the bell crank lever **60**, the carrier link **32** and the second holding link **62** remain stationary during the first movement phase, thus providing a substantially fixed pivot, the second pivot **66**, for the first holding link **54** during the first movement phase. Accordingly, during the first movement phase, and as the front guide link **36** and the back-rest guide link **44** pivot rearwardly, the holding link **54** similarly pivots rearwardly about the stationary second pivot **66** and provides support for the rearward portion of the seat **22** to maintain the substan-

tially constant angular relationship between the seat 22 and back-rest 24.

Reference may be made to my co-pending application Ser. No. 303,201 entitled Improved Reclining Chair of the Multiple Movement Type for a more generalized description of the utilization of a holding link in reclining chairs. The first holding link 54 essentially functions as a stop between the seat 22 and the back-rest 24 during the first motion phase to substantially prevent movement about the seat-back-rest pivot 42. However, in accordance with the present invention, a small initial movement is provided between the seat 22 and back-rest 24 at the beginning of the first movement phase in order to introduce a lever effect to aid the chair occupant in lifting his weight and the weight of the seat 22 at the beginning of the first movement phase. The front guide link 36 and the holding link 54 are both inclined forwardly and upwardly in the upright sitting position. Accordingly, initial movement of the seat 22 in the first movement phase has a relatively large vertical component thus requiring the chair occupant to work against the force of gravity in order to move the body-supporting means 20 out of the upright sitting position. The ease of this operation in the chair 10 is enhanced by the utilization of the relatively long lever arm constituted by the back-rest 24. Specifically, the back-rest 24 may be considered as a lever pivoted about the back-rest pivot 48 serving as fulcrum, upward force being applied to the seat 22 at the seat-back-rest pivot 42. Due to the paths of motion of the front guide link 36 and the holding link 54 (which define the path of movement of the seat 22) and the path of movement of the back-rest link 44 (which in combination with the movement of the seat 22 defines the path of movement of the back-rest 24), there is a small initial change in the angular relationship between the seat 22 and the back-rest 24 at the beginning of the first movement phase. Although this change is relatively small, it is sufficient to enable the chair occupant to utilize the back-rest 24 as a lever to lift the seat 22 and his own weight upwardly to overcome the gravitational force on the moving system of the seat 22, the back-rest 24 and the chair occupant, which force tends to keep the body supporting unit 20 in the upright sitting position. Of course, as soon as the initial movement out of the upright sitting position has been accomplished, the path of movement of the seat 22 is substantially rearwardly such that no further leverage action by the back-rest 24 is necessary. Accordingly, the angle between the seat and back-rest may be thereafter maintained or, if desirable, may be returned to its initial angle. As may be appreciated from studying the drawings of the chair 10, only a very slight initial change of angle is necessary in order to provide the advantageous function described above.

The leg-rest linkage 30 is actuated during the first movement phase to move from the collapsed position shown in FIG. 1 to the extended, leg-supporting position shown in FIG. 2. The leg-rest linkage 30 is driven from a downward extension 72 of the first holding link 54 which rotates forwardly about the second pivot 66 during the first movement phase. This forward movement is translated through the pivot 73 to a connecting link 74 to drive the linkage 30. The linkage 30 includes a first link 76 which is pivotally connected to the seat 22 at the front guide link pivot 40 and is pivoted intermediate its ends, at pivot 78, to the connecting link 74. At its lower end, the first link 76 is connected to a second link 80 at the pivotal connection 82 which link, in turn, is connected to the leg-rest 26 at the first leg-rest pivot 84. The forward end of the connecting link 74 is connected to a third leg-rest link 86 at pivot 88. The link 86 is connected at its other ends to the fourth leg-rest link 90 at pivot 92 which link is also connected to the leg-rest 26 at the second leg-rest pivot 94. The links 80 and 86 are pivotally interconnected at their cross over point 96. As may be seen in the drawings, a raised stop 98 is provided on the link 86 to positively define the collapsed position of the leg-rest position 26 (see FIG. 1). The stop 52 engages the link 76 at the end of the first movement phase to define the intermediate, tilted sitting position and halt further extension of the leg-rest linkage 30. The leg-rest linkage 30 provides a slightly rising path of movement to the leg-rest 26 as it initially moves outwardly from its collapsed position. Accordingly, once the leg-rest 26 has approached its fully collapsed position as shown in FIG. 1, it has a natural tendency to fall into and assume its fully collapsed position. The path of movement of the leg-rest 26 has been indicated approximately by the dotted line in FIG. 1 of the drawings. Accordingly, the leg-rest mounting linkage 30 cooperates with the linkage 28 to insure that the elements of the chair 10 assume the fully collapsed, upright sitting position when the chair occupant gets up.

Movement of the body-supporting unit 20 from the intermediate, tilted sitting position of FIG. 2 to the fully reclined position of FIG. 3 is instituted by the application of rearward pressure on the back-rest 24 by the chair occupant. In response to such movement, the carrier link 32 pivots upwardly from the stop 31 about the carrier link pivot 34 raising the front guide link 36 and the front of the seat 22. As the carrier link 32 rotates upwardly, the bell crank lever 60 of the second movement links is translated upwardly at its intermediate pivot 64. The third pivot 68 of the bell crank lever 60 is held downward by the second holding link 62 such that there is a controlled upward movement of the opposite end of the lever 60 at the second pivot 66 which is connected to the first holding link 54. Accordingly, the first holding link 54 is raised upwardly during the second movement phase such that the position of the seat 22 in the fully reclined position is defined by its connections to the front guide link 36 and the first holding link 54. Movement of the seat 22 during the second movement phase may be viewed as being controlled by a four-bar linkage having the support 12 between the pivots 34 and 70 as the stationary link. The second holding link 62, the bell crank lever 60 and the carrier link 32 are the movable links of the four-bar linkage. The seat 22 is directly attached to this four-bar linkage since the front guide link 36 is more or less stationary relative to the seat 22 and the first holding link 54 is blocked relative to the seat 22 by the action of stop 52 on leg-rest link 76 during the second movement phase. The effective connection of the seat 22 to the four-bar linkage is at extensions of the two movable links 32 and 60 at the front pivotal mount 38 and the second bell crank pivot 66 respectively.

The position of the seat 22, through the pivotal connection 42 of the seat 22 to the back-rest 24, controls the position of the back-rest as supported by the back-rest guide link 44. As may be appreciated by inspecting FIGS. 2 and 3, the back-rest link 44 remains more or less stationary during the second movement phase. This is accomplished by the use of the second holding link 62 which has the effect of a stop supporting link 44 in a stationary position. The second holding link 62, by controlling the seat movement in such a way that the seat-back-rest pivot 42 moves in an arc about a fixed point in the vicinity of pivot 48 on the back-rest when the chair is in the intermediate, tilted sitting position, holds the back-rest link 44 in much the same manner as a stop engaging its rear surface. As will be best appreciated by comparing FIGS. 2 and 3, the angle between the seat 22 and back-rest 24 varies from the intermediate, tilted sitting position to the fully reclined position and specifically, that angle increases to provide a more relaxed position for the chair occupant.

The termination of the second movement phase is defined by a lost motion stop and sequencing mechanism generally designated by the numeral 100 and specifically

y pin **102** as it engages the upper end of a slot **104** in nk **107**. The pin **102** is mounted on the end of extenion **106** of the front guide link **36** and the slot **104** is ormed in the lost motion link **107** which is pivotally nounted on the support at the pivot **108**. The pivot **108** s effectively coaxial with the front pivotal mount **38** on he carrier member **32** when the carrier member **32** is in ither the upright sitting position or the intermediate, ilted sitting position. In each of these positions, as will e seen from inspecting FIGS. 1 and 2, the pin **102** is n the inner end of the slot, i.e., the end closest the pivot 108. Those skilled in the art will appreciate that the ost motion mechanism **100** serves as an automatic equencing means in addition to its stop functions. Specifically, the reception of the pin **102** in the slot **104**, nd the angular orientation of the lost motion link **107** with respect to the path of travel of the carrier link **32**, nakes it impossible for the carrier link **32** to pivot upwardly about the carrier link pivot **34** until the intermediate, tilted sitting position has been achieved. Accordingly, the raising of the carrier link **32** and the start of the second movement phase cannot be accomplished until the intermediate, tilted sitting position has been reached.

A further stop **109** is provided on the frame **12**, and specifically on the mounting plate **70***a*, and is positioned to engage the second holding link **62** at the end of the second movement phase (see dotted line configuration of FIG. 3). This provides further positive stop means to define the fully reclined position of the body-supporting unit **20** and also prevents links **62** and **60** from going past dead center.

The foregoing description of the reclining chair **10** will be more fully understood by considering the following description of a typical sequence of operation:

With the chair **10** in the position shown in FIG. 1, and specifically with the seat **22** and back-rest **24** in the upright sitting position, the chair occupant presses rearwardly on the back-rest **24** to initiate movement to the first movement phase. Due to the mechanical advantage of the relatively long lever arm of the back-rest **24** about the back-rest pivot **48** as a fulcrum and the seat-back-rest pivot **42** as the point of application of pressure, the seat **22** and back-rest **24** are moved slightly upwardly and rearwardly through a tilting motion with the front guide link **36** and the back-rest guide link **44** rotating rearwardly about the respective front and rear pivotal mounts **38**, **46**. The relative position of the back-rest **24** with respect to the seat **22** during the first movement phase is governed by the first holding link **54** which pivots rearwardly about the second pivot **66** of the bell crank lever **60**. As the body-supporting unit **20** is moved from the upright sitting position of FIG. 1 to the intermediate tilted sitting position of FIG. 2, the downward extension **72** of the first holding link **54** is effective, through the pivot **73** to the connecting link **74**, to extend the leg-rest linkage **30** and to move the leg-rest **26** from its collapsed position below the seat **22** to its extended, leg-supporting position forwardly of the seat **22**.

Upon further rearward pressure on the back-rest **24** by the chair occupant, movement of the body-supporting unit **20** through the second movement phase is initiated. The carrier link **32** pivots upwardly about the carrier link pivot **34** to raise and further tilt the seat **22**. As the carrier link **32** is rotated upwardly, the second movement links **60** and **62** begin operation to guide the rearward end of the seat **22** and the seat-back-rest pivot **42** along an appropriate path such that the back-rest **24**, supported by the back-rest guide link **44**, assumes a position such that the angle between the seat **22** and the back-rest **24** is substantially increased as compared with the intermediate, tilted sitting position. Upon abutment of the pin **102** with the end of the lost motion slot **104**, and upon engagement of the second holding link **62** with the stop **109**, the second movement phase is terminated and the fully reclined position is established.

In order to collapse the chair **10** from the fully reclined position of FIG. 3 to the intermediate, tilted sitting position of FIG. 2 and subsequently to the upright sitting position of FIG. 1, the occupant merely moves his weight forwardly in reverse procedure to that recited above.

It will be appreciated that the reclining chair **10** according to the present invention provides a structure wherein the center of gravity of the moving body-supporting unit **20**, when it is adjacent the upright sitting position, is forwardly of the point in space about which that moving system rotates. Accordingly, there is a natural tendency for the unoccupied chair to assume its upright sitting position. Specifically, there is a tendency, under the force of gravity, for the seat **22** and back-rest **24** to fall downwardly into the upright sitting position with the front guide link **36** and the holding link **54** rotating forwardly and downwardly under the influence of gravity. Furthermore, the leg-rest linkage **30** provided in association with the chair **10** is such that the leg-rest **26** also demonstrates a tendency to fall into its completely collapsed position. Furthermore, due to the mechanical advantage which is achieved by the relatively long lever arm of the back-rest **24** about the back-rest pivot **48** and the arrangement of the point application of the lever force at the seat-back-rest pivot **42**, it is relatively easy for a chair occupant to overcome the gravity forces to institute movement of the seat and back-rest unit **20** out of the upright sitting position and through the first and second movement phases.

Now referring to FIGS. 4, 5 and 6, there is shown a second embodiment of the present invention, constituting a reclining chair generally designated by the numeral **110**, which is similar to the chair **10** described above. The reclining chair **110** includes a support or frame **112** having conventional arms or side rails **114**, **116** which are structurally joined together by appropriate cross braces **118**. The frame **112** is supported above the ground by conventional legs **119** and the chair itself is of the type designated in the trade as a high-leg chair. A body-supporting unit **120** is mounted for movement within the frame **112** and includes the seat **122** and back-rest **124** which are pivotally interconnected as will be described below. A leg-rest **126**, including its associated folded extension **126***a*, is mounted on the chair **110** and has a movement associated with the movement of the body-supporting unit **120**.

The seat **122** and back-rest **124** are supported within the frame **112** by an appropriate mounting linkage **128** for movement through a first movement phase from the upright sitting position illustrated in FIG. 4 to the intermediate, tilted sitting position as illustrated in FIG. 5. During the first-movement phase the seat and back-rest translate and rotate somewhat rearwardly with the angle between the seat and back-rest remaining substantially fixed. The seat **122** and back-rest **124** may then move through a second movement phase to the fully reclined position as illustrated in FIG. 6 during which the angle between the seat and back-rest is increased to provide a position for more complete relaxation.

The leg-rest **126** and its extension **126***a* are mounted on the chair **110** by means of a leg-rest mounting linkage **130**. The leg-rest moves from its position beneath the forward end of the seat **122**, as shown in FIG. 4, to its extended, leg-supporting position, as shown in FIGS. 5 and 6, in response to movement of the seat **122** through the first movement phase. As will be seen by comparing FIGS. 5 and 6, the leg-rest **126** maintains its extended, leg-supporting position during the second movement phase.

The mounting means **128** for the body-supporting unit **120** includes a carrier link **132** which is mounted on the frame **112** on a carrier link pivot **134** and rests on a stop **131** on the frame **112** when the seat **122** and back-rest **124** are in the upright sitting position and the intermediate, tilted sitting position. A front guide link **136**

is pivotally mounted at a front pivotal mount **138** on the forward end of the carrier link **132** and is pivotally connected to the seat **122** at a front guide link pivot **140**. The front guide link pivot **140** is formed on a mounting strap **122***a* conveniently secured to the seat along the lower inside part of the seat frame. The seat **122** is pivotally connected to the back-rest **124** at a seat-back-rest pivot **142**. A bracket **123** is rigidly secured to the outside of the seat **122** and a back-rest mounting strap **124***a* is conveniently secured to the back-rest **124** and the seat-back-rest pivot **142** is formed between the upper end of the bracket **123** and the forward end of the strap **124***a*. A back-rest guide link **144** is secured at its lower end to the frame **112** at a rear pivotal mount **146** and is connected to the back-rest **124** at the rear end of the back-rest strap **124***a* at the back-rest pivot **148**. The back-rest guide link **144** is curved as shown in FIGS. 5 and 6 to avoid the rear cross brace **118** during the first and second movement phases.

As may be seen by comparing FIGS. 4 and 5, the body-supporting unit **120** is guided through the first movement phase by the rearward rotation of the front guide link **136** about the front pivotal mount **138** and the back-rest guide link **144** about the rear pivotal mount **146**. A stop **150** on the seat strap **122***a* engages the front guide link **136** to support the weight of the chair occupant in the upright sitting position and a second stop **152**, also on the seat strap **122***a*, engages the first holding link **154**, described below, to halt the first movement phase and to define the intermediate, tilted sitting position.

The angle between the seat **122** and the back-rest **124** is maintained substantially uniform during the first movement phase by the operation of a first holding link **154**. The first holding link **154** is pivotally connected to the seat **122** at a pivot point **158** spaced rearwardly of the front guide link pivot **140**. The effect of the first holding link **154** is to serve as a stop during the first movement phase to maintain a substantially constant angle between the seat **122** and back-rest **124**, as will be described below.

Second movement links are provided which include, a bell crank lever **160** and a second holding link **162**. The bell-crank lever **160** has the normal three pivot points and is connected at the first pivot point **164** intermediate its ends to the carrier link **132**. The bell-crank lever **160** is pivotally connected to the first holding link **154** at a second pivot point **166** and is connected to the second movement link **162** at the third pivot point **168**. The second holding link **162** is pivotally mounted on the frame **112** at the second movement holding pivot **170** which is conveniently provided on a mounting plate **170***a* secured to the support **112**. As will be seen by comparing FIGS. 4 and 5, the bell-crank lever **160**, the carrier link **132**, and the second holding link **162** remain stationary during the first movement phase, thus providing a substantially fixed pivot, the second pivot **166**, for the first holding link **154** during the first movement phase. Accordingly, during the first movement phase and as the front guide link **136** and the back-rest guide link **144** pivot rearwardly, the holding link **154** similarly pivots rearwardly about the stationary second pivot **166** and provides support for the rearward portion of the seat **122** to maintain the substantially constant angular relationship between the seat **122** and back-rest **124**. The first holding link **154** essentially functions as a stop between the seat **122** and the back-rest **124** during the first motion phase to substantially prevent movement about the seat-back-rest pivot **142**. However, in accordance with the present invention, a small initial movement is provided between the seat **122** and the back-rest **124** at the beginning of the first movement phase in order to introduce a lever effect to aid the chair occupant in lifting his weight and the weight of the seat **122** at the beginning of the first movement phase. The front guide link **136** and the holding link **154** are both inclined forwardly and upwardly in the upright sitting position. Accordingly, initial movement of the seat **122** in the first movement phase has a relatively large vertical component thus requiring the chair occupant to work against the force of gravity in order to move the body-supporting means **120** out of the upright sitting position. The ease of this operation in the chair **10** is enhanced by the utilization of the relatively long lever arm constituted by the back-rest **124**. Specifically, the back-rest **124** may be considered as a lever pivoted about the back-rest pivot **148** serving as a fulcrum, upward force being applied to the seat **122** at the seat-back-rest pivot **142**. Due to the paths of motion of the front guide link **136** and the holding link **154** (which define the path of movement of the seat **122**) and the path of movement of the back-rest link **144** (which in combination with the movement of the seat **122** defines the path of movement of the back-rest **124**), there is a small initial change in the angular relationship between the seat **122** and the back-rest **124** at the beginning of the first movement phase. Although this change is relatively small, it is sufficient to enable the chair occupant to utilize the back-rest **124** as a lever to lift the seat **122** and his own weight upwardly to overcome the gravitational force on the moving system of the seat **122**, the back-rest **124** and the chair occupant which force tends to keep the body-supporting unit **120** in the upright sitting position. Of course, as soon as the initial movement out of the upright sitting position has been accomplished, the path of movement of the seat **122** is no longer upwardly so that no further leverage action by the back-rest **124** is necessary. Accordingly, the angle between the seat and back-rest may be thereafter maintained, or, if desirable, may be returned to its initial angle. As may be appreciated from studying the drawings of the chair **110**, only a very slight initial change of angle is necessary in order to provide the advantageous function described above.

The leg-rest linkage **130** is actuated during the first movement phase to move from the collapsed position shown in FIG. 3 to the extended, leg-supporting position shown in FIG. 4. The leg-rest linkage **130** is driven from a downward extension **172** of the first holding link **154** which rotates forwardly about the second pivot **166** during the first movement phase. This forward movement is translated through the pivot **173** to a connecting link **174** to drive the linkage **130**. The linkage **130** includes a first link **176** which is pivotally connected to the seat **122** at the pivot **177** and is pivoted intermediate its ends, at pivot **178**, to the connecting link **174**. At its forward end, the first link **176** is connected to a second link **180** at the intermediate pivotal connection **182** which in turn is connected to the leg-rest **126** at the first leg-rest pivot **184**. The third leg-rest link **186** is connected to the second link **180** a pivot **188** and is pivotally connected to the seat **122** at pivot point **189** on the strap **122***a* spaced rearwardly from pivot **177**. The link **176** is connected intermediate its ends to the fourth leg-rest link **190** at pivot **192** which link is also connected to the leg-rest **126** at the second leg-rest pivot **194**. An extension **196** of link **190** drives the leg-rest extension **126***a* through the connecting link **197** and its pivots **198**, **199** with the leg-rest extension **126***a* being mounted on the leg-rest **126** at pivot **184** to operate in the manner well known in the art for folding leg-rests. A stop **136***a* is mounted on the strap **122***a* and provides a positive stop for the leg-rest mounting linkage **130** in the upright sitting position. The leg-rest linkage **130** provides a slight rise in the path of movement to the leg-rest **126** as it moves outwardly from its collapsed position. Accordingly, once the leg-rest **126** has approached its fully collapsed position as shown in FIG. 4, it has a natural tendency to fall into and assume its fully collapsed position. The path of movement of the leg-rest **126** is generally similar to the dotted line path shown in FIG. 1 of the drawings. Accordingly, the leg-rest mounting linkage **130** cooperates with the linkage **128** to insure that the elements of the chair **110** assume

the fully collapsed, upright sitting position when the chair occupant gets up.

Movement of the body-supporting unit **120** from the intermediate, tilted sitting position of FIG. 5 to the fully reclined position of FIG. 6 is instituted by the application of rearward pressure on the back-rest **124** by the chair occupant. In response to such movement, the carrier link **132** pivots upwardly from the stop **131** about the carrier link **134** raising the front guide link **136** and the front of the seat **122**. As the carrier link **132** rotates upwardly, the bell-crank lever **160** of the second movement links is translated upwardly at its intermediate pivot **164**. The third pivot **168** of the bell-crank lever **160** is held downward by the second holding link **162** such that there is a controlled upward movement of the opposite end of the lever **160** at the second pivot **166** which is connected to the first holding link **154**. Accordingly, the first holding link **154** is raised upwardly during the second movement phase such that the position of the seat **122** in the fully reclined position is defined by its connections to the front guide link **136** and the first holding link **154**. Movement of the seat **122** during the second movement phase may be viewed as being controlled by a four-bar linkage having the support **112** between the pivots **134** and **170** as the stationary link. The second holding link **162**, the bell-crank lever **160** and the carrier link **132** are the movable links of the four-bar linkage. The seat **122** is directly attached to this four-bar linkage since the front guide link **136** is more or less stationary relative to the seat **122** and the first holding link **154** is rigid with the seat **122** during the second movement phase. The connection of the seat **122** to the four-bar linkage is at extensions of the two movable links **132** and **160** at the first pivotal mount **138** and the second bell crank pivot **166** respectively.

The position of the seat **122**, through the pivotal connection **142** of the seat **122** to the back-rest **124**, similarly controls the position of the back-rest as supported by the back-rest guide link **144**. As may be appreciated by inspecting FIGS. 5 and 6, the back-rest link **144** remains more or less stationary during the second movement. This is accomplished by the use of the second holding link **162** which has the effect of a stop supporting link **144** in a stationary position. The second holding link **162**, by controlling the seat movement in such a way that the seat-back-rest pivot **142** moves in an arc about a fixed point in the vicinity of pivot **148** on the back-rest when the chair is in the intermediate tilted sitting position, holds the back-rest link **144** in much the same manner as a stop engaging its rear surface. As will be best appreciated by comparing FIGS. 5 and 6, the angle between the seat **122** and back-rest **124** varies from the intermediate, tilted sitting position to the fully reclined position and specifically, that angle increases to provide a more relaxed position for the chair occupant.

The termination of the second movement phase is defined by a stop **200** which is provided on the frame **112**, and specifically on the mounting plate **170***a*, and is positioned to engage the second holding link **162** at the end of the second movement phase (see dotted line configuration of FIG. 6). This provides positive stop means to define the fully reclined position of the body-supporting unit **120** and also prevents links **162** and **160** from going past dead center. A sequencing stop **201** is mounted on the support **112** adjacent the carrier link pivot **134** and is positioned to engage an extension of member **172** thereby providing positive blocking means preventing movement in the second movement phase until the first movement phase has been initiated and the link **154–172** has rotated out of blocking engagement with the sequencing pin **201**.

The foregoing description of the reclining chair **110** will be more fully understood by considering the following description of a typical sequence of operation:

With the chair **110** in the position shown in FIG. 4, and specifically with the seat **122** and back-rest **124** in the upright sitting position, the chair occupant presses rearwardly on the back-rest **124** to initiate movement to the first movement phase. Due to the mechanical advantage of the relatively long lever arm of the back-rest **124** about the back-rest pivot **148** as a fulcrum and the seat-back-rest pivot **142** as the point of application of pressure, the seat **122** and back-rest **124** are moved upwardly initially and then rearwardly through a tilting motion with the front guide link **136** and the back-rest guide link **144** rotating rearwardly about the respective front and rear pivotal mounts **138**, **144**. The relative position of the back-rest **124** with respect to the seat during the first movement phase is governed by the first holding link **154** which pivots rearwardly about the second pivot **166** of the bell crank lever **160**. As the body-supporting unit **120** is moved from the upright sitting position of FIG. 4 to the intermediate, tilted sitting position of FIG. 5, the downward extension **172** of the first holding link **154** is effective, through the pivot **173** to the connecting link **174**, to extend the leg-rest linkage **130** and to move the leg-rest **126** from its collapsed position below the seat **122** to its extended, leg-supporting position forwardly of the seat **122**.

Upon further rearward pressure on the back-rest **124** by the chair occupant, movement of the body-supporting unit **120** through the second movement phase is initiated. The carrier link **132** pivots upwardly about the carrier link pivot to raise and further tilt the seat **122**. As the carrier link **132** is rotated upwardly, the second movement links **160** and **162** begin operation to guide the rearward end of the seat **122** and the seat-back-rest pivot **142** along an appropriate path such that the back-rest **124**, supported by the back-rest guide link **144**, assumes a position such that the angle between the seat **122** and the back-rest **124** is substantially increased as compared with the intermediate, tilted sitting position. Upon abutment engagement of the second holding link **162** with the stop **200**, the second movement phase is terminated and the fully reclined position is established.

In order to collapse the chair **110** from the fully reclined position of FIG. 6 to the intermediate, tilted sitting position of FIG. 5 and subsequently to the upright sitting position of FIG. 4, the occupant merely moves his weight forwardly in reverse procedure to that recited above.

It will be appreciated that the reclining chair **110** according to the present invention provides a structure wherein the center of gravity of the moving body-supporting unit **120**, when it is adjacent the upright sitting position, is forwardly of the point in space about which that moving system rotates. Accordingly, there is a natural tendency for the unoccupied chair to assume its upright sitting position. Specifically, there is a tendency, under the force of gravity, for the seat **122** and back-rest **124** to fall downwardly into the upright sitting position with the front guide link **136** and the holding link **154** rotating forwardly and downwardly under the influence of gravity. Furthermore, the leg-rest linkage **130** provided in association with the chair **110** is such that the leg-rest **126** also demonstrates a tendency to fall into its completely collapsed position. Furthermore, due to the mechanical advantage which is achieved by the relatively long lever arm of the back-rest **124** about the back-rest pivot **148** and the arrangement of the point application of the lever force at the seat-back-rest pivot **142**, it is relatively easy for a chair occupant to overcome the gravity forces and to institute movement of the seat and back-rest unit **120** out of the upright sitting position and through the first and second movement phases.

It should be noted that in both embodiments the action of the first holding link is such that it not only contributes to the upward movement of the seat initially and the consequent tendency of the chair to stay closed, i.e., in the upright sitting position, but it also produces the desired initial tilting of the back-rest which provides the

lever effect used by the occupant to overcome the aforesaid tendency of the chair to stay closed. Thus, the arrangement of the holding link produces both of the desired results, results which appear at first to be the antithesis of each other, i.e., the tendency of the body-supporting unit to always move into the closed position and ease to chair occupant to move the body-supporting unit out of the closed position.

Likewise, it should be noted that the arrangement of the leg-rest mounting linkages in each of the two embodiments produces the tendency of the leg-rests to assume their retracted positions. It will be seen in FIG. 1 that the leg-rest link **76** is lifted by the seat as the link **76** swings forwardly. At the same time the first holding link **54** swings in such a manner that pivot **73** at the lower end of extension **72** swings downwardly and forwardly initially. Thus, the connecting link **74** acts to lift the leg-rest as the latter swings forwardly.

In a similar manner the leg-rest links **176** and **186** of chair **110** in FIGS. 4, 5 and 6 act to guide link **180** in such a manner that the leg-rest **126** is moved upwardly initially as it is actuated. Because pivots **188** and **189** on link **186** are more or less in line with pivot **177** between link **176** and the seat strap **122***a*, pivot **188** (which is also on link **180**) moves downward faster than the middle pivot **182** on link **180**. Thus, the front pivot **184** on link **180** is lifted slightly to produce the desired effect on the leg-rest **126** during its initial movement out of its retracted position.

Although only two embodiments of the present invention have been specifically described above and illustrated in the drawings, numbers of design changes may be made which do not depart from the basic teachings of the present invention. Therefore, the following claims should be construed broadly and in a manner consistent with the scope of the teachings of the invention.

What I claim is:

1. In a reclining chair having an arm frame, a body-supporting unit including a pivotally interconnected seat and back-rest, a mounting linkage mounting said body-supporting unit for movement through a first movement phase from an upright sitting position to an intermediate, tilted sitting position with the angle between said seat and back-rest remaining substantially constant and then through a second movement phase to a fully reclined position with the angle between said seat and back-rest increasing, said mounting linkage including a carrier link pivotally mounted on said arm frame and stationary during said first movement phase and pivoting upwardly during said second movement phase, the improvement comprising a sequencing link for blocking movement of said carrier link and maintaining the angle between said seat and back-rest substantially constant during said first movement phase, said sequencing link comprising a link secured to said arm frame at a sequencing pivot, lost motion means interconnecting said sequencing link and said carrier link, said sequencing link blocking movement of said pivotal interconnection out of its position coaxial with sad sequencing pivot until the completion of said first movement phase.

2. In a reclining chair having an arm frame, a body-supporting unit including a pivotally interconnected seat and back-rest, a mounting linkage mounting said body-supporting unit for movement through a first movement phase from an upright sitting position to an intermediate, tilted sitting position with the angle between said seat and back-rest remaining substantially constant and then through a second movement phase to a fully reclined position with the angle between said seat and back-rest increasing, a leg-rest and leg-rest mounting and guiding linkage for moving said leg-rest in response to movement of said seat and back-rest, said mounting linkage including a carrier link pivotally mounted on said arm frame and stationary during said first movement phase and pivoting upwardly during said second movement phase, and a guide link pivoted to said carrier link and to said body-supporting means guiding said body-supporting means for movement relative to said carrier link during said first movement phase and movable upwardly with said carrier means during said second movement phase, the improvement comprising a sequencing link for blocking movement of said carrier link and maintaining the angle between said seat and back-rest substantially constant during said first movement phase, said sequencing link comprising a link secured to said arm frame at a sequencing pivot, said sequencing pivot being substantially coaxial with the pivotal interconnection of said carrier link and said guide link durng said first movement phase, and lost motion means interconnecting said sequencing link and said guide link operable during said second movement phase and inoperable during said first movement phase for blocking movement of said pivotal interconnection out of its position coaxial with said sequencing pivot until the completion of said first movement phase.

3. In a reclining chair having an arm frame, a body-supporting unit including a pivotally interconnected seat and back-rest, a mounting linkage mounting said body-supporting unit for movement through a first movement phase from an upright sitting position to an intermediate, tilted sitting position with the angle between said seat and back-rest remaining substantially constant and then through a second movement phase to a fully reclined position with the angle between said seat and back-rest increasing, a leg-rest and leg-rest mounting and guiding linkage for moving said leg-rest in response to movement of said seat and back-rest, said mounting linkage including a carrier link pivotally mounted on said arm frame and stationary during said first movement phase and pivoting upwardly during said second movement phase, and a guide link pivoted to said carrier link and to said body-supporting means guiding said body-supporting means for movement relative to said carrier link during said first movement phase and movable upwardly with said carrier means during said second movement phase, the improvement comprising a sequencing link for blocking movement of said carrier link and maintaining the angle between said seat and back-rest substantially constant during said first movement phase, said sequencing link comprising a link secured to said arm frame at a sequencing pivot and having formed therein an elongated slot, said sequencing pivot being substantially coaxial with the pivotal interconnection of said carrier link and said guide link during said first movement phase, said guide link having a fixed pin therein engaged within said slot of said sequencing link at the end of said slot closest to said sequencing pivot, said sequencing link blocking movement of said pivotal interconnection out of its position coaxial with said sequencing pivot until the completion of said first movement phase.

4. In a reclining chair having an arm frame, a body-supporting unit including a pivotally interconnected seat and back-rest, a control linkage mounting said body-supporting unit for movement through a first movement phase from an upright sitting position to an intermediate, tilted sitting position with the angle between said seat and back-rest remaining substantially constant and then through a second movement phase to a fully reclined position with the angle between said seat and back-rest increasing, a leg-rest and leg-rest mounting and guiding linkage for moving said leg-rest in response to movement of said seat and back-rest, said control linkage including a carrier link pivotally mounted on said arm frame and having a stationary position relative to said arm frame and being movable out of said stationary position about its pivotal mount, a guide link pivoted to said carrier link and to said body-supporting means for guiding said body-supporting means for movement relative to said carrier link, a pin on said guide link of said control linkage having a first motion along one path when said body-supporting

nit is moved in said first movement phase and a second notion along a different path when said body-supporting nit is moved in said second movement phase, a sequencng link pivotally connected to said guide link at said in and to said support at a sequencing pivot to guide aid pin in an arc of said first path, and a lost motion neans in one of said sequencing link pivotal connections o allow said pin to move in said second path, said sequencing link blocking movement of said carrier link and naintaining the angle between said seat and back-rest substantially constant during said first movement phase, said sequencing pivot being substantially coaxial with the pivotal interconnection of said carrier link and said guide link when said carrier link is in its stationary position.

5. In a reclining chair having an arm frame, a body-supporting unit including a pivotally interconnected seat and back-rest, a mounting linkage mounting said body-supporting unit for movement through a first movement phase from an upright sitting position to an intermediate, tilted sitting position with the angle between said seat and back-rest remaining substantially constant, then through a second movement phase to a fully reclined position with the angle between said seat and back-rest increasing, a leg-rest and leg-rest mounting and guiding linkage for moving said leg-rest in response to movement of said seat and back-rest, said mounting linkage including a carrier link pivotally mounted at its rear end on said arm frame, means for supporting said carrier link in a stationary position relative on said arm frame, said carrier link being pivotable out of said stationary position about its pivotal mount, a guide link pivoted to the forward end of said carrier link and to said body-supporting means for guiding said body-supporting means for movement relative to said carrier link, the improvement comprising a sequencing link for blocking movement of said carrier link and maintaining the angle between said seat and back-rest substantially constant during said first movement phase,

when said chair is in its upright sitting position, said sequencing link being secured at its upper end to said arm frame at a sequencing pivot, the other end of said sequencing link having formed therein an elongated slot, said guide link having a downward extension, a pin mounted at the lower end of said downward extension, said pin being engaged in said elongated slot, said pin on said guide link having a first path of motion along one path for guiding said chair in said first movement phase, said pin on said guide link having a second path of motion for guiding said chair in said second movement phase, said slot in said sequencing link allowing said pivot to move in said second path during said second movement phase, said sequencing pivot being substantially coaxial with the pivotal interconnection of said carrier link and said guide link when said carrier link is in its stationary position, said pin being engaged in the end of said slot closest to said sequencing pivot during said first movement phase, said sequencing link blocking movement of said pivotal interconnection between said carrier link and said guide link out of its position coaxial with said sequencing pivot until the completion of said first movement phase.

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