Sept. 20, 1960 F. F. SCHLIEPHACKE 2,953,193

CHAIR WITH ADJUSTABLE BACK-REST

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FIG. 1.

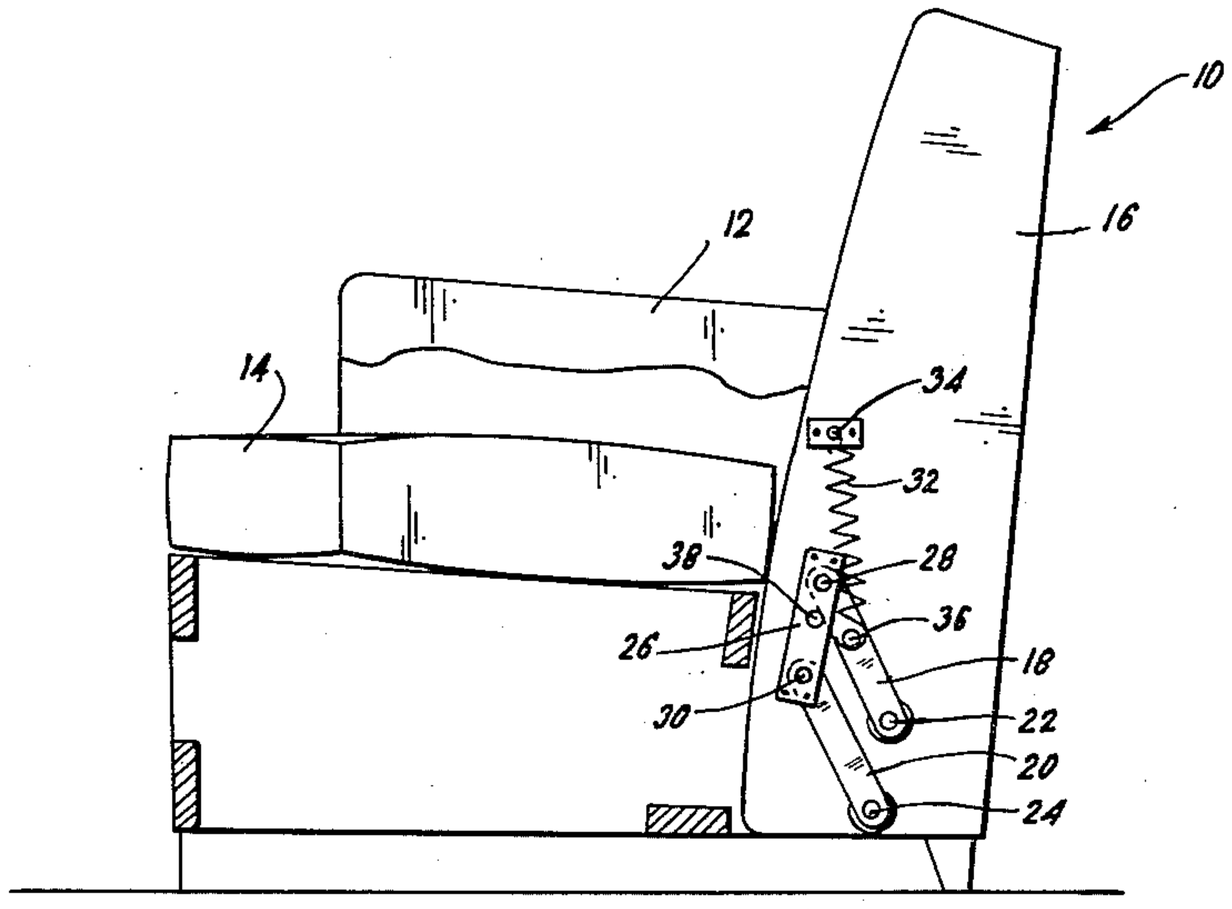
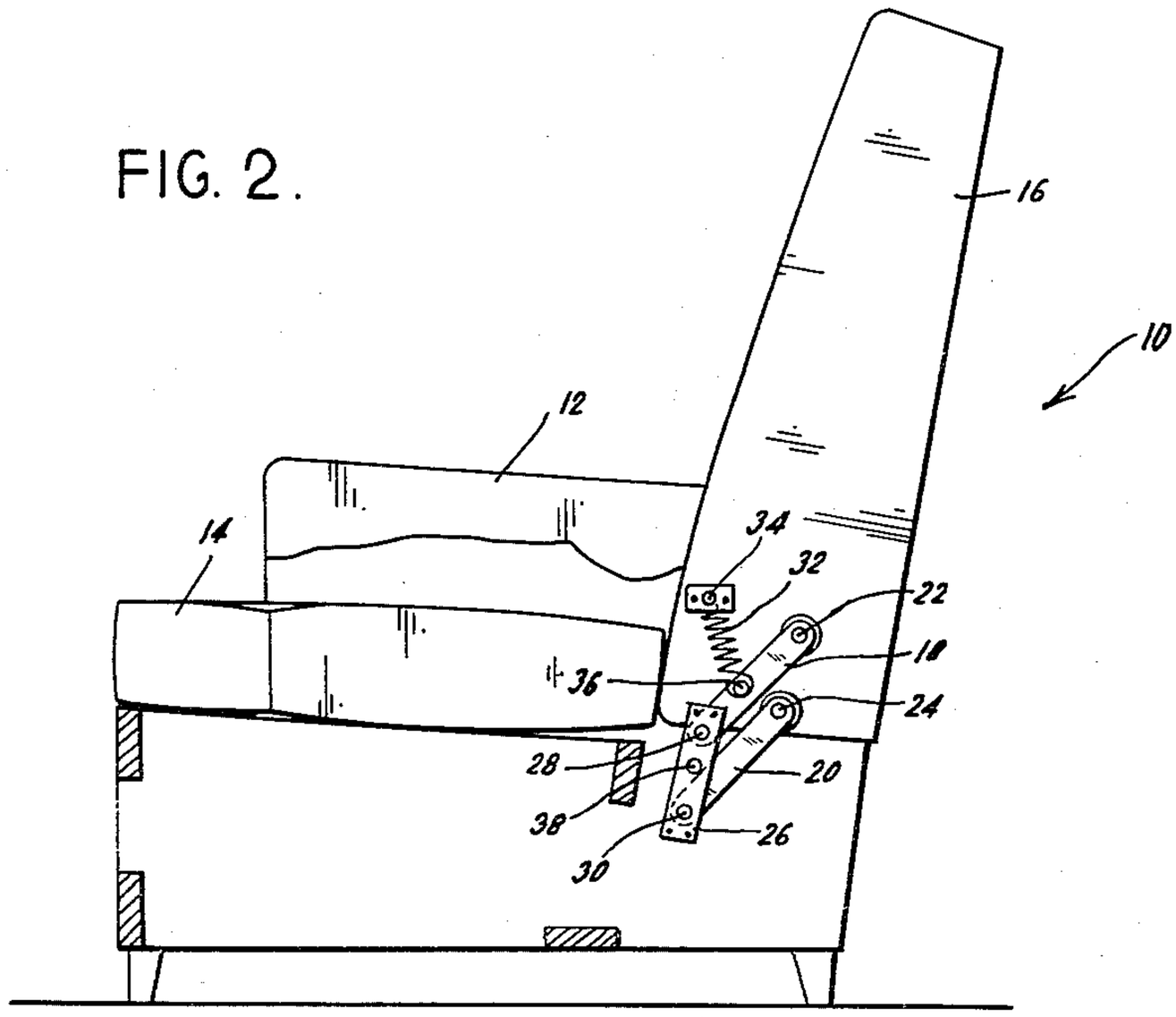


FIG. 2.



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CHAIR WITH ADJUSTABLE BACK-REST

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FIG. 3.

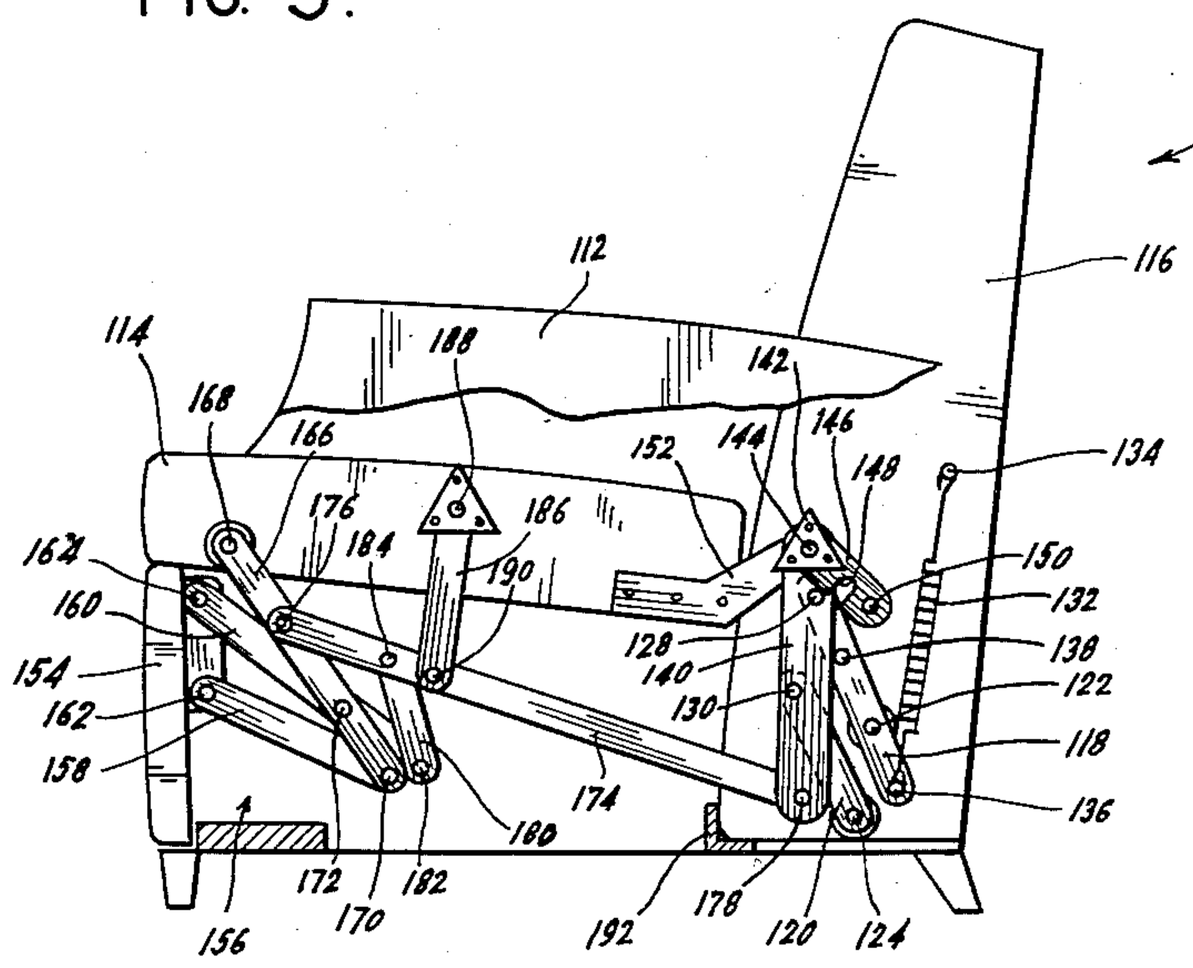
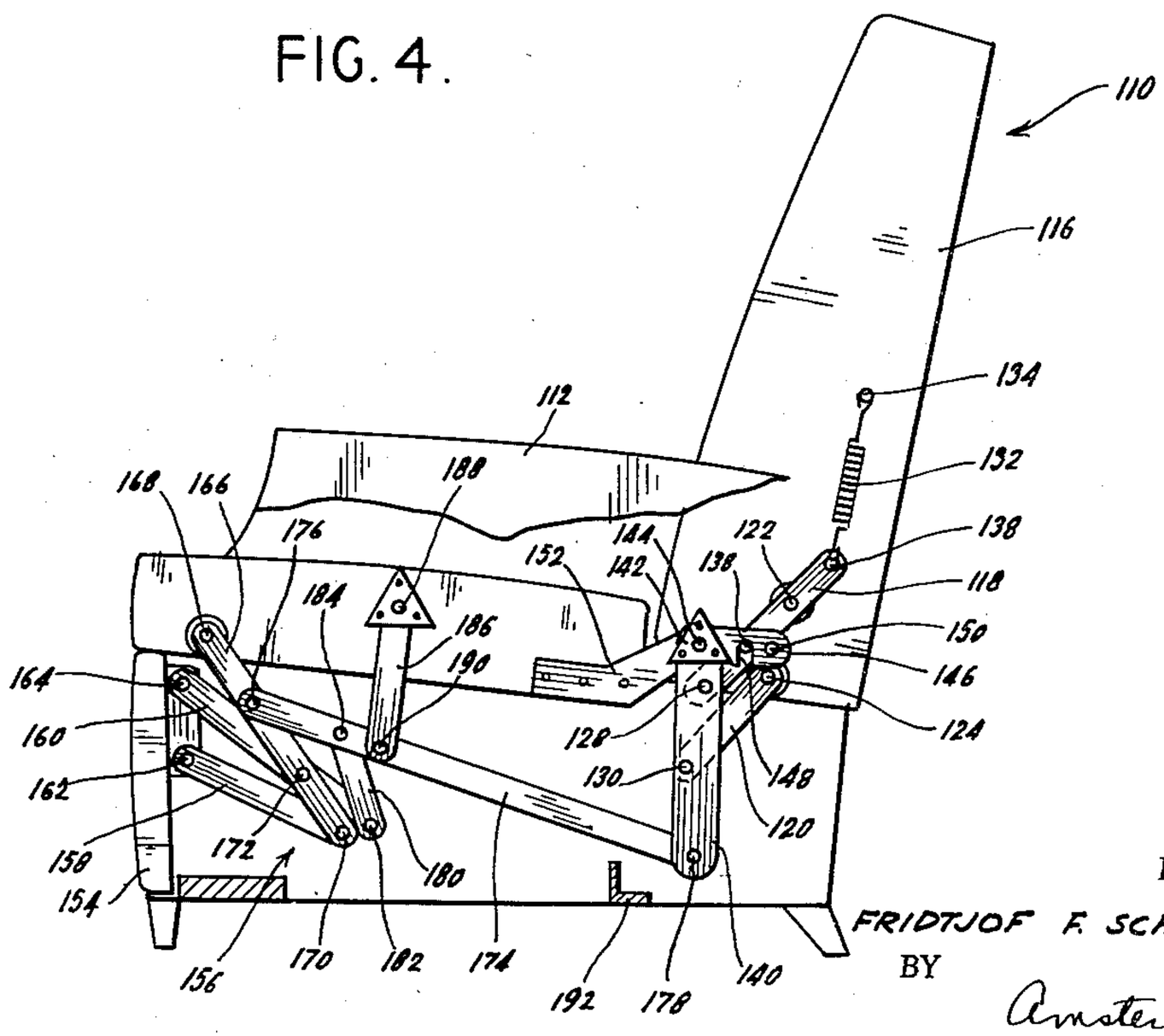


FIG. 4.



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CHAIR WITH ADJUSTABLE BACK-REST

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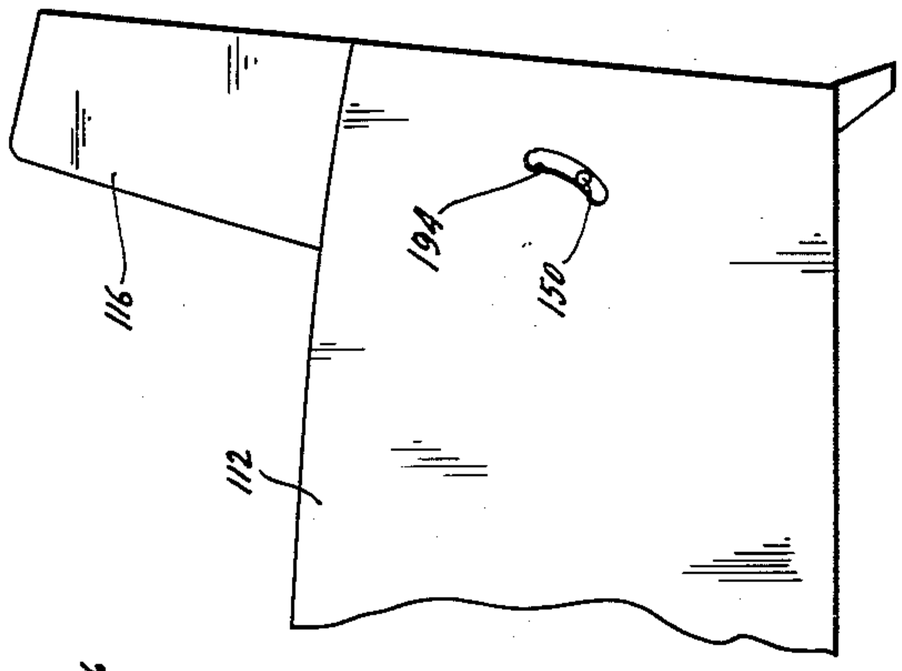

FIG. 6.

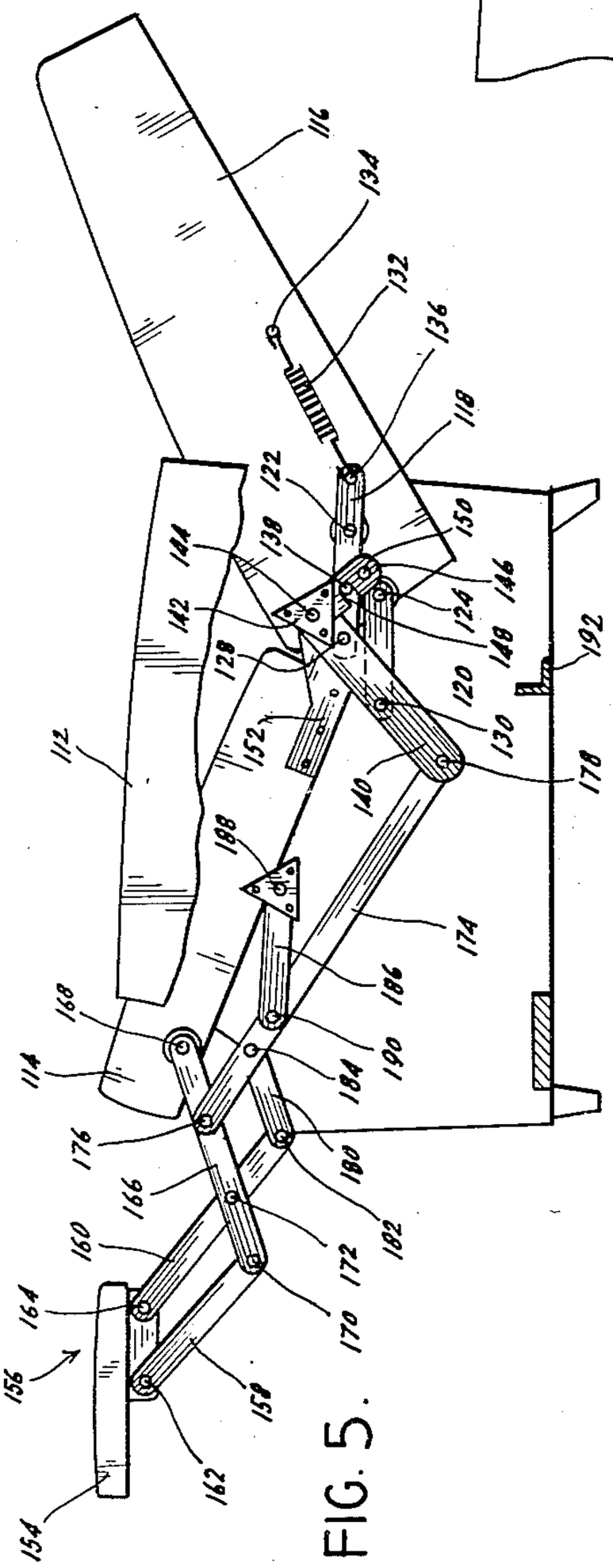

FIG. 5.

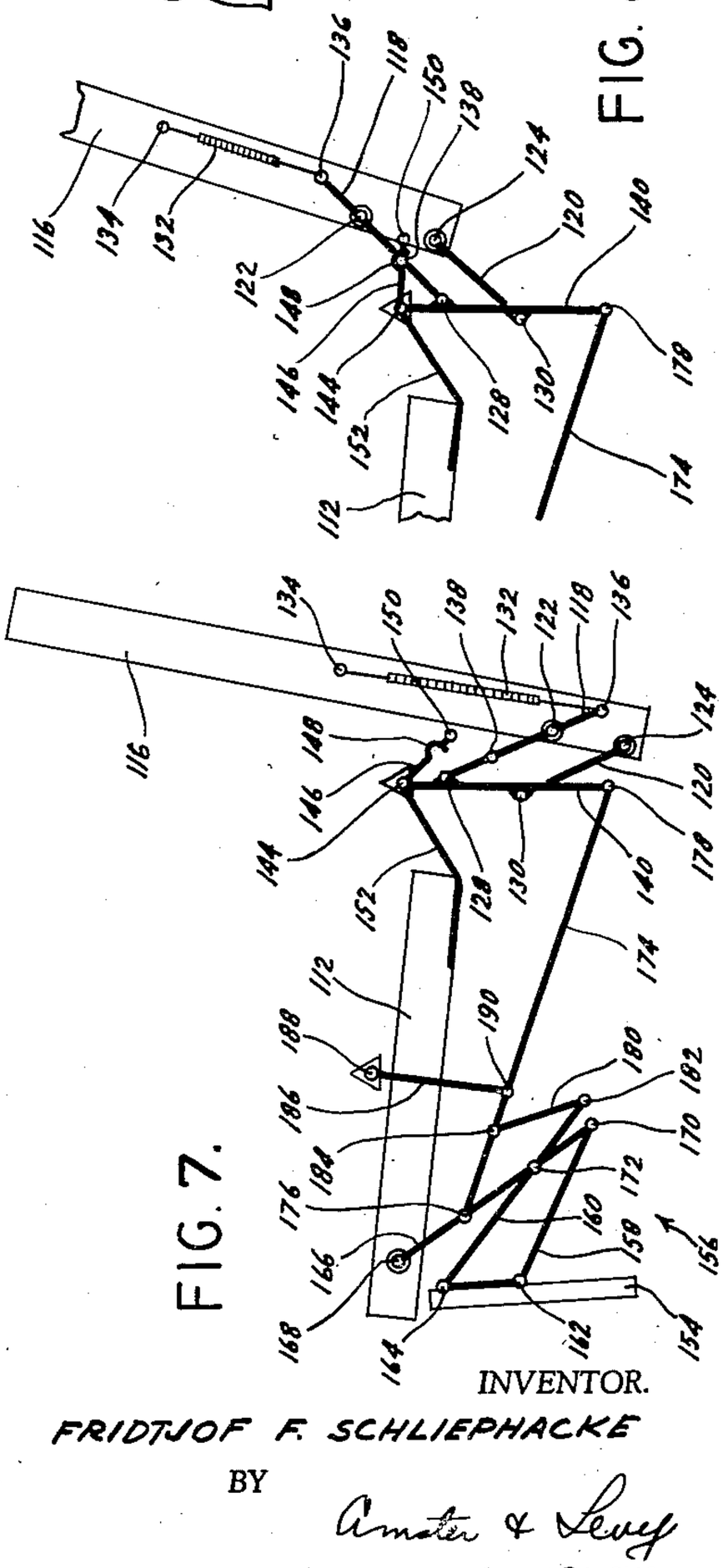

FIG. 7.

FIG. 8.

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FIG. 9.

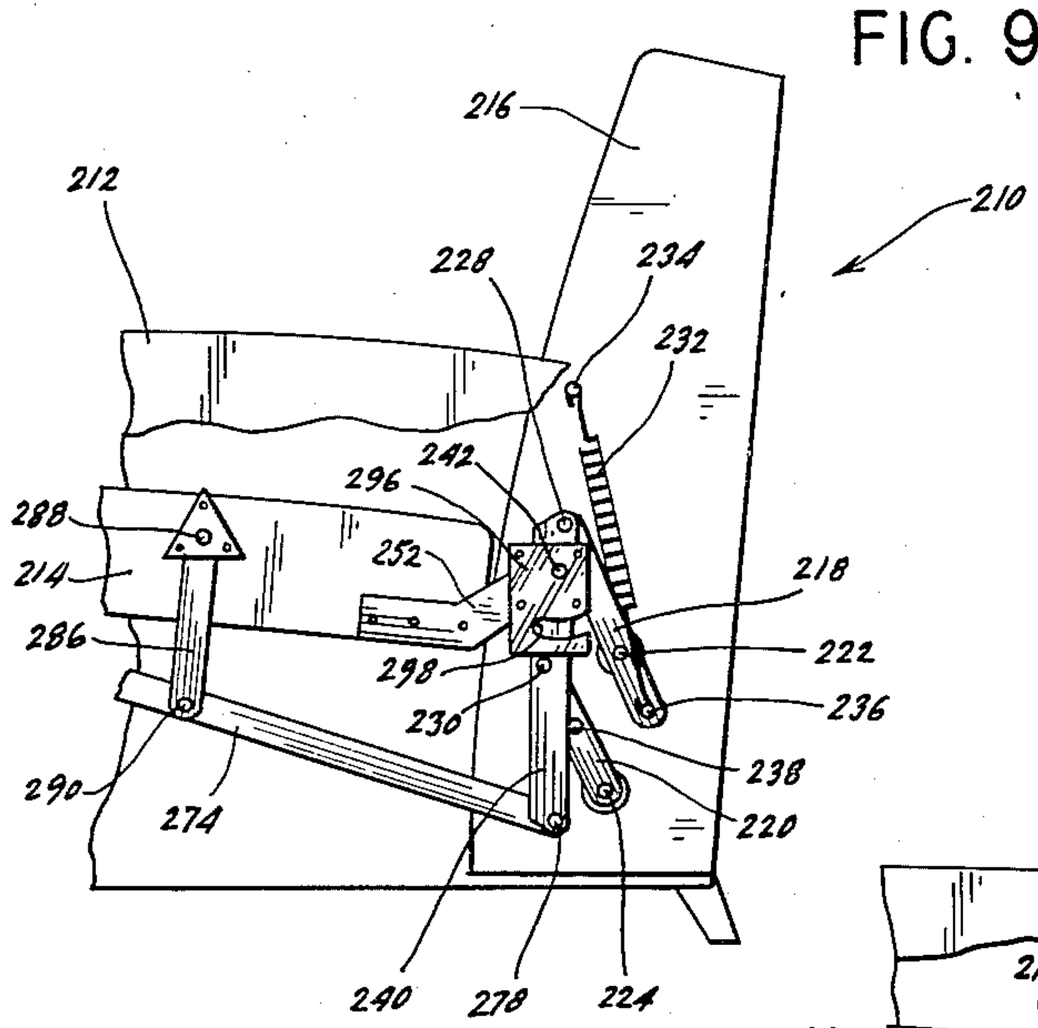


FIG. 10.

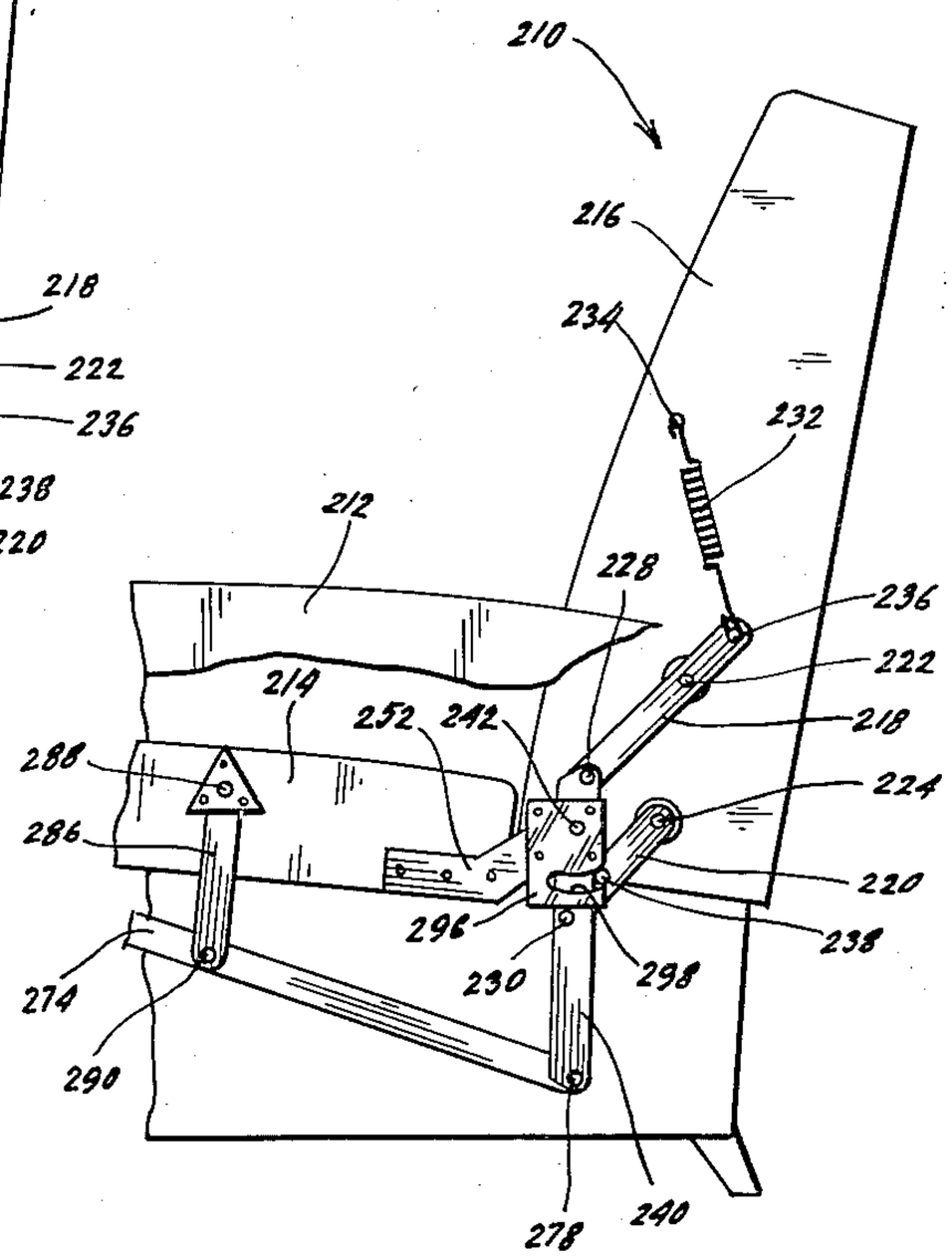
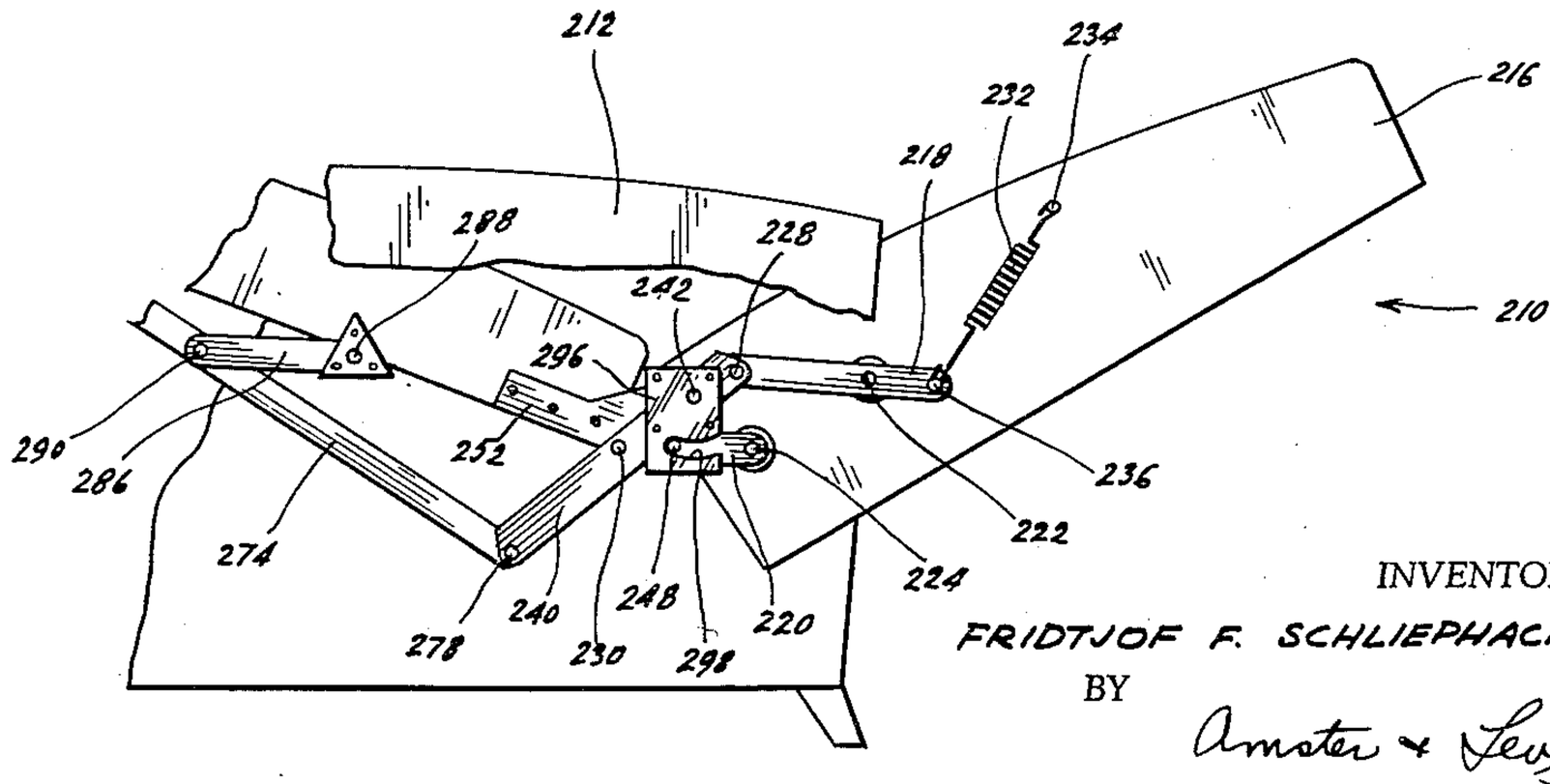


FIG. 11.



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CHAIR WITH ADJUSTABLE BACK-REST

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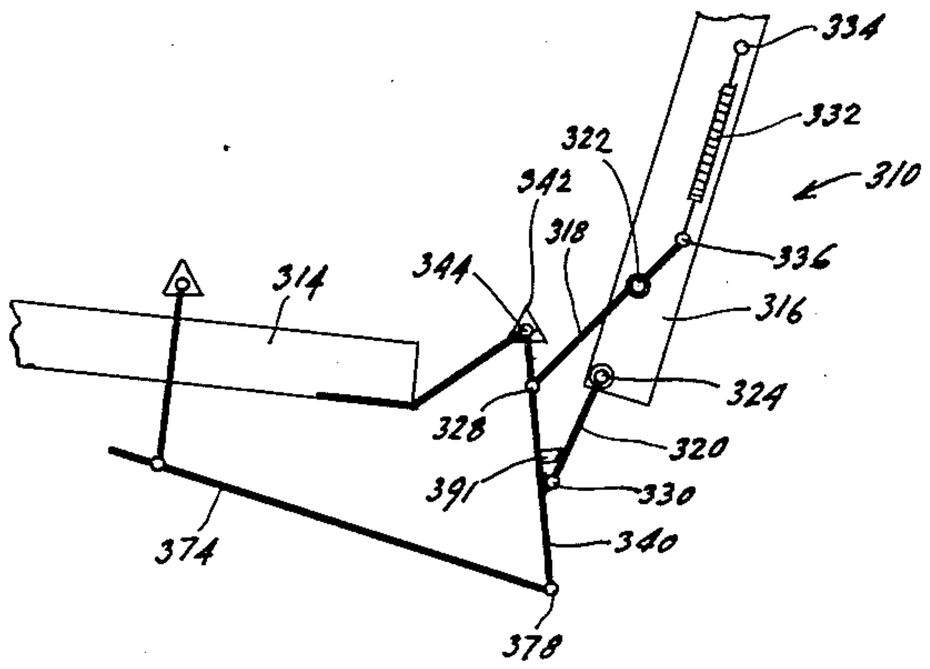

FIG. 13.

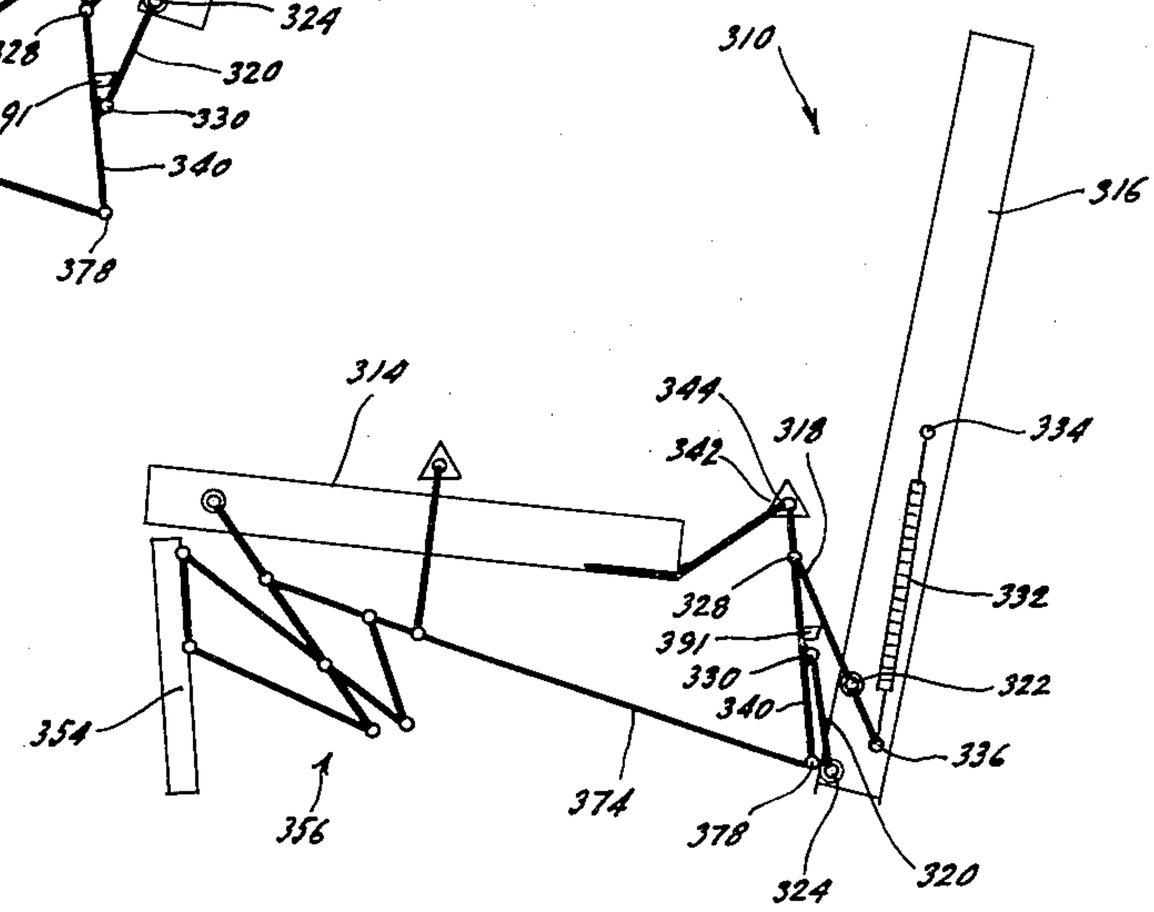

FIG. 12.

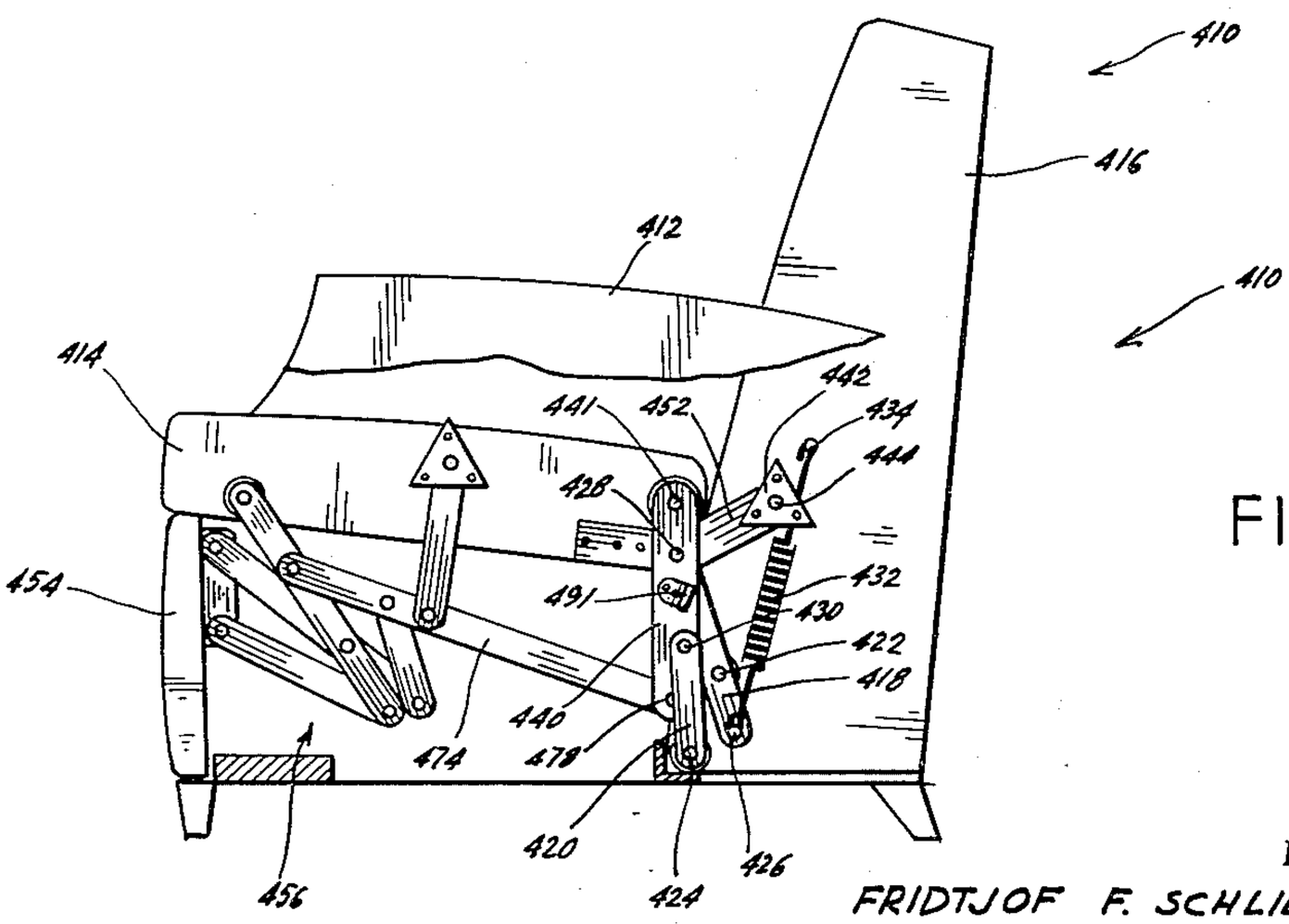

FIG. 14.

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FIG. 16.

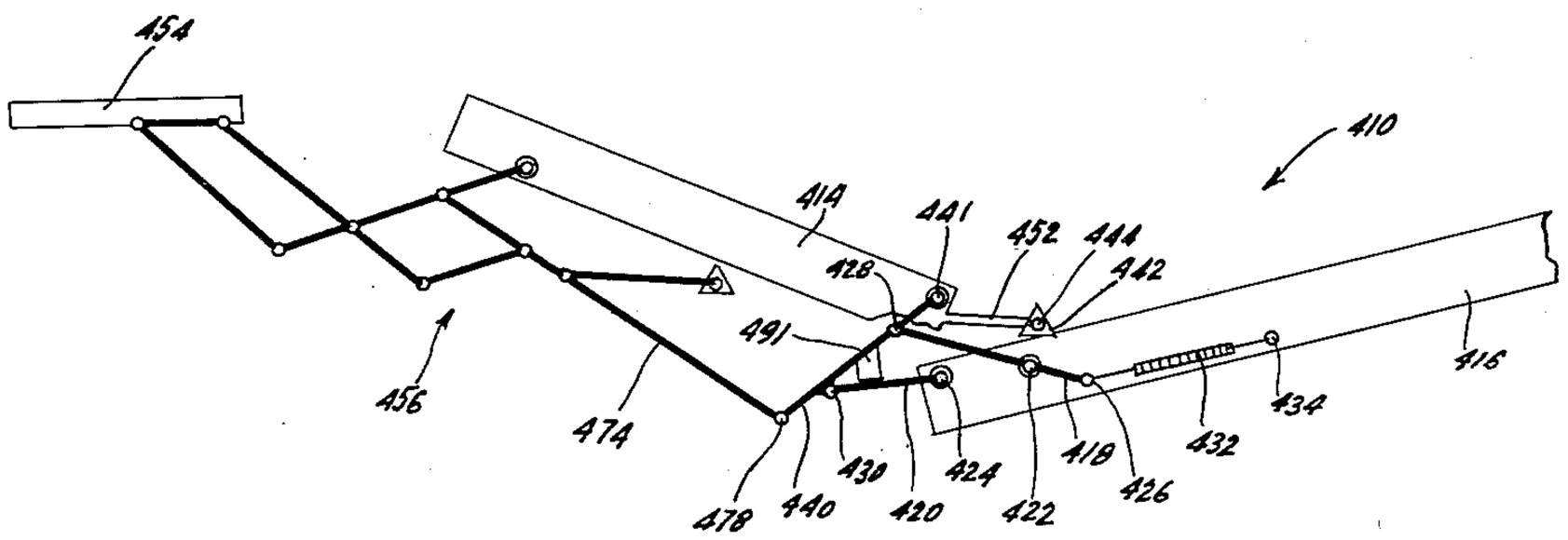
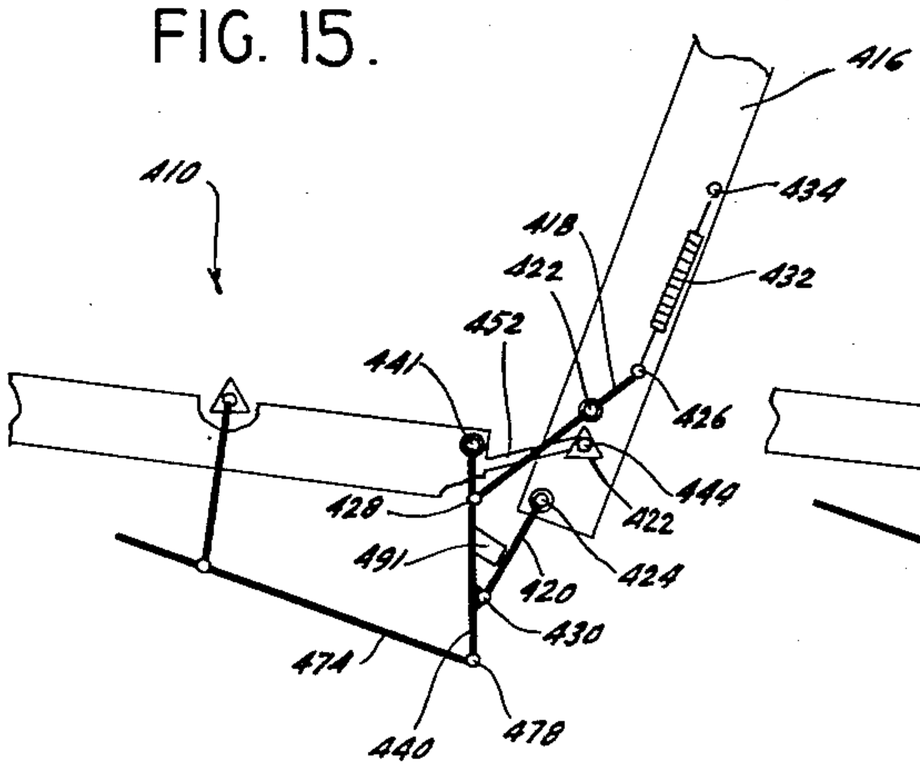


FIG. 15.



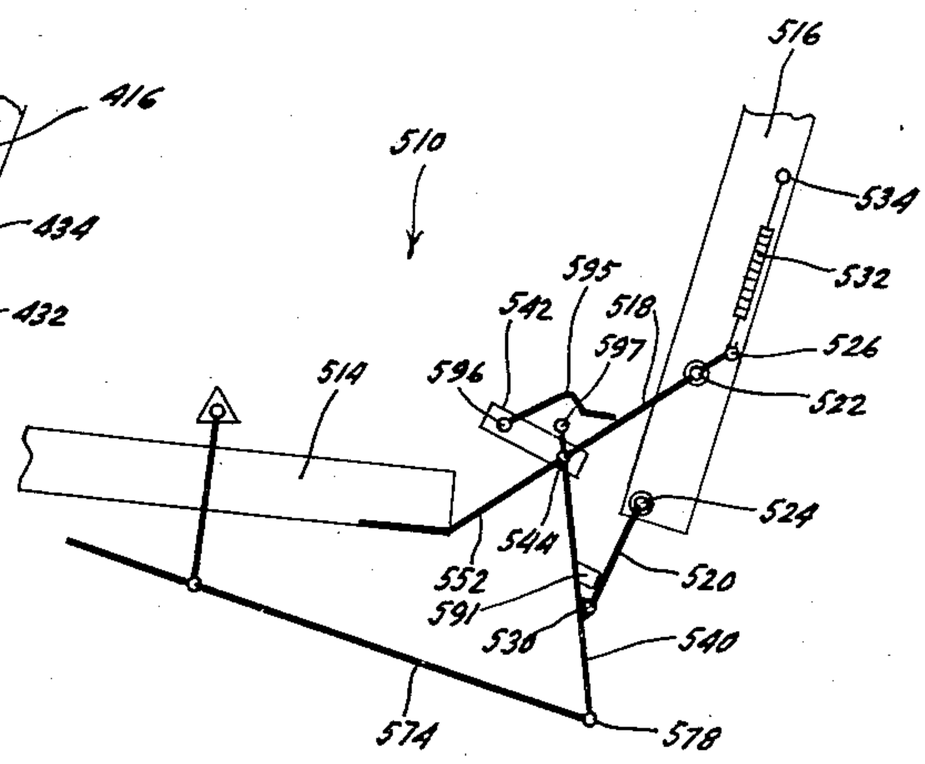


FIG. 18.

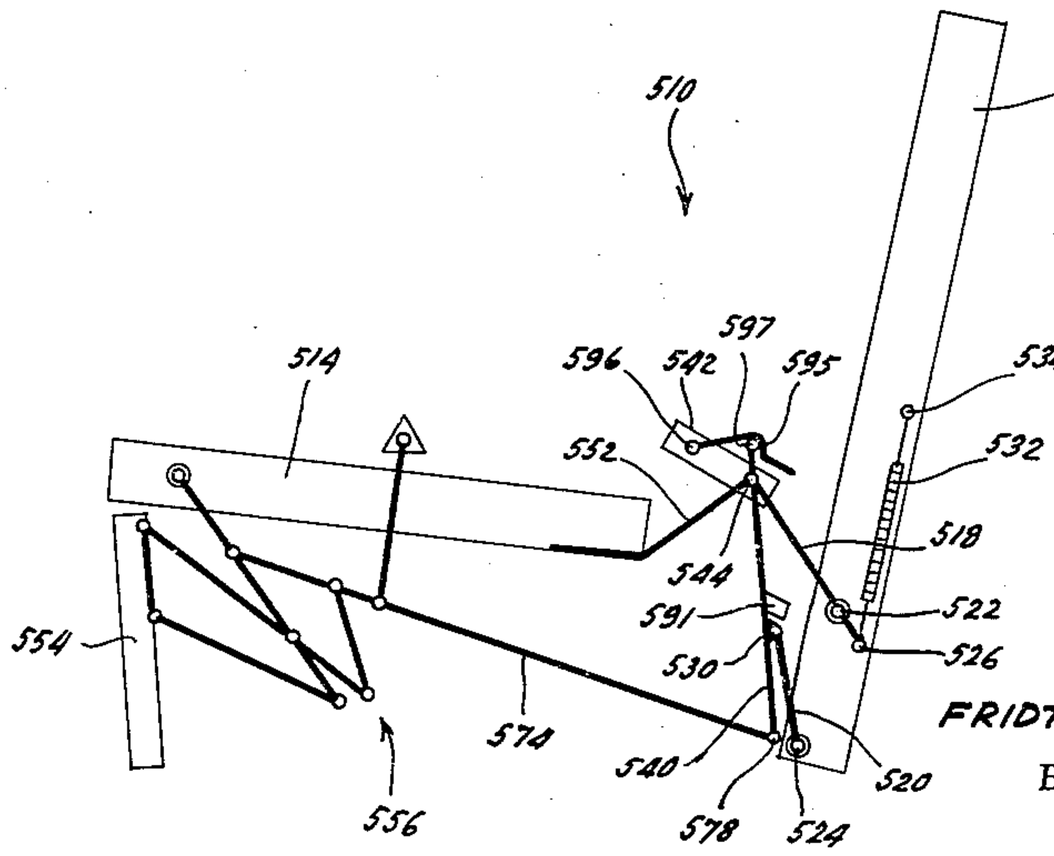


FIG. 17.

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United States Patent Office

2,953,193

Patented Sept. 20, 1960

2,953,193

CHAIR WITH ADJUSTABLE BACK-REST

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Filed July 1, 1957, Ser. No. 668,991

7 Claims. (Cl. 155—106)

The present invention relates generally to articles of furniture, and in particular to an improved chair incorporating a back-rest which may be adjusted upwardly and downwardly relative to the seat of the chair.

Quite often the aesthetic and functional requirements for a chair are antagonistic. Illustrative of this problem is the difficulty of styling a chair with a high back-rest to conform with and adapt to the present-day tendency for streamlined, low-backed chairs. From the standpoint of comfort, a chair is far more acceptable if the back-rest is high enough to support the entire back, shoulders and head of the person seated in the chair. Further to this end, it has been suggested that a head-rest be provided on the back-rest to provide a support for the head of the occupant of the chair. However difficulty is encountered in attempting to reconcile these functional requirements to the styling and proportioning of a chair which appear to require that the chair be no higher than the shoulder portion of the occupant.

It is an object of the present invention to provide a chair assembly including a movable back-rest, which back-rest is made of a sufficiently long size so that it may support the head of a person leaning thereagainst when in an extended raised position, but which is capable of being lowered into a retracted position relative to the chair structure. In the retracted position of the back-rest, the lower portion of the back-rest is sunk into the chair structure so that it presents with the seat an aesthetic chair assembly which conforms to present-day style requirements.

Another object of the invention is the provision of a chair assembly of the character described in which a simple linkage arrangement is utilized for guiding the back-rest between its raised position and its lowered position, the movement of the back-rest being therefore effected in a simple and economical manner. The linkage arrangement presents a self-balancing structure whereby the back-rest is retained in its raised and lowered positions, and so that only a slight manual effort is required to raise or lower said back-rest when desired.

In accordance with the invention, the vertically-movable back-rest may be incorporated in a reclining chair of the type in which the back-rest and seat are both capable of being pivoted or tilted rearwardly to a reclining position, and in addition in which a movable leg-rest is coordinated with the rearward pivoting movement of the back-rest and seat.

It is another object of the invention to provide in a reclining chair of the type described, a back-rest which is mounted for movement between a lowered retracted position, and a raised, extended position, the back-rest being locked against the rearward pivoting movement in its lowered, retracted position, and being capable of rearward pivoting or tilting only in its raised, extended position. In this construction, means are provided to lock the back-rest in its raised, extended position with the leg-rest control linkage, so that rearward pivoting or tilting

movement of the back-rest will cause coordinated movement of the leg-rest and seat.

Additional objects and advantages of the invention will become apparent during the course of the following specification when taken in connection with the accompanying drawings in which:

Fig. 1 is an elevational view of a chair of the non-reclining type incorporating improved linkage means for raising and lowering the back-rest relative to the seat and the remainder of the chair structure, the back-rest being shown in its lowered, retracted position and a portion of the chair being broken away for clarity of illustration;

Fig. 2 is an elevational view of the chair shown in Fig. 1, with the back-rest shown in its raised or extended position;

Fig. 3 is an elevational view showing the invention applied to a reclining chair of the type in which the seat and back-rest are mounted for rearward pivoting or tilting movement, and in which a leg-rest is mounted for coordinated movement in response to rearward pivoting movement of the back-rest, the back-rest being shown in its lowered, retracted position in which it is locked from rearward pivoting movements, and portions of the chair structure being broken away to reveal inner structural details;

Fig. 4 is an elevational view of the chair shown in Fig. 3, with the back-rest shown in its raised, extended position in which it is locked with the controlling linkage of the leg-rest;

Fig. 5 is an elevational view of the chair shown in Fig. 4, showing the back-rest in its rearwardly pivoted or tilted position in which the leg-rest is extended;

Fig. 6 is an elevational view of the outer rear portion of the chair shown in Figs. 3–5, illustrating a guiding slot in the fixed chair structure which guides and permits movement of the linkage arrangement, the back-rest being shown in its lowered, retracted position in this view;

Fig. 7 is a diagrammatic view showing the linkage arrangement of the reclining chair illustrated in Figs. 3, 4, 5 and 6, the linkage arrangement in this view being in the position shown in Fig. 3 with the back-rest locked in its lowered, retracted position;

Fig. 8 is a diagrammatic view of the rear portion of the linkage system, corresponding to the position shown in Fig. 4 with the back-rest in its raised, extended position, but not rearwardly pivoted;

Fig. 9 is an elevational view, partially broken away, of a reclining chair of the type shown in Fig. 3, but including a modified type of arrangement for locking the back-rest in its lowered position, the back-rest in this view being shown in its lowered, retracted position;

Fig. 10 is an elevational view of the rear portion of the chair shown in Fig. 9 but with the back-rest shown in its raised, extended position;

Fig. 11 is an elevational view of the rear portion of the chair shown in Figs. 9 and 10, with the back-rest shown in its rearwardly pivoted or tilted position;

Fig. 12 is a diagrammatic view of a modified type of linkage arrangement in a reclining chair of the type shown in Fig. 3, the back-rest in this view being shown in its lowered position;

Fig. 13 is a diagrammatic view of the rear portion of the linkage system illustrated in Fig. 12, with the back-rest shown in its raised position;

Fig. 14 is an elevational view of a reclining chair which includes a modified type of linkage structure for raising and lowering the back-rest as well as for locking the back-rest in its lowered position and connecting the back-rest to the leg-rest control linkage in its raised position, the back-rest in this view being shown in its lowered position;

Fig. 15 is a diagrammatic view of the rear portion of the linkage arrangement shown in the chair of Fig. 14, with the back-rest being shown in its raised, extended position;

Fig. 16 is a diagrammatic view of the linkage arrangement of the chair shown in Fig. 14, the back-rest in this view being shown in its rearwardly pivoted or tilted position;

Fig. 17 is a diagrammatic view of a modified type of linkage arrangement used for raising and lowering the back-rest of a reclining chair, the back-rest being shown in its lowered position;

Fig. 18 is a diagrammatic view of the rear portion of the linkage shown in Fig. 17, with the back-rest shown in this view in its raised, extended position.

Referring now in detail to the drawings and specifically to Figs. 1 and 2, there is shown a chair designated generally by the reference numeral **10**, in which the seat is made an immovable part of the fixed chair structure, and in which the back-rest is mounted for substantially vertical movement relative to the chair structure including the seat. The chair **10** includes a supporting frame **12** on which a seat **14** is immovably mounted and is therefore positioned at a fixed level above the floor surface. A back-rest **16** is mounted on the support frame **12** for movement in a substantially vertical direction relative to the support frame and to said seat **14**. The means for mounting the back-rest **16** on the support frame **12** includes a pair of parallel links **18** and **20** which are pivotally connected to the lower portion of the back-rest **16** at spaced points by a respective pair of pivots **22** and **24**. The opposite ends of the links **18** and **20** are connected to a fixed portion **26** of the support frame **12** by a respective pair of spaced pivots **28** and **30**. A coiled tension spring **32** is mounted at one end to a fixed portion **34** of the support frame **12**, and is mounted at its other end on a pin **36** which is fixed intermediate the end of the upper link **18**.

A stop member **38** is fixedly secured to the support frame portion **26** between the pivot **28** and **30**. This stop member **38** is adapted to limit the upward and downward movement of the back-rest **16**, as will be presently explained in greater detail.

In the lowered or retracted position of the back-rest **16**, shown in Fig. 1, the lower portion of the back-rest is sunk within the body of the chair support structure and the top of the back-rest **16** is located only a short distance above the level of the seat **14**. In this retracted position of the back-rest, the top of the back-rest **16** would be located substantially at the level of the shoulders of a person seated in the chair, and is therefore in accordance with the present-day style of chairs. In this position, the bottom of the back-rest **16** is substantially at the level of the bottom of the support frame **12**, and the links **18** and **20** extend downwardly and rearwardly from the support frame portion **26**. The spring **32** is so mounted that in this retracted position of the back-rest, the spring is substantially aligned with the axis of the upper link **18** to which it is attached, the spring **32** being thus in a dead center position and being ineffective to pivot the link **18** upwardly about its pivot **28**.

When it is desired to move the backrest **16** to its raised, extended position, it is merely necessary for the user to lift manually at the top of said back-rest. Such lifting movement will cause the links **18** and **20** to pivot upwardly about their respective pivots **28** and **30**, said links **18** and **20** guiding the back-rest **16** in a substantially vertical direction. The back-rest is lifted until the link **18** has pivoted upwardly past the aforementioned dead center position, and approaches a horizontal position, at which time the spring **32** becomes effective to bias the link **18** upwardly at the fixed point **36**. Thus, by a slight manual upward lifting movement, the spring **32** raises the back-rest **16** during the rest of the vertical movement to its fully raised, extended position shown in Fig. 2.

In the raised position of the back-rest shown in Fig. 2, the lower portion of the back-rest **16** is brought to the level or above the level of the seat **14**, and the links **18** and **20** are inclined upwardly and rearwardly from the support frame portion **26**. In this position, the spring **32** through its fixed connection **36** biases the upper link **18** upwardly and forwardly and is effective to maintain the back-rest **16** in its raised position even when the weight of the user is directed against said back-rest. The top of the back-rest **16** is now located a substantial distance above the seat **14** and is at a level in which the head of the user may be rested thereagainst.

The fixed stop member **38** mounted on the support frame portion **26** is positioned to engage the lower edge of the uppermost link **18** in the lowered retracted position of the back-rest shown in Fig. 1, thereby limiting further downward movement of said back-rest past its fully retracted position. In addition, the stop member **38** also engages the upper edge of the lowermost link **20** in the raised, extended position of the back-rest **16**, as shown in Fig. 2, thereby also acting as a stop means to prevent further upward movement of the back-rest past its fully extended position.

It will be appreciated that the arrangement of the links **18** and **20** together with the spring **32** effects a self-locking of the back-rest **16** in both its lowered or retracted position and its raised or extended position. In the lowered position of the back-rest shown in Fig. 1, the spring **32**, being in its dead center position, presents no appreciable biasing force on the link **18** which would cause the link **18** to pivot upwardly. The back-rest **16**, therefore by its own weight, is maintained in its lowered position. In the raised position of the back-rest shown in Fig. 2, the spring **32** automatically presents a strong upward biasing force on the uppermost link **18** which retains the back-rest **16** in its raised position.

It will be observed that the linkage arrangement shown in Figs. 1 and 2 forms a four-bar linkage consisting of the links **18** and **20**, the portion of the back-rest **16** between the pivots **22** and **24**, and the portion of the support frame between the pivots **28** and **30**. While in the structure shown in Figs. 1 and 2, this four-bar linkage is in the form of a parallelogram, this linkage may assume other forms, as will be presently shown and described.

Figs. 3–8 show a linkage arrangement for raising and lowering the back-rest applied to a reclining chair in which the back-rest and the seat are movably mounted on the support for movement to a rearwardly tilted reclined position. This reclining chair includes a leg-rest and a leg-rest control linkage adapted to move the leg-rest between a retracted position beneath the forward end of the seat and an extended position located forwardly of and substantially at the level of the front of the seat. Means are provided to disengage the back-rest from the leg-rest control linkage when the back-rest is in its lowered position, and to lock the back-rest to the leg-rest control linkage when the back-rest is in its raised position; whereby rearward pivoting or tilting movement of the back-rest to its reclined position is translated into coordinated movement of the leg-rest through its control linkage.

In the embodiment shown in Figs. 3 through 8, those parts which are similar to the parts shown in the embodiments of Figs. 1 and 2 are given like reference numerals, except that they are a part of the "100" series.

Referring specifically to Fig. 3, the chair, indicated generally by reference numeral **110**, includes a support frame **112** upon which a seat **114** and a back-rest **116** are mounted. The seat **114** is mounted on the back-rest **116** by means of a bracket **152** which is pivoted to a fixed portion **142** of the support frame **112** by a pivot **144**.

A pair of links **118** and **120** are mounted at the lower end of the back-rest **116** at spaced points by respective

pivots **122** and **124**. The opposite end of the links **118** and **120** are pivotally connected at spaced apart points to an arm **140** at respective pivots **128** and **130**. The arm **140** is pivotally mounted on the support by the pivot **144**, and depends therefrom. Also mounted at one end on the pivot **144** is a coupling link **146** which has a pin or finger **150** at its opposite end, and a slot **148** intermediate its ends. The upper link **118** has a fixed pin **138** located between the pivots **128** and **122**, which pin **138** is positioned to enter the slot **148** of the coupling link **146** when the back-rest **116** is brought to its raised position, whereby the back-rest is pivotally coupled to the support for rearward tilting or pivoting movement, as will be presenting described in greater detail.

A tension spring **132** is mounted upon the back-rest **116** by means of a pin **134** which is fixed to said back-rest. The other end of the spring **132** is connected to a pin **136** rigidly mounted on the free end of the upper link **118** which extends beyond the pivot **122**.

It will be observed that in this embodiment, the spring **132** is arranged to present a biasing force constantly upon the end of the upper link **118** to pivot in a counter-clockwise direction about its pivot **122**. That is to say, the spring tension is constantly in a radial direction, and there is no dead-center position as in the embodiment of Figs. 1 and 2. However, spring **132** is not made strong enough to lift the back-rest **116**; it merely acts in this instance as a counter-balancing force which assists the user in raising the back-rest.

The chair **110** also includes a leg-rest **154** and a leg-rest control linkage **156** adapted to move the leg-rest from the retracted position shown in Fig. 3 to the extended position shown in Fig. 5, when the back-rest **116** is pivoted rearwardly to its reclined position. The leg-rest control linkage **156** includes a pair of links **158** and **160** which are connected at spaced apart points to the leg-rest **154** by respective pivots **162** and **164**. A link **166** is connected at one end to the seat **114** at pivot **168**, and at its other end is connected by pivot **170** to the free end of link **158**. An intermediate portion of the link **166** crosses an intermediate portion of the link **160** and is connected thereto at the crossing point by a pivot **172**.

Movement of the leg-rest control linkage is effected by means of a drive or actuating link **174**, the forward end of which is connected to the link **166** by pivot **176**. The opposite end of the drive link **174** is connected to the lower end of the arm **140** at pivot **178**. A link **180** connects an intermediate portion of the drive link **174** to the free end of the leg-rest link **160**, being pivotally connected to drive link **174** by pivot **184** at one end, and at the other end being pivotally connected to the free end of link **160** by pivot **182**. A control link **186** is mounted at its top end on the support by a pivot **188**, the bottom end of the control link **186** being connected by pivot **190** to the drive link **174** at a point spaced rearwardly from the pivot **184**.

In the lowered position of the back-rest **116**, the bottom portion of the back-rest is located well below the level of the seat **114**. The forward corner of the back-rest **116** is seated against a stop member in the form of an angle bracket **192**, which acts as stop means to prevent the back-rest **116** from being rearwardly pivoted in its lowered position. As shown in Fig. 3, the back-rest connecting links **118** and **120** are downwardly and rearwardly inclined and the spring **130** is tensioned. The back-rest **116** is maintained in its lowered position by its own weight. Further, the back-rest **116** is connected to the support **112** only by means of the connecting links **118** and **120** through the pivotal connection of the latter with the arm **140** which is swingably mounted on the support portion **142**. The back-rest **116** may therefore be raised relative to the support.

In raising the back-rest **116** to its raised, extended position shown in Fig. 4, the user may again lift the back-rest, the counter-balancing force of the spring **132** aiding the user to raise the back-rest to its fully extended position shown in Fig. 4.

As the back-rest **116** is raised, and the links **118** and **120** pivot upwardly about their respective pivots **128** and **130**, the pin **138** of the link **118** engages the rear end of the coupling link **146**, pivoting said coupling link **146** upwardly about the fixed pivot **144** until it reaches the horizontal position shown in Fig. 4, at which time, the pin **138** enters the slot **148** in said coupling link **146**. Engagement of the pin **138** with the slot **148** locks the link **118** rigidly to the arm **140**, that is to say there is formed a rigid linkage connection in triangular form consisting of the upper end of arm **140**, the lower end of link **118** and the forward end coupling link **146**. The back-rest **116** is therefore now pivotally coupled to the support **112** on pivot pin **144** and the arm **140** is now rigidly connected to and turnable with the back-rest **116**, functioning as a rigid extension thereof below the pivot **144**. The bottom end of the back-rest **116** is now located at or above the level of the seat **114**, and the back-rest is operatively connected to the seat control and leg-rest control linkage **156** for actuation of said linkage when the back-rest is pivoted rearwardly about the pivot **144**.

When a person seated in the chair leans rearwardly upon the raised, extended back-rest **116**, the back-rest pivots rearwardly about the fixed pivot **144** to the reclined position shown in Fig. 5. Since the arm **140** is rigidly coupled to the back-rest **116** by the coupling link **146** and the upper back-rest link **118**, the arm **140** moves with said back-rest and pivots about the fixed pivot **144** with its lower end moving forwardly, and thereby pushing the drive link **174** forwardly. The drive link **174** in moving forwardly is guided in its movement by guide link **186**, and causes the link **166** to pivot forwardly and upwardly about its pivot **168**. This movement of the link **166** causes the leg-rest **154** to be raised to its extended position shown in Fig. 5 in which it is spaced forwardly of and at the level of the front end of the seat **114**. At the same time, the link **166** also operates to raise the forward end of the seat **114** causing the seat to pivot upwardly in response to the rearward pivoting movement of the back-rest **116**.

To return the chair assembly from its reclined position to the upright position of Fig. 4, it is merely necessary for the user to shift his weight forwardly and to press downwardly with his legs upon the leg-rest **154**.

In the raised, extended position of the back-rest **116**, shown in Fig. 4, the back-rest **116** is rigidly locked in raised position by coupling link **146** and a manual adjustment is required for releasing the back-rest from this position. For this purpose, the side of the support frame **112** is provided with an arcuate slot **194**, shown in Fig. 6, through which the pin or finger **150** of the coupling link **146** extends. The slot **194** is shaped and made of sufficient length to allow pivoting movement of the coupling link **146** between the various positions of the chair assembly. The pin or finger **150** projects outwardly from the slot **194** so that it may be grasped by the user in order to release the back-rest **116** for movement downwardly to its retracted position of Fig. 3. In performing this latter operation, the user manually moves the finger **150** upwardly in the slot **194**, thereby lifting or pivoting the coupling link **146** until the pin **138** is free of the slot **148**. This unlocks the upper back-rest link **118** from the coupling link **146** and from the arm **140**, and permits the back-rest **116** to be pushed downwardly to its retracted position of Fig. 3.

Figs. 9, 10 and 11 show a similar reclining chair in which again a parallogram four-bar linkage is utilized for raising and lowering the back-rest, but in which a modified structure is provided for locking the extended back-rest to the leg-rest control linkage. Again similar reference numerals are used for like parts, these numerals being in the "200" series.

Referring specifically to Fig. 9, the chair **210** includes a support frame **212** on which a seat **214** and back-rest **216** are movably mounted. The seat **214** is connected through a bracket **252** to a plate **296** fixed to the support frame **212** by a main pivot **242**. Also mounted on the fixed pivot **242** is the vertically disposed arm **240**. A pair of parallel back-rest links **218** and **220** are connected at one end to the back-rest **216** by respective pivots **222** and **224** and at their opposite ends are connected to the arm **240** by pivots **230** and **228**. A tension spring **232** is connected at one end to the back-rest **216** at point **234** and at its other end is connected to the end of the upper link **218** beyond the pivot **222** by the fixed pin **236**. The spring **232** is arranged in the manner described in the embodiment of Figs. 1 and 2, that is to say its tension is directed along the axis of the upper link **218** or in a dead-center position substantially radially of the pivot point **222** when the back-rest **216** is in its lowered, retracted position of Fig. 9. However, when the back-rest is manually lifted a short distance, and the link **218** approaches a horizontal plane, the spring **232** becomes effective to provide a biasing circumferential force on the link **218** tending to pivot said link about its pivot point **222** and raising the back-rest **216** to its extended position of Fig. 10.

The plate **296** is provided at its rear edge with an arcuate, inwardly directed slot **298**. When the back-rest **216** is brought to its extended position of Fig. 10, the upward pivoting of the lowermost link **220** causes the fixed pin **238** carried thereby to enter the mouth of the slot **298** as is clearly shown in Fig. 10. In this position, the pin **238** engages the edge of the arm **240** and thereby prevents any further upward pivoting movement of the link **220**. This has the effect of preventing the movement of the back-rest **216** past its extended position.

When the back-rest **216** is in its extended position of Fig. 10 and a person seated in the chair leans rearwardly upon said back-rest, the back-rest pivots rearwardly about the main pivot **242**, the upper link **218** and the portion of the arm **240** between pivot **228** and the fixed pivot **242** acting in this instance as a rigid back-rest connection with the pivot **242**. In addition, the upper back-rest link **218** pulls rearwardly on the upper end of arm **240** above the fixed pivot **242** causing the arm **240** to pivot with the back-rest **216** as a rigid extension thereof, and causing the lower end of arm **240** to move forwardly. In this rearward pivoting movement of the back-rest **216** to its reclined position shown in Fig. 11, the lower back-rest link **220** moves forwardly with its attached portion of the arm **240** and the slot **298** in plate **296** provides clearance for the pin **238**, to permit this forward movement. The arm **240** is connected at its bottom end to the end of the drive link **274** of the leg-rest control linkage at pivot **278**. Movement of the drive link **274** is controlled by guide link **286** which is mounted on the support **212** at pivot **288** and is connected to an intermediate portion of the drive link **274** at the pivot **290**. The remainder of the leg-rest control linkage is similar to that shown in Fig. 3, and for convenience has not been illustrated in this embodiment. When the chair structure is brought to the reclined position shown in Fig. 11, the leg-rest will be extended by the drive link **274** to a position corresponding to that shown in Fig. 5. Engagement of the pin **238** at the end of the slot **298** prevents further rearward pivoting movement of the back-rest **216** past its reclined position of Fig. 11.

In this embodiment, when it is desired to lower the backrest **216** from its raised position of Fig. 10 to its retracted position of Fig. 9, it is merely necessary for the user to press manually downwardly upon the top of the back-rest **216** with sufficient force to overcome the biasing force of the spring **232**. It will be observed that in the lower, retracted position of the back-rest shown in Fig. 9, the pin **238** engages the rear edge of the arm **240**, thereby also serving as a stop means to limit the downward movement of the backrest **216** past its retracted position.

In the embodiments of the invention which have been illustrated and described up to the present point, the four-bar linkage connection of the back-rest has been in the form of a parallelogram. Figs. 12 and 13 illustrate a modified form of linkage arrangement in which the links are not parallel to each other and do not form a four-bar parallelogram linkage connection. In these views the corresponding linkage portions are again given the same reference numerals, except that they are part of the "300" series.

In the chair **310** shown in Figs. 12 and 13, the seat **314** is pivotally mounted on a fixed position **342** of the support by a fixed pivot **344**. Also mounted on a fixed pivot **344** and depending therefrom is an arm **340**. The back-rest connecting links **318** and **320** are connected at spaced points to the back-rest **316** by respective pivots **322** and **324**, and at their opposite ends are connected at spaced points to the arm **340** at their respective pivots **328** and **330**. The link **318** has an end portion which projects beyond pivot **322** and is connected at **336** to one end of a tension spring **332** whose other end is fixed to the back-rest **316** at **334**.

In the lowered, retracted position of the back-rest **316**, it will be observed that the link **320** is substantially aligned with and parallel to the arm **340**, so that the four-bar linkage arrangement is substantially in the form of a triangle, one arm of which is formed by the link **318**, one arm by the backrest portion between the pivots **322** and **324**, and the remaining arm of which is formed by the link **320** and the portion of the arm **340** between the pivots **330** and **328**. In this retracted position of Fig. 12, the alignment of the link **320** with the arm **340** prevents the link **320** from further downward pivoting and thus retains the back-rest **316** in its retracted position. When the back-rest **316** is raised to its extended position of Fig. 13, the link **320** engages and is stopped by a stop member or plate **391** which is fixed to the arm **340**, the stop member **391** limiting further upward movement of the back-rest **316**. In this extended position, again the four-bar linkage is in the form of a triangle, one arm of which is formed by the link **318**, one arm by the portion of the arm **340** between the pivots **330** and **328**, and the remaining arm being formed by the link **320** and the coextensive portion of the back-rest **316** between the pivot **322** and the pivot **324**. The link **320** is now aligned with the axis of the back-rest **316**, and is effective to hold the back-rest in its raised position.

When a person leans rearwardly upon the back-rest **316**, the rearward pressure against the back-rest above the pivot **322** causes the link **320** to press against the stop member **391** thereby locking together the link **320** and arm **340**. The triangular form of the four-bar linkage shown in this embodiment is therefore effective to automatically cause the arm **340** to become rigid with the back-rest **316** in the raised, extended position of the back-rest shown in Fig. 13.

The leg-rest actuating link **374** is connected to the bottom end of the arm **340** at pivot **378**. The actuating or drive link **374** is also connected to the leg-rest control linkage **356** which carries the leg-rest **354**. This leg-rest control arrangement **356** is identical to that shown in the previous embodiment and will therefore not be described in detail. It will be understood, however, that rearward pivoting movement of the back-rest **316** will cause the leg-rest control linkage **356** to bring the leg-rest forwardly and upwardlly to its extended position as was hereinbefore described.

To lower the back-rest **316** from its raised position of Fig. 13, the user need merely tilt the back-rest slightly forwardly and then press downwardly.

Figs. 14 through 16 illustrate a linkage arrangement similar to that shown in Figs. 12 and 13, except that the back-rest extension arm **440** is pivoted to the seat rather

than to the support. The numerals in these views are in the "400" series.

The seat **414** of chair **410** has a rearwardly-extending rigid bracket **452** which is pivoted to a fixed portion **442** of the support frame **412** at pivot **444**. The upper end of arm **440** is pivoted at **441** to the rear end portion of the seat **414**.

The links **418** and **420** are again connected to the back-rest **416** at spaced-apart points by respective pivots **422** and **424**. The opposite ends of the links **418** and **420** are connected to spaced points on the arm **440** by respective pivots **428** and **430**. The links **418** and **420** are again not parallel to each other and are arranged similarly to the links shown in Figs. 12 and 13. A tension spring **432** is connected at one end to the end of the link **418** which extends beyond the pivot **422** and at its other end is connected at **434** to the back-rest **416**. The back-rest structure is therefore mounted upon the seat **414**, and is not directly connected to the support.

In the extended position of the back-rest **416**, shown in Fig. 15, the links **418** and **420**, together with the corresponding portions of the arm **440** and the back-rest **416**, form a triangle which is effective to hold the back-rest **416** in its raised, extended position and is also effective to lock the back-rest **416** to the arm **440** so that rearward pivoting movement of the back-rest **416** will provide forward pivoting movement of the arm **440** about pivot **441**. This is accomplished by engagement of the link **420** with a stop member or plate **491** which is rigidly fixed to the arm **440**, as shown in Fig. 15.

When the person sitting in the chair leans rearwardly upon the back-rest **416**, the back-rest pivots rearwardly through the locked linkage about the pivot **441** on the seat **414**. Simultaneously, the arm **440** is pivoted forwardly about the pivot **441** and the actuating or drive link **474** which is connected to the bottom of arm **440** at pivot **478** actuates the leg-rest control linkage **456** to raise the leg-rest **454** to its extended position shown in Fig. 16.

Figs. 17 and 18 show a modified type of linkage arrangement contained in reclining chair **510**, in which a hook member is used to lock the back-rest **516** against rearward pivoting movement when the back-rest is in its lowered, reclined position. The seat **514** is connected to a rigid rearwardly extending bracket **552** which is mounted at pivot **544** to a fixed portion **542** of the chair support frame. The support arm **540** is also pivotally mounted to the support frame on pivot **544** as is the end of the upper back-rest link **516**. The other end of link **518** is connected to the back-rest **516** at pivot **552**. The link **516** has a portion extending rearwardly of the pivot **522** which is connected by tension spring **532** to the back-rest at **534**. The lower back-rest link **520** is connected at one end to the back-rest **516** by pivot **524** and at its other end is connected to the arm **540** by pivot **530**.

A hook member **595** is pivoted at **596** to the fixed portion **542** of the support frame, and in the lowered, retracted position of the back-rest **516** shown in Fig. 17, is adapted to engage and hold a projection **597** on the end portion of the arm **540** which extends beyond the fixed pivot **544**. Engagement of the hook **595** with the arm projection **597** locks the arm **540** rigidly and immovably relative to the support so that the arm **540** may not pivot about the fixed pivot **544**. Thus, in the retracted position of the back-rest **516**, said back-rest may not be pivoted or tilted rearwardly and the leg-rest and seat cannot move relative to the support frame. When the back-rest **516** is raised to its extended position shown in Fig. 18, however, the link **518** pivots upwardly and engages the end portion of the hook **595** as shown in Fig. 18, raising the hook **595** out of engagement with the projection **597** of the arm **540** and releasing the arm **540** for pivoting movement about the fixed pivot **544**. Thus, when the back-rest **516** is brought to its raised, extended position, and the person sitting in the chair leans rearwardly upon said back-rest, the back-rest will pivot rearwardly about the fixed pivot **544** and the triangular arrangement of the linkage system together with the engagement of the link **520** with a projection **591** on the arm **540** locks the arm **450** rigidly with the back-rest and causes said arm to pivot forwardly. This forward pivoting of the arm **540** moves the drive link **574** forwardly, causing the latter to actuate the leg-rest control linkage **556** and raise the leg-rest **554** to its extended position.

When the back-rest **516** is returned to its lowered, retracted position shown in Fig. 17, the weight of the hook member **595** causes the latter to drop and again engage with the projection **597** of the arm **540**.

While preferred embodiments of the invention have been described herein, it is obvious that numerous additions, changes and omissions may be made without departing from the spirit and scope of the invention.

What I claim is:

1. An improved chair comprising a support, a seat carried on said support, a back-rest disposed rearwardly of said seat and cooperating therewith to accommodate a person seated in said chair, linkage means pivotally mounting said back-rest for translation upwardly and downwardly relative to said seat in an arcuate path, said linkage means establishing a first limit position wherein a major portion of said back-rest extends above said seat and a second limit position wherein the lower portion of said back-rest extends below said seat, said linkage means including a pair of links pivoted at one pair of ends to said support and at the other pair of ends to said back-rest, said pair of links extending downwardly and rearwardly from said one pair of ends in said second limit position and swinging upwardly and rearwardly as said back-rest is moved into said second limit position, the weight of said back-rest normally maintaining the same into second limit position, and a spring operatively connected to said linkage means for urging said back-rest into said first limit position, said spring exerting a pull substantially in line with said linkage means in said second limit position and exerting a pull substantially at right angles to said linkage means in said first limit position.

2. In an article of furniture including a support, a seat mounted on said support, a back-rest disposed rearwardly of said seat and cooperating therewith to accommodate a person seated in said article of furniture, a leg-rest disposed adjacent to and beneath the forward end of the seat, a carrier for said back-rest movably mounted on said support, means operatively connected to said carrier and said back-rest and mounting said back-rest on said carrier for up and down movement between lower and upper limit position, releasable means on said carrier operative to lock said back-rest to said carrier in said upper limit position, the assembly of said carrier and back-rest in said upper limit position being movable to various reclined positions, and means operatively connected to said carrier and to said seat and leg-rest for coordinating movement of said seat and leg-rest to reclining movement of said back-rest.

3. In an article of furniture including a support and a seat mounted on said support, a back-rest, a carrier arm pivotally mounted on said support adjacent said back-rest, a pair of links connecting the lower portion of said back-rest to said carrier arm for up and down movement of the back-rest relative to said carrier arm between a retracted position wherein a lower portion of said back-rest extends below said seat and an elevated position wherein at least a portion of said lower portion of said back-rest extends above the prescribed level of said seat, coupling means for locking one of said pair of links to said carrier arm in the elevated position of said back-rest, a leg-rest, a leg-rest control linkage connected to said leg-rest for moving the leg-rest from a retracted position beneath the forward end of the seat to

an extended position forwardly of and substantially at the level of the forward end of said seat, said leg-rest control linkage including a drive link connected to said carrier arm, said coupling means being effective to lock said carrier arm to the lower end of the back-rest in the elevated position of the latter for rearward pivoting movement of said back-rest about the pivotal connection of said carrier arm on said support, said carrier arm thereby serving as a rigid depending extension of said back-rest and being moved forwardly by rearward pivoting of said back-rest to actuate said leg-rest control linkage through said drive link.

4. An article of furniture according to claim 3 in which said coupling means includes a coupling link pivotally mounted on said support and having a slot therein, one of said pair of links having a pin engageable in said slot when said back-rest is raised to its elevated position, said one link, said carrier arm and said coupling link forming a locked triangle to lock said carrier arm to said back-rest.

5. An article of furniture according to claim 3 in which said coupling means includes a fixed abutment on one of said pair of links, said abutment being positioned to engage said carrier arm in the elevated position of said back-rest to limit further movement of said back-

rest relative to said carrier arm, the other of said pair of links being pivoted to said carrier arm above the pivotal connection of said carrier arm to said support, whereby rearward pivoting movement of said back-rest causes said carrier arm to pivot on said support.

6. An article of furniture according to claim 3 in which said coupling means includes a projection on said carrier arm, said pair of links being arranged to form a triangular linkage with said carrier arm and a portion of the back-rest included in the triangle when said back-rest is in its elevated position, one of said pair of links being positioned to engage said projection to lock said triangular linkage and rigidly couple the carrier arm and back-rest.

7. An article of furniture according to claim 3 which also includes stop means for restraining rearward pivoting movement of said back-rest when the latter is in its retracted position, said stop means comprising a hook member pivotally mounted on the support and positioned to engage and hold the carrier arm.

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