

Dec. 18, 1951

C. E. CUSHMAN

2,579,305

POSITION-ADJUSTING MECHANISM

Filed Jan. 26, 1948

5 Sheets-Sheet 1

Fig. 1.

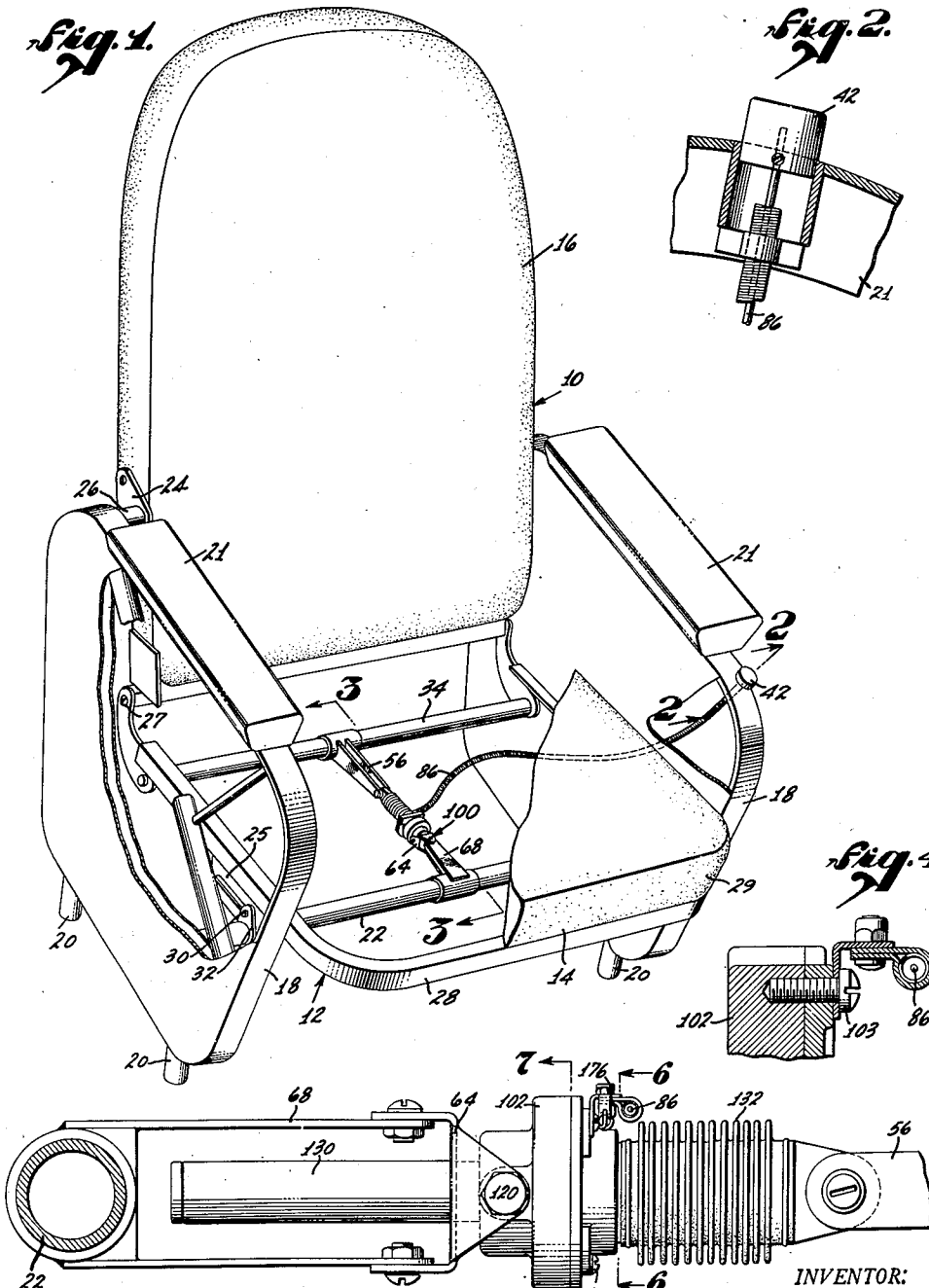


Fig. 2.

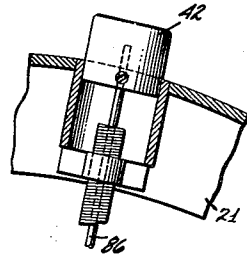


Fig. 4.

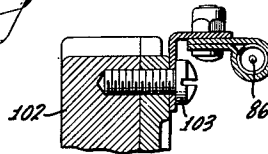
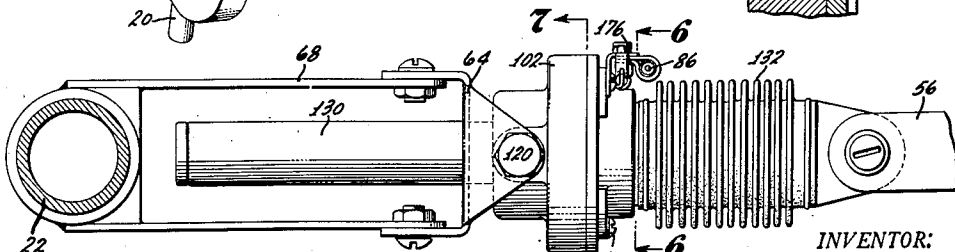


Fig. 3.



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5 Sheets-Sheet 2

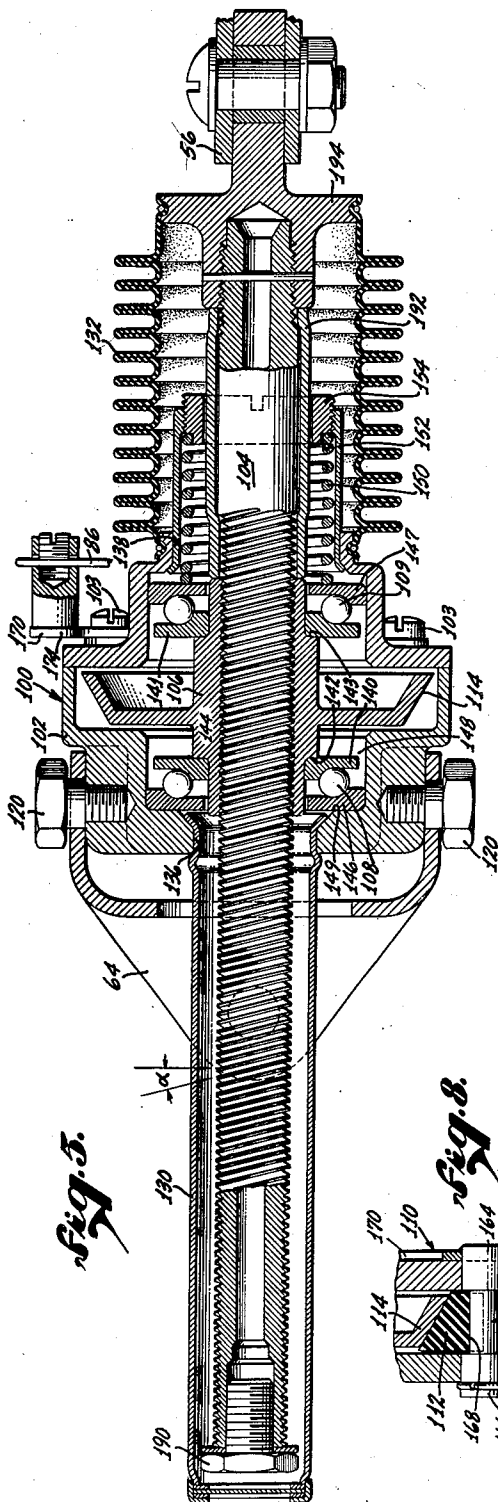


Fig. 7.

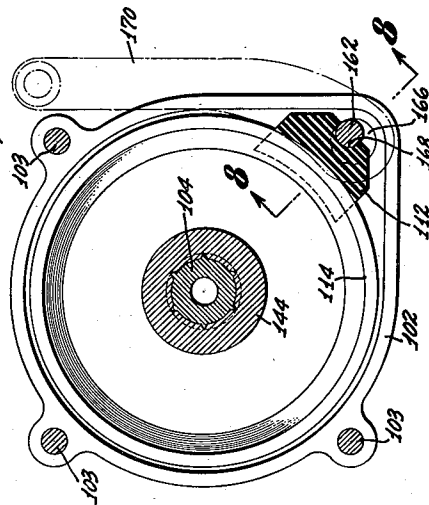


Fig. 6.

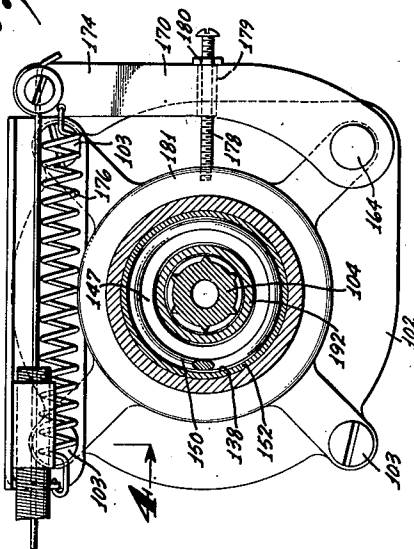
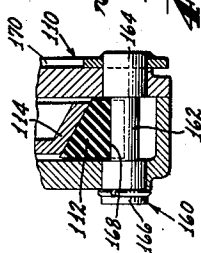


Fig. 8.



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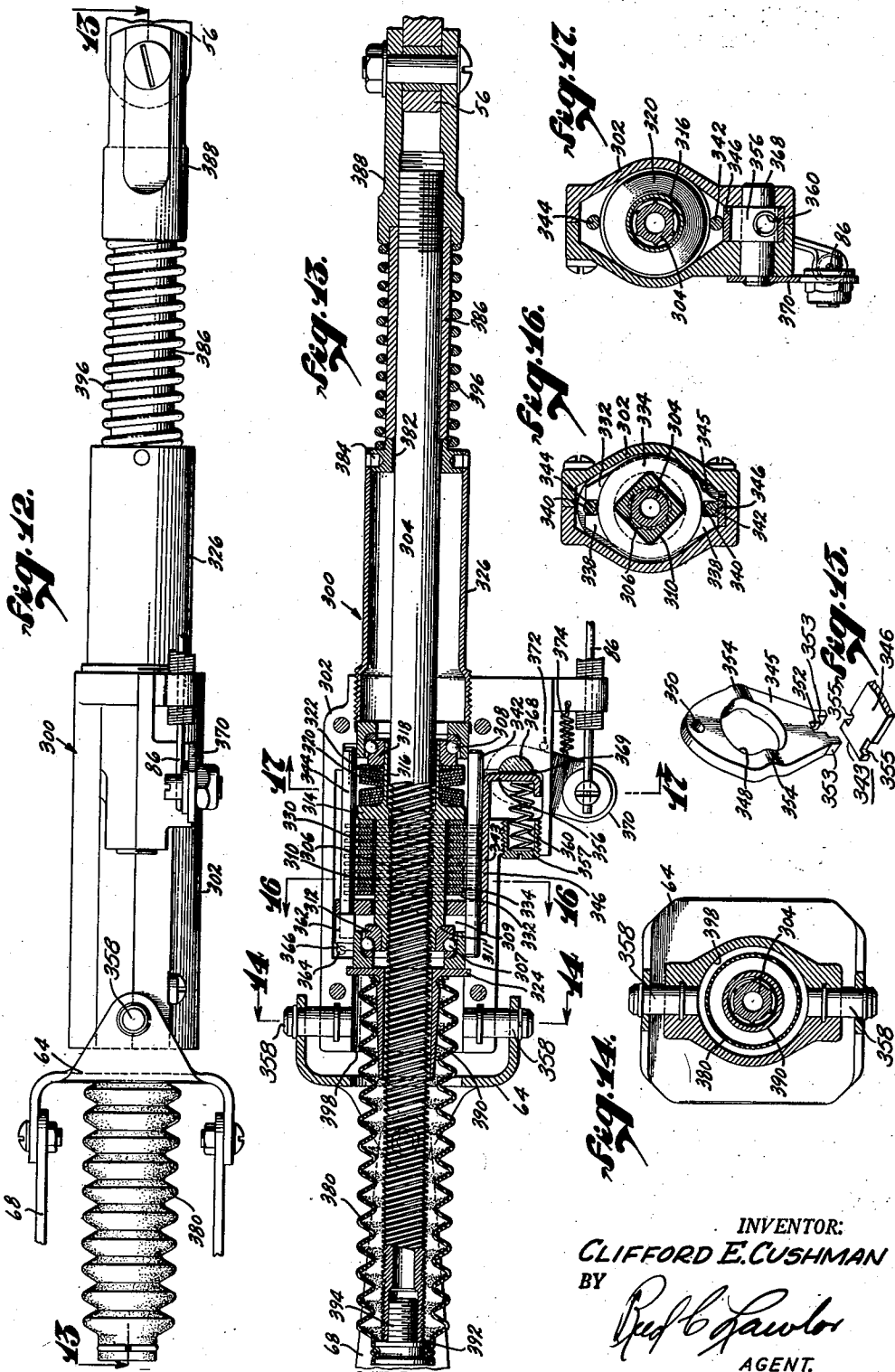
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POSITION-ADJUSTING MECHANISM

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5 Sheets-Sheet 4



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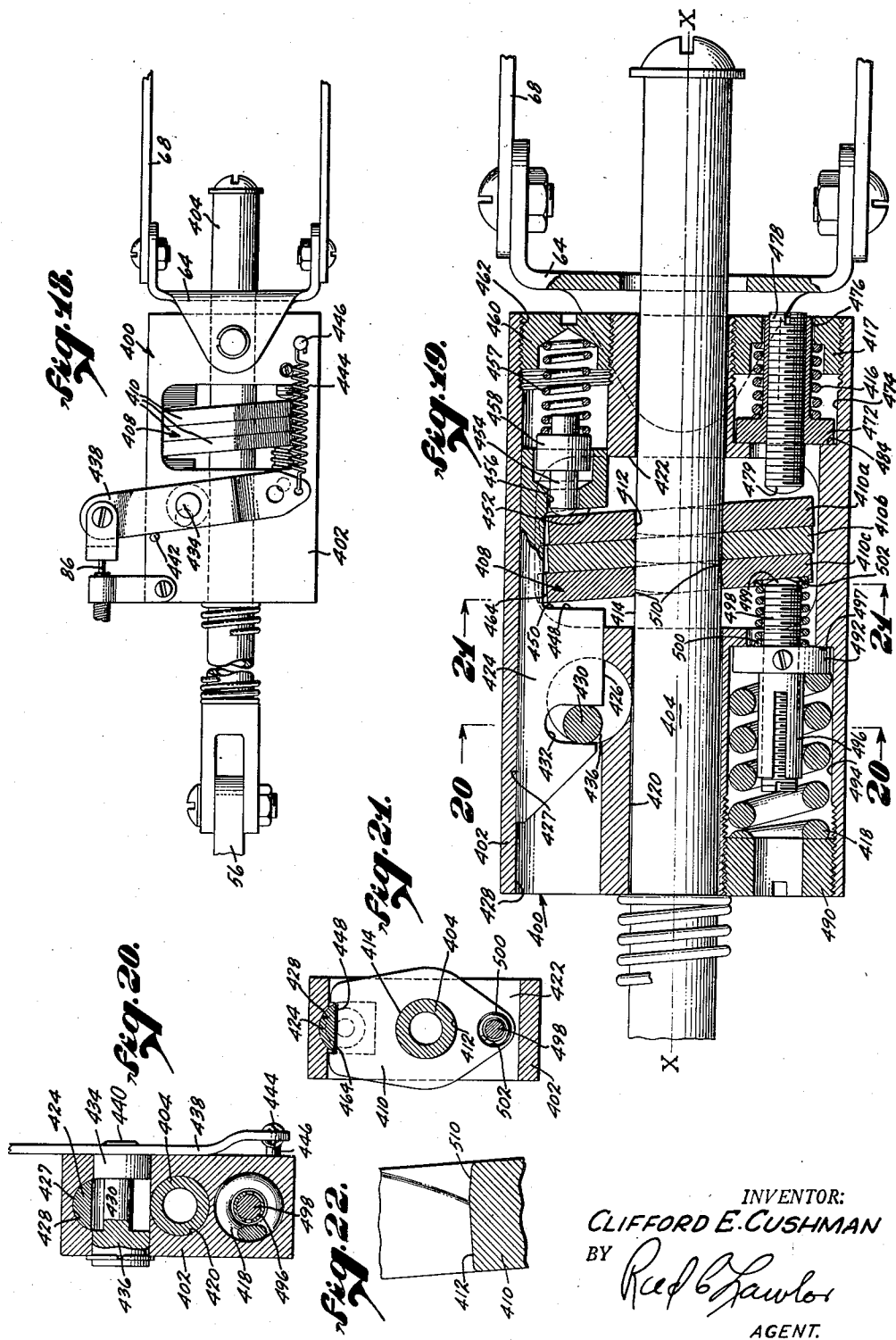
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POSITION-ADJUSTING MECHANISM

Filed Jan. 26, 1948

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UNITED STATES PATENT OFFICE

2,579,305

POSITION-ADJUSTING MECHANISM

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Application January 26, 1948, Serial No. 4,347

33 Claims. (Cl. 155-116)

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This invention relates to adjustable mechanical structures and particularly to improved position-adjusting mechanisms. The invention possesses particular utility in connection with reclining chairs having tiltable backs and for this reason is described in detail in connection therewith. Although the invention is described with particular reference to such chairs, it is to be understood that many of its features are applicable in connection with other mechanical structures comprising pairs of relatively movable interconnected structural members, such as pairs of pivoted members.

A position-adjusting mechanism of the type to which this invention is particularly directed includes a braking mechanism including a pair of frictionally engageable holding members which are respectively mounted on or otherwise connected to two such relatively movable structural members. In particular, for example, an adjustable reclining chair of the type which is employed on airplanes and to which this invention is especially applicable includes three chair members, namely: a support member, a seat member, and a tiltable back member, or chair back. Such a support member is rigidly mounted on the floor of an airplane and the seat member in many instances is slidably carried by the support member in such a way that it can move backward and forward thereon, and the back member is pivotally attached to the support member and also attached to the seat member in such a way that, as the back member is tilted backward and forward with respect to the support member, the seat member is also carried backward and forward into corresponding positions. Adjusting mechanisms of the type with which this invention is concerned are connected between any two of such relatively movable members in such a way as to hold them securely together thereby locking the chair in some predetermined shape to suit the comfort of the occupant. The adjustment of such a chair is preferably under the control of the chair occupant, the adjustment being accomplished most conveniently by means of a control member mounted at the side of the chair, such as on the chair arm.

The type of position-adjusting mechanism to which this invention is primarily directed comprises a pair of frictionally engageable members or groups of members which serve as a brake for locking the chair members in any selected relative positions. The frictionally engageable members form a part of a friction-type locking device which preferably includes suitable means for releasing the braking members under man-

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ual control of the chair occupant in order to permit relative movement of the frictional members in either direction. With this arrangement, it is relatively easy to release the brake and adjust the shape of the chair by moving the chair members relatively between predetermined extreme positions.

Usually a series of chairs employing such position-adjusting mechanisms is arranged seriatim, one behind another, such as in the cabin of an airplane. It is, of course, necessary for the locking device to hold in one direction against the weight of the chair occupant or any other similar force that might be applied to the chair in a similar direction. Frequently, however, it is desirable to permit the locking device on one of the chairs to be released readily when a force is applied to the chair in an opposite direction. For example, if one chair is vacant and the occupant in the chair behind wishes to rise, it is often desirable that he be able to push or tilt the back of the chair immediately preceding him forwardly into a more upright position, in order to give him more room for rising. Also, of course, when a chair is unoccupied, it is often desirable to move the chair-back to the upright position for the maximum convenience of the occupant of the chair behind.

In the copending patent application Serial No. 1,864 filed January 12, 1948, now abandoned, there has been described and claimed a position-adjusting mechanism which comprises a pair of complementarily threaded members such as a nut and a screw, which is adapted to be compressed and extended by means of axial forces applied therebetween. The two threaded members are connected between two relatively movable structural members and can be arranged to be locked in any desired position by means of a brake shoe which is adapted to frictionally engage a brake drum on the periphery of the nut. The present invention is applicable to that type of position-adjusting mechanism as well as to others in which frictionally engageable brake members are employed for locking the mechanism in a predetermined position, as more fully described hereinafter.

One of the objects of the invention is to provide an adjustable chair with an adjustable positioning device employing frictionally engageable braking surfaces with means for holding the back member of the chair against relatively large rearward-tilting forces but which permits the back member to be moved by forward-tilting forces exceeding a relatively low predetermined value.

Another object of the invention is to provide a position-adjusting mechanism employing frictionally engageable braking surfaces with means for permitting relative movement of the members of the positioning mechanism in opposite directions in response to oppositely directed forces exceeding corresponding predetermined values.

Another object of the invention is to provide an adjustable positioning mechanism having two relatively movable members and employing a brake mechanism utilizing frictionally engageable braking surfaces with means which opposing forces applied in one direction between said members and with means which causes slippage of said braking surfaces when such force exceeds a predetermined value.

Another object of the invention is to provide an adjustable positioning mechanism employing a braking mechanism having frictionally engageable braking surfaces with means including a spring for urging said braking surfaces together to resist relative movement thereof by forces applied in one direction and means cooperating with the spring for maintaining the frictional force between said braking surfaces substantially constant independently of the coefficient of friction therebetween so that the positioning mechanism may be adjusted when such forces exceed a substantially constant predetermined value.

Another object of the invention is to provide a position-adjusting mechanism with a preloaded spring which opposes adjustment forces in a predetermined direction and which urges frictionally engageable braking surfaces together to produce frictional forces which resist such adjustment forces.

Another object of the invention is to provide a position-adjusting mechanism which employs such a preloaded spring with means for adjustably varying the value of the force which must be exceeded to cause adjusting of the mechanism.

Another object of the invention is to provide such a position-adjusting mechanism which is of simple low cost light weight construction, which operates silently and reliably.

According to the present invention, a friction-type locking device is provided with means for holding the pair of frictionally engageable elements together in braking, or locking, engagement for a large range of forces applied in a forward direction to the top of the chair-back, but only for a small range of forces applied in the opposite direction. With this arrangement, the locking device is adapted to hold a chair locked in a predetermined shape against the weight of its occupant or any similar force which tends to tilt the chair back rearwardly, but at the same time, is adapted to permit the chair-back to be tilted upwardly, or forwardly, into an erect position by means of a relatively small forwardly directed force.

More particularly, in accordance with this invention, such a locking device is provided with two springs or other resilient or compressible members one of which determines the maximum load which the lock can hold in one direction and the other of which determines the maximum load which the lock can hold in the opposite direction. For convenience, the first spring is hereinafter referred to as the overload, or holding, spring and the second spring is referred to as the override, or push-up, spring.

While the invention is particularly shown and described in connection with its application to

reclining chairs, it is to be understood that it is also applicable to other types of structures in which it is desired to provide a locking device which holds against relatively large forces in one direction and relatively small forces in the opposite direction. The foregoing and other advantages, objects, and features of the invention which distinguish it from the prior art, will be readily apparent from a consideration of the several embodiments of the invention which are illustrated in the accompanying drawing and the following description thereof.

In the drawings, wherein the same numbers in the several views represent like parts:

Figure 1 is a partly broken away isometric view of an airplane chair incorporating the invention; Fig. 2 is a fragmentary view showing the control button mounted on the chair arm;

Fig. 3 is a side elevational view of a first form of the improved position-adjusting mechanism; Fig. 4 is a fragmentary sectional view of the first position-adjusting mechanism taken on the plane 4—4 of Fig. 6;

Fig. 5 is a longitudinal sectional view of the first position-adjusting mechanism of Fig. 1;

Fig. 6 is a view of the first position-adjusting mechanism of Fig. 1 taken on the plane 6—6 of Fig. 3;

Fig. 7 is a detailed sectional view of the first position-adjusting mechanism taken on the plane 7—7 of Fig. 3;

Fig. 8 is a detail view of the brake mechanism of the first position-adjusting mechanism taken on the plane 8—8 of Fig. 7;

Fig. 9 is a longitudinal sectional view of a second form of the position-adjusting mechanism;

Fig. 10 is a sectional view taken on the plane 10—10 of Fig. 15 showing details of the braking mechanism of the second form of the position-adjusting mechanism;

Fig. 11 is an exploded isometric view of the braking device of the second form of the position-adjusting mechanism;

Fig. 12 is a side elevational view of a third form of the position-adjusting mechanism;

Fig. 13 is a longitudinal sectional view of the third form of the position-adjusting mechanism taken on the plane 13—13 of Fig. 12;

Fig. 14 is a detailed sectional view of the third form of the position-adjusting mechanism taken on the plane 14—14 of Fig. 13;

Fig. 15 is an isometric exploded view of the brake lever of the third form of the position-adjusting mechanism;

Fig. 16 is a sectional view of the third form of the position adjusting mechanism taken on the plane 16—16 of Fig. 13 showing details of the braking mechanism;

Fig. 17 is a detailed sectional view of the third form of the position-adjusting mechanism taken on the plane 17—17 of Fig. 13;

Fig. 18 is a side elevational view of a fourth form of the position-adjusting mechanism;

Fig. 19 is an enlarged fragmentary view showing details of the fourth form of the position-adjusting mechanism;

Fig. 20 is a sectional view taken on the plane 20—20 of Fig. 19 showing details of the braking mechanism of the fourth form of the position-adjusting mechanism;

Fig. 21 is a detail view taken on the plane 21—21 of Fig. 19, also showing details of the last mentioned braking mechanism; and

Fig. 22 is a fragmentary view of a canting leaf

employed as a braking member of the last mentioned braking mechanism.

PART I

Introduction

In the drawings, there are illustrated four forms of position-adjusting mechanism incorporating the features of the present invention as applied to a reclining airplane chair. Each of these position-adjusting mechanisms comprises a housing or body member and a rod member longitudinally movable therein. These two members are connected respectively to two of the relatively movable structural members of the airplane chair or other articulated structure which is to be adjustably set in predetermined positions. Each of these position-adjusting mechanisms is arranged to be extended, or expanded, and to be compressed, or contracted, in response to axial forces applied between the body member and the rod member. Each of the position-adjusting mechanisms includes a braking mechanism which comprises two frictionally engageable braking members which are adapted to hold or lock the position-adjusting mechanism in any pre-set position when they are engaged. In practice, a brake-release mechanism is provided for disengaging the braking members to release the brake mechanism in order to accomplish the desired extension and compression from one predetermined position to another. In practice, as applied to a reclining chair in the embodiments of the invention illustrated, each of the position-adjusting mechanisms is compressed when the back member of the chair is tilted backwardly and is extended when the back member is raised to its upright position. A backwardly directed force may be applied to the top of the chair-back to effect the compression and a forwardly directed force to effect the extension. For convenience they are referred to herein as compression and extension forces respectively.

The three forms of the invention illustrated in Figs. 1 to 17 inclusive, are of the type covered by the aforesaid copending patent application in which the braking mechanism comprises one brake member, or one group of brake members, mounted on the body member and another brake member, or group of brake members, mounted on the rod member. In this type of the invention, the rod member is in the form of a threaded screw and the brake member, which is mounted thereon, is rotated relative to the body member by means of a threaded nut which engages the threaded rod. In another type of the invention illustrated in Figs. 18 to 21 inclusive, the first brake member or group of brake members, is also mounted on the body member, but the second brake member is provided by the surface of the rod member itself. In all forms of the invention, the first and second brake members are normally urged together into frictional engagement to lock the position-adjusting mechanism in any set position and the brake members may be disengaged by means of a brake-release mechanism controllable from the arm of the chair to which the position-adjusting mechanism is applied. In addition, means such as an overload spring is provided in each form of the invention for maintaining the brake members engaged as long as any compression force is less than a predetermined relatively large value. Also, in addition, means such as an override spring is provided in each form of the invention for main-

taining the members engaged as long as any extension force is less than a predetermined relatively small value.

Before considering the details of construction of the two types of position-adjusting mechanisms illustrated, it is first desirable to consider the structure of an airplane chair 10 in connection with which each of these position-adjusting mechanisms is used.

The chair 10 comprises a support member 12, a seat member 14, and a tiltable back member 16. The support member 12 comprises two internally-braced side members 18 having feet 20 by means of which the chair 10 is secured to the floor of an airplane and having arms, or arm-rests, 21 for the comfort of the chair occupant. The support member 12 also includes a front cross-bar or cross-rod 22 interconnecting the side members 18 just below seat-height. The back member 16, which carries a back cushion, is pivotally attached to the rear portion of side members 18 by means of brackets 24 attached to opposite sides of the back member and pins 26 projecting inwardly from the back ends of the arms 21. The pivotal interconnections between the support member 12 and the back member 16 serve to further strengthen the chair 10. The seat member 14 comprises a seat frame 28 which bears a seat cushion 20. The back end of the seat is pivotally supported by pins 27 on the lowermost end of the back member 16 and its front end is slidably supported on the front cross-bar 22 by means of slotted guides 25 extending downwardly from the seat frame and pins 30 carried by lugs 32 extending upwardly from the front cross-bar. A rear cross-bar 34 is attached to opposite sides of the back member 16 at the bottom end thereof beneath the pivot pins 27.

Each of the four position-adjusting mechanisms incorporating the present invention and hereinafter designated by the numerals 100, 200, 300, and 400, is preferably mounted beneath the seat member 14 in interconnecting relationship between the two cross-bars 22 and 34 and midway between the two side members 18. Each of these position-adjusting mechanisms is locked and unlocked by manipulation of a control member in the form of a button 42 mounted at the front end of one of the chair arms 21. While the position-adjusting mechanism is thus unlocked, permitting it to be extended or compressed, the back member 16 may be readily moved by the chair occupant from one tilted position to another. But while the position-adjusting mechanism is locked, the back member 16 is held firmly in the tilted position selected.

PART II

Screw type

Form 1.—The first position-adjusting mechanism 100 comprises a divided housing member 102 and a rod member 104 which are respectively pivotally mounted on the two cross-bars 22 and 34. The housing member 102 is held together by means of screws 103. The rod member 104 carries a threaded nut 106 which is mounted for rotation in the housing 102 by means of front and rear ball-bearing assemblies 108 and 109 at opposite ends thereof. Both the rod member 104 and the nut 106 are provided with multiple-start threads. Rotation of the nut 106 in the housing 102 is prevented by means of a braking mechanism 110 including a stator member in the form of a segmental conical brake

shoe 112 which mates with and frictionally engages a rotor member in the form of a conical brake drum 114 arranged on the periphery of the nut. The brake shoe 112 and the brake drum 114 are tapered forwardly, the former being suitably made of Micarta and the latter aluminum.

When the braking mechanism is engaged, the position-adjusting mechanism 100 is locked against extension and compression as long as the extension and compression forces lie below corresponding limits as more fully explained hereinbelow.

It is to be noted that the housing 102 carries trunnions 120 at opposite sides thereof by means of which it is supported on a universal coupling 64 which is pivotally attached to a front bracket 68 extending rearwardly from the front cross-rod 22, and that the rod member 104 is pivotally connected to the rear cross-rod 34 by means of a rear bracket 56 extending forwardly therefrom. Furthermore, it is to be noted that the working parts of the position-adjusting mechanism 100 are arranged within a dust-proof housing including the housing member 102, a forwardly-extending tube 130, and a collapsible tubular member 132 in the form of a Sylphon bellows. The threaded rod 104 is arranged to be longitudinally movable in the housing 102 through concentric front and rear openings 136 and 138 at the front and rear ends respectively of the housing member 102. These and many other details of construction are described more fully in the aforesaid copending patent application.

The inner races 140 and 141 of the ball-bearing assemblies 108 and 109 abut front and rear shoulders 142 and 143 at opposite ends of a central collar 144 of the nut 106. The outer races 146 and 147 of the ball-bearing assemblies 108 and 109 slidably engage the cylindrical wall of the main cavity 148 which extends longitudinally within the housing member 102 in coaxial relationship with the openings 136 and 138. The front outer race 146 normally engages the inner surface of the wall portion 149 surrounding the front opening 136. However, the rear outer race is free to move within the space at the rear end of the cylindrical cavity 148.

The nut 106 and the ball-bearing assemblies 108 and 109 are normally urged forwardly within the cavity 148 by means of a preloaded push-up, or override, spring 150. The override spring 150 is of helical configuration and is mounted concentrically with the threaded rod 104 within a sleeve 152 which is rigidly mounted upon and extends rearwardly from the housing member 102 coaxially with the rear opening 138. The axial length of the spring 150 and hence the force which it exerts against the rear outer bearing 146 is adjustable by means of an annular nut 154 which threadably engages the rear end of the sleeve 152.

Pressure of the brake shoe 112 is exerted against the drum 114 by means of a crank 160 including an eccentric cylindrical crank rod 162 supported between a crank hub 164 and a crank pin 166 both of which are journaled in facing walls of a portion of the housing member 102 as illustrated in Figs. 7 and 8. The crank rod 162 rests within a semi-cylindrical cross-slot 168 on the side of the brake shoe 112 opposite the conical braking surface 158 thereof.

A crank arm 170 is welded to the crank hub 164 and extends radially therefrom in the same direction in which the crank rod 162 is offset

from the center of the crank 160. The crank arm 170 stands adjacent to the periphery of the housing member 102 and its outer end 174 is drawn toward the housing member by means of a coiled tension spring 176.

The inward movement of the crank arm 170 toward the housing member 102 is limited by means of a stop screw or stop pin 178 projecting radially therefrom. This stop pin or stop screw 178 extends radially inwardly toward the housing member 102 and is adjustable radially in a threaded female part 179 welded to the crank arm 178 and is locked in any desired position by means of a holding nut 180. Preferably the inner end of the stop pin is spaced slightly from the outer surface 181 of the wall of the housing member 102 when the brake shoe 112 engages the brake drum 114 in the most forward position of the threaded nut 106 in the housing 102 and engages the housing member 102 firmly when the nut 106 is drawn rearwardly in the housing member 102 against the force of the override spring 150.

Thus, with this arrangement, a substantially constant pressure is exerted by the brake shoe 112 against the brake drum 114 while engaged, irrespective of the axial position of the threaded nut 106 in the housing 102 so long as the pin 178 is spaced from the surface 181. The brake shoe 112 may be withdrawn from the brake drum 114 by means of a flexible cable or wire such as a Bowden wire 86 which is controllable by means of the release button 42 mounted on one of the chair arms 21 as more fully set forth in the aforesaid copending patent application to permit the chair-back 16 to be raised and lowered.

In said copending patent application, it has been explained how a position-adjusting mechanism of the type described above is capable of supporting large axial loads by means of a small force exerted by an overload spring 176 provided that the pitch angle α of the threads of the rod 104 and the nut 106 is only slightly greater than the binding angle. The binding angle is the minimum pitch angle α at which the nut 106 would be locked against rotation on the rod 104 when an axial thrust is applied therebetween, while the nut is constrained against axial movement in the housing 102. The binding angle depends upon the coefficient of friction of the threads and also upon the angle β between the faces of the threads. As pointed out in said application, the binding angle is approximately 17.5° for dry metal-to-metal bearing surfaces. The actual mechanical advantage of such an arrangement, that is, the value of the load which may be held, divided by the force exerted by the holding or overload spring 176 is approximately inversely proportional to the deviation of the actual pitch angle from the binding angle. For this reason, in practice, the pitch angle is set at about one or two degrees greater than the binding angle, and the threads are maintained substantially dry so that the binding angle and hence the mechanical advantage of the mechanism are maintained at a high constant value.

The actual force that must be exerted by the brake shoe 112 on the brake drum 114 to hold against a predetermined load is inversely proportional to the coefficient of friction μ between the two frictionally engageable members. In other words, the maximum compression load

which can be held is given by the following equation

$$F_c = K_1 \mu F_1 \quad (1)$$

where

F_c = maximum compression load,

μ = coefficient of friction of brake shoe on brake drum,

F_1 = tension exerted by overload spring,

K_1 = constant depending on the following factors:

- (a) the binding angle,
- (b) the pitch angle,
- (c) the mechanical advantage of the crank arm,
- (d) the force exerted by the overload spring on the crank arm,
- (e) the radius of the thread,
- (f) the radius of the brake drum,
- (g) the angle the braking surfaces make with the axis of the rod member.

It is to be noted that the maximum compression load which can be held by any given overload spring, varies with μ and is therefore affected by the condition of the braking surfaces. In practice, since the value of μ varies with age and use of the brake mechanism, the value of the spring force F_1 is set at a value which will hold against the desired maximum compression load for the smallest expected value of μ likely to occur under operating conditions.

As a matter of fact, it is noted that with the arrangement described, the nut 106 is constrained against any substantial axial movement in the housing member 102 when compression thrusts are applied. As long as the axial load in this direction is less than the maximum load that can be held by the overload spring 176 as determined by Equation 1 the position-adjusting device remains securely locked. But on the other hand, it is noted that the nut 106 is free to move axially in the opposite direction against the force of the push-up or override spring 150 when an extension thrust is applied between the rod member 104 and the housing member 102. If such a force is applied while the brake mechanism 110 is disengaged, the rearward movement of the nut is very slight and extension occurs.

But when an extension force is applied while the brake mechanism 110 is engaged, the nut 106 is moved rearwardly within the housing 102 against the force of the push-up spring 150. During the initial portion of this movement, that is, while the extension force is small, the brake 110 remains fully engaged. However, when the crank arm 170 has moved inwardly to the point where the stop pin 178 contacts the surface 181, the pressure of the brake shoe 112 against the brake drum 114 becomes relieved. Application of further extension forces in opposition to the force of the override spring 150 decreases the actual force applied to the brake drum 114 by the overload spring 176 until such time as the net force F_1 exerted between the braking surfaces falls below the value required to hold against the extension force as determined by Equation 1 above. When this occurs, the nut 106 rotates on the threaded rod member 104.

It is to be noted at this point that as soon as rotation of the nut 106 commences, further rearward movement of the nut in the housing 102 is retarded, the nut being thus resiliently constrained against further movement. As a result, frictional engagement of the two brake members 112 and 114 is maintained as the nut rotates, and the actual force of friction existing therebetween

is governed by the override spring 150 in accordance with the magnitude of the extension force. If still larger extension forces are applied, especially if they are applied suddenly, the nut 106 may be forced rearwardly to the point where the brake drum 114 becomes completely disengaged from the brake shoe 112, and even though the nut 106 accelerates, the braking mechanism 110 may remain disengaged for a substantial period, so long as such a large extension force is applied.

It is to be noted that the magnitude of the extension force which is required to permit the crank arm 170 to move inwardly to the point where the stop pin 178 contacts the surface 181 is determined by the compliance, or rate factor, of the override spring 150, and the actual degree of compression of the override spring 150 between the nut 154 and the rear outer race 146. Thus, the magnitude of the force extension required to cause extension of the position-adjusting mechanism 100 is approximately equal to the force exerted by the preloaded override spring 150 on the outer race 146.

In fact, it can be shown that the minimum value of the extension force required to release the brake is substantially independent of the coefficient of friction μ existing between the braking surfaces of the brake shoe 112 and the brake drum 114. Thus suppose that initially, the override spring 150 is compressed to such a degree as to exert a force on the rear outer race 147 of the rotating nut 106 when in its most rearward position which force is approximately equal to the maximum force against which the lock is to hold in the extension direction. When an extension force is applied to the rod member 104, the stop pin 180 gradually moves to the point where it contacts the surface 181. During this action, the override spring 150 is gradually compressed. The actual force exerted on the nut 106 by the override spring 150 is greater than the extension force because it is balanced by the latter plus the rearward axial component of the braking force. However, the axial component is small, so that to a first approximation, it may be said that the extension force is approximately equal to the force exerted by the override spring at this time. If the amount of movement required to seat the stop pin 179 on the surface 181 is small, this force is approximately equal to the preloading force of the override spring 150.

As the extension force is increased further, the stop pin 179 compresses the surface 181 thereby reducing the force between the braking surfaces. But since only slight movement of the nut 102 is required to reduce the force between the brake members 112 and 114 to zero, the actual value of extension force does not vary appreciably between the time the stop pin 179 engages the surface 181 and the time that the brake members are completely disengaged. Just prior to complete disengagement the residual braking force falls below the value given by the equation

$$F_E = \frac{F_2}{K_2 \mu} \quad (2)$$

where

F_E = residual braking force just sufficient to hold nut locked against rotation caused by extension forces,

F_2 = maximum extension load to be held,

μ = coefficient of friction, and

K_2 = a constant depending on the same factors as K_1 , except (c) and (d).

When this occurs the nut 106 rotates at a speed

sufficient to permit maintenance of the residual braking force just below the holding value F_r .

It is to be noted that if the coefficient of friction μ changes for some reason even by a large amount, only a slight change in the extension force is required to establish the residual braking force below the holding value. In other words, the force required to extend the position-adjusting mechanism 100 is practically independent of the coefficient of friction μ between the braking surfaces of the brake shoe 112 and the brake drum 114.

With the arrangement described, it is clear that by suitable selection of physical constants of the apparatus, the position-adjusting mechanism 100 may be readily designed to hold against compression forces up to a relatively large overload value and still permit extension when forces exceeding a relatively small value are applied in the opposite direction.

It is to be noted that the extreme positions to which the seat member 14 and the back member 16 of the chair may be moved relative to the support member 12 is determined by the stroke of the rod member 104 relative to the housing member 102. The length of this stroke is determined by the stop screw 190 at the forward end of the rod member 104 and the length of the stop sleeve 192 which is positioned between the nut 106 and the bonnet 194 within which the back end of the rod member 104 is supported.

Form 2.—A second form of the position-adjusting mechanism 200 of this invention which may be employed for adjusting the shape of the chair 10 is illustrated in detail in Figs. 9 to 11 inclusive. This position-adjusting mechanism 200 likewise comprises a divided member 202 and a threaded rod member 204 which are supported between the two cross-rods 22 and 34 of the chair in the manner hereinbefore described. In this case, a threaded nut 206 which engages the threaded rod 204 is constrained for limited axial movement within the housing member 202 between thrust-bearing assemblies 208 which are firmly secured therein by means of locking rings 210 which engage the outer races 212 of the ball-bearing assemblies. The inner races 214 of the ball-bearing assemblies abut opposite ends of an enlarged rectangular portion 216 of the nut 206 in order to limit the axial movement of the nut in the housing of the two bearing assemblies. A flange 218 extends outwardly from the nut 206 between the ends of the rectangular portion 216 to provide shoulders to accept the thrust of sections of the braking mechanism 220 which is employed in this form of the invention to lock the position-adjusting mechanism 200 against compression and extension.

The braking mechanism 220 of this position-adjusting mechanism 200 includes a front section 222 and a rear section 224, the front section 222 being arranged on the front side of the flange 218 and the rear section being arranged on the rear side of the flange 218. The two sections 222 and 224 of the braking mechanism 220 are of similar construction, the details of the rear section 224 being illustrated best in the exploded view of Fig. 11.

The rear section 224 of the braking mechanism comprises a pair of rear rectangular stator discs, leaves, or plates 226 which are provided with central apertures 228 which encircle the nut 206 and which are held against substantial rotation within the housing member 202 by virtue of their loose fit therewithin. The rear section 224 also

includes a group of rear rotor discs, leaves, or plates 232 and a rear spacer 234. One of the rear rotor discs 232 is arranged between the forward stator disc 226 and the flange 218. A pair of the rear rotor discs 232 are arranged adjacent the facing surfaces of the two rear stator leaves 226 and the rear spacer 235 is located between this pair of rotor discs. All three rear rotor leaves 232 and the rear spacer 234 are provided with rectangular apertures which register with the rectangular portion 216 of the nut, so that the rotor discs and the spacer 234 rotate with the nut 206 but are free to move longitudinally thereon. The front section 222 of the braking mechanism 220 comprises front stator discs, leaves, or plates 236 and front rotor discs 242 and a front rotor spacer 244 similarly arranged on the front side of the flange 218.

Front and rear brake levers 248 and 250 are provided for urging the stator leaves and the rotor leaves of the respective sections 222 and 224 of the braking mechanism 220 into frictional engagement. The two levers 248 and 250 extend crosswise within the housing member 202 and are provided with central openings 252 and 254 which encircle the nut 206 at the outer ends of the stacks of stator and rotor leaves of the two sections 222 and 224. The broad ends of the two levers 248 and 250 abut two reentrant fingers 256 and 258, being urged thereagainst by a coil spring 259 in order to form pivots for the levers. The spring 259 extends through slots 261 in the ends of the stator leaves 226 and 236. Opposite ends of the spring 228 rest within recesses 260 and 262 in the broad ends of the respective levers 248 and 250 in order to maintain positive pressure of the levers 248 and 250, against the fingers 256 and 258 at all times.

The two levers 248 and 250 are provided with inwardly directed protrusions 264 and 266 respectively extending crosswise diametrically adjacent the corresponding central openings 252 and 254 along lines parallel to the pivot axes, in order to press the respective stator leaves and rotor leaves of each section 222 and 224 into braking engagement. The opposite ends of the levers 248 and 250 are provided with opposed offset arms 268 and 270. A relatively stiff overload spring 272 is mounted between a recess 274 in the arm 268 and an adjusting cap nut 276 screwed into the housing member 202 in order to urge the front stator leaves 236 and the front rotor leaves 242 into frictional engagement by means of pressure exerted thereon by the protrusions 264 of the front lever 248. Likewise, a relatively weak override spring 282 is mounted between a recess 284 in the other arm 270 and an adjusting cap nut 286 similarly screwed into the housing member 202 in order to urge the rear stator leaves 226 and the rear rotor leaves 232 into frictional engagement by means of pressure exerted thereon by the protrusions 266 of the rear lever 250.

By maintaining the stator leaves 226 and 236 in frictional engagement with the respective rotor leaves 232 and 242, the overload spring 272 and the override spring 282 cooperate to maintain the position-adjusting mechanism 200 locked in a predetermined condition. Disengagement of the stator leaves from the rotor leaves is effected by means of a flat lift cam 287 located between the two arms 268 and 270 and rotatable there by means of an arm 288 which is controllable by suitable means including the Bowden wire 86. When the cam 287 is rotated to engage both arms 268 and 270, the protrusions 264 and 266 are lifted

off the end stator leaves 226 and 236 thereby relieving the pressure between the stator leaves and the rotor leaves, thus disengaging both sections 222 and 224 of the braking mechanism 220. While the braking mechanism 220 is thus disengaged, the position-adjusting mechanism 200 may be extended or compressed as desired by means of suitable thrusts applied to the rod member 204. The stator leaves 226 and 236 may be made of stainless steel and the rotor leaves 232 and 242 of copper or any other suitable pair of non-galling materials. The spacers 235 and 245 may be made of horn paper.

Normally the lift cam 287 may be maintained in a neutral position between the arms 268 and 270 merely by floating therebetween or they may be maintained in a neutral position by means of a tension spring 299 which draws the release arm 288 forwardly into engagement with a step pin 290 projecting outwardly from the side of the housing member 202. In either case, the opposite faces 292 and 293 of the lift cam 287 are spaced a very short distance from the adjacent opposed faces of the arms 268 and 270 forming front and rear gaps 294 and 295.

It is to be noted that the working parts of the position-adjusting mechanism are also enclosed by a dust-proof housing formed by the housing member 202, a forward tubular cap member 296, and a rear tubular member 297 but that in this case, the rod member 204 extends through and slides in a bushing 298 at the rear end of the latter tubular member 297.

In practice, advantage is taken of the slight amount of play or back-lash in each of the bearing assemblies 208 in order to cause the stator leaves and the rotor leaves to slide or rotate relatively to each other when thrust forces exceeding predetermined amounts are applied to the rod member 204 in one direction or the other. More particularly, when a compression thrust is applied to the rod member 204, the nut 206 is pressed forwardly in the housing member 202 against the force exerted thereon by the overload spring 272 through the action of the front brake lever 248. As the nut 206 moves in this direction, the width of the front gap 295 gradually increases and the width of the rear gap 294 gradually diminishes. Finally, the rear lever arm 270 contacts the rear face 293 of the lift cam 287 thereby relieving the pressure between the frictionally engaged stator leaves 226 and rotor leaves 232 of the rear section 224 of the brake mechanism. This action is facilitated by providing sufficient back-lash in the front bearing assembly 208.

In compressing the position-adjusting mechanism 200, compression occurs after the pressure exerted by the override spring 282 on the rear section 224 of the brake mechanism 220 is reduced to zero. Thus, after the rear section 224 becomes completely disengaged, all the back-lash in the front bearing assembly 208 is then taken up and the nut 106 rotates when the braking force established by the overload spring 272 between the front stator and the front rotor leaves 236 and 242 is overcome. The magnitude of the minimum force required to produce such rotation of the nut 106 depends in part upon the mechanical advantage of the threads of the rod member 204 and the nut 206, the strength of the overload spring 272, and the coefficient of friction of the engaging surfaces of the front section 222 of the braking mechanism 220.

In a similar manner, as larger and larger extension thrusts are applied to the rod member 204

in the opposite direction, commencing with the lift cam in its neutral position the width of the rear gap 295 increases and the width of the front gap 294 gradually diminishes until the front arm 268 engages the front face 292 of the lift cam 287 thereby relieving the pressure between the front stator leaves 236 and the front rotor leaves 242. Thereafter, the nut 206 becomes free to rotate when the extension thrust increases to a value exceeding the force which can be held by the override spring 282 acting alone considering the mechanical advantage of the threads and the coefficient of friction of the rear stator and rotor leaves 232 and 236.

From the foregoing it is readily seen that by employing a relatively strong overload spring 272 and a relatively weak override spring 282, the position-adjusting mechanism 200 is capable of remaining locked in a set position against compression forces less than a relatively high predetermined value established by the overload spring 272 and is capable of becoming unlocked against extension forces which exceed a relatively low value established by the strength of the override spring 282. Thus when the adjusting mechanism 200 is mounted on an airplane chair 10 in the manner hereinabove described, the chair is able to withstand relatively large rearwardly directed forces exerted against the back member but still is adapted to be raised readily when only relatively small forwardly directed forces are applied thereto.

Form 3.—The third form of position-adjusting mechanism illustrated in Figs. 12 to 17 inclusive also comprises a split housing member 302 and a threaded rod member 304 respectively connected between the front and rear cross-rods 22 and 34 of an airplane chair in the manner hereinbefore explained. The position-adjusting mechanism 300 also comprises a threaded nut 306 supported between front and rear ball-bearing assemblies 307 and 308 along an axis extending longitudinally through a passage 309 within the housing member 300. The nut 306 is provided with an enlarged middle portion 310 of rectangular configuration providing a shoulder 311 at the front end thereof which firmly abuts the inner race 312 of the front ball-bearing assembly 307. A flange 314 is formed on the nut 306 at the other end of the rectangular portion 310 and intermediate the ends of the nut. A narrow tubular neck 316 extending rearwardly from the flange 314, is adapted to slide freely within the inner race 318 of the rear ball-bearing assembly 308.

An override spring 320 is mounted coaxially with the rod member 304 in compressed condition between the flange 314 and a washer 322 which engages the inner race 318 of the rear ball-bearing assembly 308. The override spring 320 acts to force the nut 306 into its most forward position between the two bearing assemblies 307 and 308. The front bearing assembly 307 is normally held stationary within the housing member 302 firmly against a retainer ring 324 or other stop member mounted firmly on the housing member 302.

On the other hand, the rear bearing assembly 308 is slidable within the housing member 302 and is adjustably positioned therein by engagement with the inner end of an adjusting tube 326 which is threadably movable inwardly and outwardly of the housing member 302. By adjusting the position of the tube 326 in the housing member 302, it is possible to vary the force exerted by the override spring 320 on the flange

314 of the nut 306 and thus to vary the maximum value of extension thrust against which the position-adjusting mechanism 300 may remain locked.

While the override spring 320 may be in the form of a helical spring, it is preferably in the form of two sets of Belleville washers arranged in opposing relationship, since such a spring has an extremely high compliance per unit length. In other words, the ratio of compression force to distance compressed for such a spring is very high even though it is very compact.

A braking mechanism 330 is provided for preventing rotation of the nut 306 in the housing 302 so the position-adjusting mechanism 300 can be set in any desired position. The braking mechanism 330 comprises a group of stator discs, plates, or leaves 332 interleaved alternately with a group of rotor discs, plates, or leaves 334. The two sets of leaves 332 and 334 are frictionally engageable in order to prevent rotation of the nut 306 within the housing 302. The rotor leaves 334 are provided with central square apertures 336 which embrace the rectangular portion 310 of the nut 306 sufficiently closely to cause them to rotate with the nut but at the same time permit them to slide axially thereon. The stator leaves 332 are provided with ears 330 on opposite sides thereof provided with slots 340 which embrace guide rods 342 and 344 firmly held within the housing member 302 on opposite sides of the passage 309 therein. This arrangement prevents the stator leaves 334 from rotating within the housing member 302 but at the same time permits them to slide axially therein.

The braking mechanism 330 also includes a brake lever 343 comprising a pressure arm 345 and a cross-arm 346 arranged at right angles within the housing member 302. The pressure arm 345 lies cross-wise within the housing member 302 and is provided with a central aperture 343 which encircles the square portion 310 of the nut 306. The two ends of the pressure arm 345 are provided with passages 350 and 352 which encircle the guide rods 342 and 344. The passage 352 adjacent the connection of the pressure arm 345 to the cross-arm 346 encircles the corresponding rod 342 very loosely the two fingers 353 on opposite sides of the passage 352 projecting into slots 355 on opposite sides of the cross-arm 346. But the other passage 350 encircles the corresponding rod 344 closely but without binding. The pressure arm 345 is provided with protrusions 354 on opposite sides of the opening 348 and along an axis perpendicular to the line between the holes 350 and 352. These protrusions serve to press the interleaved stator and rotor plates 332 and 334 together to lock the position-adjusting mechanism 300 in a set position.

The stator plates 332 and the rotor plates 334 are made of any suitable pair of brake materials such as Phosphor bronze and low carbon steel.

The cross-arm 346 lies substantially parallel to the axis of the housing and adjacent one of the guide rods 342, extending rearwardly in the housing in a direction away from the trunnions 358. The cross-arm 346 includes a branch arm or finger 356 lying at right angles to the main portion thereof and extending radially outwardly from the center of the housing member. An overload spring 360 lies on the forward side of the branch arm 356 and is compressed thereagainst by means of a plug 357 which is threadably adjustable in and out of the housing member 302. The spring 360 tends to rock the pressure arm

345 at the protrusions 354, but the forward movement of the upper end of the pressure arm 345 is limited by means of a head 362 at the forward end of the upper guide rod 344. This head is arranged to be moved backward and forward slightly within the housing member 302 by means of an adjusting screw 364 having a tapered point which engages a tapered crown 366 on the head 362.

With this arrangement, the spring 360 exerts a force through the protrusions 354 to maintain the leaves 332 and 334 in braking engagement as long as the force tending to compress the position-adjusting mechanism 300 lies below a predetermined overload value. This value is determined partly by the force exerted by this spring on the finger 356 and partly by the mechanical advantage of the threads and partly by the coefficient of friction of the contacting surfaces of the leaves.

The brake release mechanism comprises a semi-cylindrical lift cam 368 which is rotatable about its axis within the housing into and out of engagement with the finger 356 by means of an external lever 370 which is controlled by means of the Bowden wire 86. While the brake mechanism 330 is engaged, a small gap 369 exists between the finger 356 and the flat face of the lift cam 368, so that the full force of the spring 360 on the leaves 332 and 334 may be obtained. To assure the existence of such a gap during brake engagement the crank arm 370 is normally urged against a stop pin 372 by means of a tension spring 374. However, if desired, the pin 372 and spring 374 may be omitted permitting the cam to tilt against the finger 356 lightly without diminishing the braking force of the overload spring 346 appreciably.

In order to disengage the brake mechanism 330 the lift cam 368 is turned, thereby engaging finger 356 pressing it against the spring 360. Due to the loose fit of the hole 350 with the guide rod 344, the pressure arm 345 is pivoted on the rod 344 as the finger 356 is pressed against the spring 360. This action relieves the pressure of the protrusions 354 on the leaves 332 and 334, thus disengaging the braking mechanism and permitting the rod 304 to be moved in either direction through the housing member 302, by means of a small force applied in either direction to the back member 16 of the chair. When the lift cam 368 is returned to its normal position, the spring 360 forces the protrusions 354 against the leaves 332 and 334 again thereby engaging the brake mechanism 330 and locking the position-adjusting mechanism 300 in the desired position.

If, while the braking mechanism 330 is engaged, a compression thrust is exerted against the rod member 304, the nut 306 is moved slightly forwardly within the housing member 302 by virtue of the play or back-lash in the front bearing assembly 307, thereby slightly increasing the compression of the leaves 332 and 334 between the flange 314 and the pressure arm 345.

In view of the fact that the compression spring 360 exerts a very small force compared to the thrust in question, the leaves 332 and 334 are not compressed substantially but merely shift forwardly within the housing member 302 causing the pressure arm 345 to pivot slightly maintaining the full force of the spring 360 thereon.

Thereafter as the compression thrust increases, the resultant turning moment exerted by the threads of the rod member 304 on the nut 306

increases until it equals the frictional retarding force exerted between the two sets of frictionally engaged leaves by the overload spring 360. Further increase of thrust causes the nut 306 to rotate, permitting the position-adjusting mechanism to compress. The value of compression force at which such compression occurs depends upon the coefficient of friction of the frictionally engaged surfaces of the leaves 332 and 334. For this reason the strength of the overload spring 332 is adjusted by means of the plug 357 to permit the position-adjusting mechanism 300 to hold a given maximum load even when the coefficient of friction is at the smallest value that may be attained through wear of the leaves or in any other way.

Now if an extension thrust is exerted on the rod member 304, the neck 316 slides within the inner race 318 of the rear bearing assembly compressing the override spring 320, and the nut 306 is drawn rearwardly within the housing member 302. During the initial portion of this movement, corresponding to small extension thrusts, the pressure arm 352 pivots, reducing the width of the gap between the finger 356 and the lift cam 368. Finally, when the finger 356 engages the lift cam 368, further increase of extension thrust increases the pressure of the finger 356 on the lift cam 368 relieving the pressure between the stator and rotor leaves 332 and 334. As the force of the finger 356 on the lift cam 368 increases the force exerted by the protrusions 354 on the leaves 332 and 334 decreases, thereby reducing the braking force tending to prevent rotation of the nut 306. When the turning moment exerted on the nut 306 by the extension force exceeds the braking moment exerted by the frictional forces between the two sets of leaves 332 and 334, the nut 306 commences to rotate.

If a large extension thrust is applied suddenly, the stator leaves 332 and the rotor leaves 334 become completely disengaged, permitting the nut 306 to accelerate rapidly. However, in the normal course of events, the nut 306 accelerates to the point where its speed of rotation corresponds to the speed of extension of the position-adjusting mechanism 300 causing the stator leaves 334 and the rotor leaves 332 to engage slightly, and thereby govern the frictional force therebetween in accordance with the amount required to permit extension. Thus, it is seen that while the extension thrust applied exceeds the threshold amount mentioned required to relieve the pressure between the leaves at a constant speed, the leaves remain interengaged and the frictional force therebetween is governed automatically to correspond with the speed of extension of the position-adjusting mechanism 300.

This form of position-adjusting mechanism acts very similar to form 1 described hereinabove, in that the minimum value of the extension force required to cause extension is practically independent of the coefficient of friction of the braking surfaces. In this case, Equation 2 also applies where F_r the residual braking force, is the force exerted by the protrusions 354 upon the leaves 332 and 334. In this case, the constant of proportionality K depends on (a) the binding angle, (b) the pitch angle, (c) the radius of the threads, and (d) the effective mean radius at which the force between the leaves is applied. In this case, also, if the coefficient of friction μ changes for some reason, only a slight change in the extension force is required to adjust the residual braking force exerted by the protrusions

354 to a sufficiently low value to permit extension of the position-adjusting mechanism 300.

It is to be noted that in this form of the invention, also, the main working parts of the braking mechanism 332 are enclosed within a dust-proof housing formed by the housing member 302, the tube 326, and a Sylphon bellows 380 connected between the front end of the rod member 304 and the holding ring 324. During extension and compression of the position-adjusting mechanism a small annular gap 382 exists between the rod member 304 and a ferrule 384 mounted at the outer ends of the tube 326 and the nut 306 is properly aligned with the rod member 304 by means of the self-aligning ball bearing assemblies 308. A spacer sleeve 386 of selected length encloses the rod member 304 between the ferrule 384 and the connector 388 at the rear end of the rod member. The spacer sleeve 386 is employed to limit the compression of the position-adjusting mechanism, thereby limiting the maximum angle to which the back member 12 of the chair 10 can be lowered, or tilted rearwardly. In a similar manner a tubular member 390 extends forwardly from the holding ring 324 to engage the head 392 of the cap screw 394 at the forward end of the rod member 304 in order to determine the minimum angle to which the back member 12 may be raised, or tilted forwardly. A compression spring 396 is arranged concentrically with the sleeve 386 between the ferrule 384 and the connector 388. In order to facilitate the return of the back member 12 of the chair to its most upright position when the braking mechanism 330 is released by manipulation of the Bowden wire 86. It is to be noted that in the most upright position, the Sylphon bellows 380 is collapsed within an annular space 398 surrounding the tubular member 390 at the forward end of the housing member 302.

PART III

Canting type

A fourth form of position-adjusting mechanism 400 employing the principles of this invention is illustrated in Figs. 18 to 22 inclusive. This form of the invention does not employ threads but merely a smooth rod and canting leaves which frictionally engage and remain engaged as long as the compression and extension loads lie below corresponding predetermined limits.

The position-adjusting mechanism 400 includes a body member 402 and a rod member 404 which are respectively connected to the two cross-rods 22 and 34 of the airplane chair 10 in the manner described hereinabove. The position-adjusting mechanism 400 includes a braking mechanism 408 which is self-energizing and which comprises a plurality of canting washers or leaves 410 including front, middle, and rear canting leaves 410a, 410b, and 410c respectively, all having central openings 412, the walls of which frictionally engage the cylindrical surface 414 of the rod member 404. It is to be noted that in this instance, the surface 414 of the rod member 404 acts as one of the frictionally engageable brake elements. In this case, an overload spring 418 is employed which cooperates with other elements to determine the maximum load against which the braking mechanism holds against compression thrusts. Also in this case, an override spring 418 is employed to determine the threshold above which the

brake mechanism 408 is released by extension thrusts.

The body member 402 is of flat, elongated, rectangular configuration and is provided with a longitudinal passage 420 in which the rod member 404 slides and a transverse rectangular passage 422 in which the canting leaves 410 are located. A sliding cam bolt 424 is arranged to slide longitudinally within the body member 402 in order to release the braking mechanism 408 to permit either compression or extension of the position-adjusting mechanism 400 by means of small thrusts applied in either direction. The cam bolt 424 is provided with a flat inner side 426 and a rounded outer side 427 and the passage 428 within which it is arranged, is of similar cross-section in order to facilitate the guiding of the cam bolt backward and forward within the body member 402.

The actual movement of the cam bolt 424 and hence release of braking mechanism 408 is accomplished by means of a crank rod 430 which slides within a transverse slot 432 in the cam bolt 424. The crank rod 430 is connected between a crank hub 434 and a crank pin 436 which are rotatable within apertures in the body member 402 on opposite sides of the passage 428 behind the rectangular opening 422. The movement of the crank rod 430 is controlled by means of a lever 438 firmly secured to the crank rod 434. The lever 438 is movable about a pivot point established by a pin 440 projecting from the hub 434. Normally the lever 438 is urged into its rearmost position against a stop pin 442 at the upper end of the body member 402 by means of a compression coil spring 444 attached to the lower end of the lever and to a post 446 projecting from the body member. The lever 438 is moved to its forward position against the force of the spring 444 by means of the Bowden wire 86. The guiding of the cam bolt 424 within the passage 428 is facilitated by extending the cam bolt in the passage 428 on opposite sides of the rectangular passage 422.

The cam bolt 424 is provided with an enlarged slot 448 on the inner side thereof arranged in embracing relationship with the canting leaves 410. The rear face 450 of the slot 448 is straight, while the forward face 452 is inclined in the same direction as the canting leaves 410, being inclined with respect to the axis $x-x$ of the position-adjusting mechanism a little more than the canting leaves. The upper ends of the leaves 410 are provided with slots 464 embracing the adjacent portion of the crown 427 of the cam bolt in order to prevent rotation of the leaves 410 within the body member 402.

A first, or snubber, pin 454 projecting through a passage 456 passing through the front face 452 is normally urged into engagement with the upper end of the front canting leaf 410a by means of a spring 457 compressed between a collar 458 on the pin and a threaded plug 460 which is adjustably movable inwardly and outwardly of the body member 402 in a threaded opening 462 at the forward end of the passage 428.

The overload spring 416 is arranged between a countersunk apertured threaded plug 417 and a threaded collar 472 within a cylindrical cavity 474 at the front lower end of the body member 402. A threaded tubular member 476 extends forwardly from the threaded collar 472 and co-operates therewith to hold a second, or tripping, threaded pin 478 in any desired position therein,

the outer end of the tubular member 476 being slotted and pressed together slightly for this purpose. The tripping pin 478 carries a rounded tripping point, or tip, 479 at its inner end which is adjustable inwardly and outwardly of the rectangular aperture 422 in spaced relation with the lower end of the front canting leaf 410a. The tripping point 479 is forced by the overload spring 416 into its innermost position as determined by the shoulder 484 against which the collar 472 is forced. It is to be noted that the pin 478 and the tubular member 476 may be moved together as a unit through the central aperture of the adjusting nut 417.

The override spring 418 is also arranged between an apertured threaded plug 490 and a threaded collar 492 within a cylindrical cavity 494 at the rear lower end of the body member 402. A threaded tubular member 496 extends forwardly from the threaded collar 492 and co-operates therewith to hold a third, or holding, pin 498 in any desired position therein, the outer end of the tubular member 496 also being slotted and pressed together slightly for this purpose. The holding pin 498 also carries a rounded tripping point 499 at its inner end which is adjustable inwardly and outwardly of the rectangular aperture 422 in spaced relation with the lower end of the rear canting leaf 410c. The override spring 418 forces the tripping point 499 into its most innermost position as determined by the shoulder 497 against which the collar 472 is forced. The forward portion of the third, or holding pin 498 is encircled by a helical follower spring 500, which is arranged between the collar 492 and a recess 502 in the rear face of the rear canting leaf 410. In practice, the second and third pins 478 and 498 are aligned in opposing relation on opposite sides of the leaves 410 and the cylindrical cavities 474 and 494 in which they are arranged and formed axially in opposite ends of the body member 402 on the opposite side of the shaft 404 from the cam-bolt passage 428.

In operation, when the cam bolt 424 is in its rearmost or withdrawn position, the snubber spring 457 and the follower spring 500 urge the upper and lower ends respectively of the canting leaves 410 in opposite directions, the upper ends being urged rearwardly and the lower ends being urged forwardly causing the braking surfaces 412 of the apertures in the leaves 410 to frictionally engage the surface 414 of the rod member 404. While these braking surfaces are so engaged, the rod member 404 is locked against sliding movement within the body member 402 in either direction.

However, when the braking mechanism 408 is released by forward movement of the Bowden wire 86, the rear face 450 of the cam bolt-slot 448 engages the upper end of the rearmost canting leaf 410c. As the cam bolt 424 is pressed forward against the force of the snubber spring 457, the follower spring 500 presses the lower end of the leaves forward as a unit until the front leaf 410a contacts the tripping pin 478. At this time, further movement of the cam bolt causes the grip of the leaves 410 on the surface 414 of the rod member 404 becomes completely relieved.

While the brake mechanism is thus disengaged, the rod member 404 may be slid in either direction in the central passage 420 through the body member 402 to set it in a new position. As the cam bolt 424 is returned to its rearmost posi-

tion, the leaves 410 follow as a unit by virtue of the action of the snubber spring 458 and the follower spring 500. When the rear leaf 410c contacts the holding pin 498, the leaves cant and finally disengage the rear shoulder 459 of the cam bolt 424. When this occurs the snubber pin 454 and the holding pin 498 hold the leaves 410 in frictional engagement with the rod member 404, thus locking the position-adjusting mechanism 400 in the position in which it has been set.

With the braking mechanism 408 engaged, as compression thrusts are applied to the rod member 404, initially the leaves 410 are carried forward against the force exerted thereon by the snubber spring 457 until they engage the forward face 452 of the slot 448 in the cam bolt 424. Further forward movement of the upper end of the canting leaves 410 is precluded at that time. Thereafter as the thrust of the rod member 404 increases in the same direction, the leaves 410 deflect, pressing their braking surfaces 412 with more and more force against the braking surface 414 of rod member 404. After a little deflection, the front canting leaf 410a engages the tripping pin 479 urging it forwardly against the force of the overload spring 416. The force exerted by the leaves 410 on the rod increases as the thrust increases for a while. But further increases in the gripping force is resisted more and more by the overload spring 473, until finally this force is relieved reducing the frictional force along the surfaces 412 and 414. As the thrust continues to increase in the same direction, it finally exceeds the value of thrust which can be held by the frictional force. At this time, the brake mechanism is released permitting the rod member 404 to slide through the canting leaves 410 in continuous frictional engagement therewith. During this sliding movement, the axially directed frictional force exerted by the canting leaves 410 on the rod member 404 is governed in part by the force exerted by the overload spring 416 when compressed and in part by the coefficient of friction between the braking surfaces.

With the braking mechanism 408 engaged, as extension thrusts are applied to the rod member 404, initially the leaves 410 are carried rearwardly against the force exerted thereon by the third pin 498. After the collar 492 is lifted off the shoulder 497, the gap between the rear face 450 of the slot 448 in the cam bolt 424 and the gap between the pin 430 and the front surface of the slot 432 are taken up, causing the rear leaf 410c to engage the shoulder 459 firmly. Thereafter as the thrust on the rod member 404 increases in the same direction, the shoulder 459 exerts an increasing force on the leaves in opposition to the force of the snubber spring 458 and the force of the override spring 418. Thereafter, the force exerted between the braking surfaces 412 and 414 decreases until it reaches a value too small to hold against the extension force by virtue of the friction between the braking surfaces.

It can be shown that the minimum extension force at which slippage occurs becomes more and more independent of the coefficient of friction μ between the braking surfaces in this arrangement as the value of μM increases relative to unity, where M is the mechanical advantage of the leaves considered as levers for applying the gripping forces. μ is made a maximum value of about 0.3 for metal-to-metal surfaces by operating the braking surfaces 412 and 414 dry, that is, un-

lubricated. In practice, a value of μM equal to about 5 has been found to be very satisfactory. With smooth braking surfaces the value of μ and hence μM changes very slightly and since the percentage change of release load is very much smaller than the percentage change of μ , the minimum force required to extend the position-adjusting mechanism 400 is practically independent of the coefficient of friction.

In order to provide a braking mechanism 408 having long life and uniform characteristics, "flat" sections are formed in each of the leaves 410 at the edge thereof which contacts the rod member 404 as illustrated in Fig. 22. These "flat" sections are actually formed by placing each of the leaves on a cylindrical die and then tilting each of the leaves with a strong couple in order to crush two diagonally opposite edges. The crushed edges are then deburred, rounded, polished, and then burnished in oil. Preferably, the "flat" sections 510 extend inwardly of the apertures in the leaves 410 to a distance equal to about $\frac{1}{3}$ to $\frac{1}{2}$ of the thickness of a leaf. In this way, braking surfaces are formed in the leaves which bear upon the surface 414 of the rod member 404 over a relatively large area and thus minimize indentation and resultant wear of the cylindrical surface 414. In order to further provide a braking mechanism 408 of long life, the leaves 410 are preferably composed of hard-rolled beryllium-copper alloy Brylco 25, 2 B and S gages hard and the finished leaves are heat treated in order to raise their tensile strength to a high value. Also, the rod member 404 is composed of SAE 4130 chrom-molybdenum steel which has been treated to render its tensile strength at least 200,000 p. s. i. Both the frictionally engageable surfaces of the canting leaves 410 and the rod member 404 are finished to an uniformity of 5 micro-inch or better.

The presence of such "flat" sections draws the effective pressure point inwardly from the outer sides of the respective leaves 410, thereby increasing the mechanical advantage M of the leaves when they are considered as levers for the transmission of forces to the surface 414 of the rod member 404 from any of the pins 456, 476, and 499. This increase in mechanical advantage is achieved without, however, sacrificing the strength of the leaves 410 as would occur, if their thickness were reduced.

It is to be noted that the follower spring 500 and the snubber spring 457 cooperate to maintain the canting leaves 410 in frictional engagement with the rod member 404 even though the braking surfaces 412 of the canting leaves become worn. Even though wear results in reducing the mechanical advantage M , the minimum force required for extension remains substantially unchanged.

From the foregoing it is readily seen that this position-adjusting mechanism is also capable of remaining locked against a wide range of forces exerted in one direction thereon but is capable of being readily adjusted by relatively small forces exerted in the opposite direction.

PART IV

Résumé

Two main types of the invention have been described hereinabove. In both, frictionally engageable braking surfaces are employed to hold the body member and the rod member of a position-adjusting mechanism set in a predetermined position. Also, in both types springs are em-

played to permit the braking surfaces to slip in one direction or the other only when the thrust between the body member and the rod member in the corresponding direction exceeds a predetermined amount. These two predetermined amounts are made unequal so that the position-adjusting mechanism is capable of holding against large forces applied in one direction and against only small forces applied in the other. Such a position-adjusting mechanism finds particular utility when installed on a chair having a tiltable back member which is designed to hold against relatively large backward-tilting forces but which is designed to be raised easily by means of relatively small forward-tilting forces. In all forms of the invention, a brake release mechanism is employed for urging gap-defining elements together to relieve the pressure existing between the frictionally engageable braking surfaces in order to release their hold on the rod member so that the rod member may be moved relatively to the body member by means of very small forces applied in either direction.

In three forms of the invention, namely, forms 1 and 2 of the screw type, and the single form of the canting type illustrated, a preloaded spring and a pair of gap-defining elements are employed to prevent slippage of the frictionally engageable braking surfaces while the thrust tending to produce slippage lies beneath a predetermined value. Furthermore, the gap-defining elements are arranged to engage when the thrust attains the predetermined value mentioned and acts to relieve the pressure between the frictionally engageable braking surfaces in such a way as to maintain the frictional resisting force (which is parallel to the braking surfaces) substantially constant during slippage. In these three forms of the invention, the force exerted between the gap-defining elements during slippage varies as an inverse function of the coefficient of friction μ existing between the braking surface. In this way, the frictional force is maintained substantially constant during slippage and independent of the coefficient of friction at least over the very wide range of values of the coefficient of friction likely to be encountered in practice.

The gap-defining elements which operate in these three forms of the invention to relieve the force exerted by the override spring are usually in the form of two solid elements, one of which is mounted firmly on the body member and the other of which is carried with a brake member. It is to be noted that the variation in force that occurs between these elements between the time that they first make contact and the time when the braking surfaces would become completely disengaged, causes them to be compressed. The compression is very slight because of their high compliance. However, it is not necessary for these elements to be solid, but they may be in a form involving the action of other spring means having a higher compliance than the override spring during brake release so that the force between these points may change rapidly though the force exerted by the override spring changes only slightly when the coefficient of friction or the extension thrust changes.

Although only two types of the invention have been specifically disclosed hereinabove, it will be obvious that the invention is not limited thereto but is capable of a wide variety of mechanical embodiments. Various changes, which will suggest themselves to those skilled in the art, will therefore be made in the material, form, details of construction, and the relative arrangement of

the parts without departing from the principles of the invention. Reference is, therefore, to be had to the appended claims for a definition of the limits of the invention.

The invention claimed is:

1. In an adjustable chair comprising a support member and a tiltable back member, the improvement which comprises: an adjustable positioning mechanism comprising a body member and a rod member connected between said support member and said back member for setting said back member in a predetermined tilt position, said adjustable mechanism comprising a brake mechanism having first and second brake means interconnecting said body member and said rod member, said brake means having frictionally engageable braking surfaces adapted when engaged to oppose relative movement of said members, means for maintaining said braking surfaces engaged to hold said back member against relatively large rearward-tilting forces, a preloaded spring opposing forward-tilting forces and arranged to urge said braking surfaces into engagement to produce a frictional force along said surfaces which resists relative movement of said members by forward-tilting forces, and means including a pair of elements engageable during relative movement of said members for relieving the force urging said braking surfaces together whereby the minimum value of forward-tilting forces required to tilt said back member forward while said brake mechanism is operative is maintained at a substantially constant relatively low value irrespective of variations in the coefficient of friction between said surfaces.

2. In an adjustable chair comprising a support member and a tiltable back member, the improvement which comprises: an adjustable positioning mechanism comprising a body member and a rod member connected between said support member and said back member for setting said back member in a predetermined tilt position, said adjustable positioning mechanism comprising a brake mechanism having first and second brake means interconnecting said body member and said rod member, said brake means having frictionally engageable braking surfaces, means for maintaining said braking surfaces engaged to hold said back member set in a predetermined position against relatively large rearward-tilting forces, means including a preloaded spring for urging said braking surfaces together to resist forward-tilting forces, and a pair of elements engageable in response to forward-tilting forces exceeding a predetermined relatively low value for relieving the force urging said braking surfaces together, whereby said back member is tilted forwardly by forward-tilting forces exceeding said predetermined low value.

3. In an adjustable chair as defined in claim 1, means for adjusting the preloading force exerted by said spring to vary the predetermined low value of forward-tilting force required to relieve the force urging said braking surfaces together.

4. In an adjustable chair as defined in claim 2, brake release means controllable by a chair occupant for bringing said elements into engagement irrespective of such tilting force for disengaging said braking surfaces, whereby free relative movement of said chair members is permitted.

5. In an adjustable chair comprising a support member and a tiltable back member, the improvement which comprises: an adjustable positioning mechanism comprising a body member and a rod

member connected between said support member and said back member for setting said back member in a predetermined tilt position, said adjustable positioning mechanism comprising a brake mechanism having first and second brake means respectively associated with said body member and said rod member, said brake means having frictionally engageable braking surfaces, means manually controllable by an occupant of the chair for disengaging said braking surfaces to permit tilting said back member in either direction by relatively small forces applied thereto, means for maintaining said braking surfaces engaged to hold said back member set in a predetermined position against relatively large rearward-tilting forces, means including a preloaded spring for urging said braking surfaces together to resist forward-tilting forces, and a pair of elements engageable in response to forward-tilting forces exceeding a predetermined value for relieving the force urging said braking surfaces together, whereby said back member is tilted forwardly by forward-tilting forces exceeding said predetermined value.

6. In an adjustable chair as defined in claim 5, means for adjusting the preloading force exerted by said spring to vary the predetermined low value of forward-tilting force required to relieve the force urging said braking surfaces together.

7. In an adjustable chair comprising a support member and a tiltable back member, the improvement which comprises: an adjustable positioning mechanism comprising a body member and a rod member connected between said support member and said back member for setting said back member in a predetermined tilt position, said adjustable positioning mechanism comprising a brake mechanism having first and second brake means respectively associated with said body member and said rod member, said brake means having frictionally engageable braking surfaces, means including a first preloaded spring for urging said braking surfaces together to resist forward-tilting forces, a first pair of elements engageable in response to said forward-tilting forces exceeding a predetermined relatively low value for relieving the force urging said braking surfaces together, whereby said back member is tilted forwardly by forward-tilting forces exceeding said predetermined low value, means including a second preloaded spring for urging said braking surfaces together to resist backward-tilting forces, and a second pair of elements engageable in response to rearward-tilting forces exceeding a predetermined relatively high value for relieving the force urging said braking surfaces together, whereby said back member is tilted rearwardly by rearward-tilting forces exceeding said predetermined high value.

8. In an adjustable chair as defined in claim 7, means for adjusting the preloading forces exerted by said first spring to vary said predetermined low value of forward-tilting force, and means for adjusting the preloading force exerted by said second spring to vary said predetermined high value of backward-tilting force.

9. In an adjustable chair including two chair members, namely a support member and a tiltable back member and also including a position-adjusting mechanism and employing a pair of complementarily threaded members respectively mounted on said chair members, one of said threaded members being rotatably supported relative to the other threaded member to permit relative movement of said two threaded mem-

bers when an axial thrust is applied therebetween whereby said back member is movable from one tilted position to another, the improvement which comprises: a brake mechanism including frictionally engageable stator and rotor brake means for holding said back member set in a predetermined position, said rotor brake means being carried by said rotatable threaded member, first and second springs for urging said two brake means into engagement to resist rotation of said rotatable threaded member, said first spring acting to prevent slippage between said stator and rotor brake means while said backward tilting forces are less than a relatively large overload value, said second spring acting in opposition to forward-tilting forces, and means including a pair of elements engageable when said second spring is compressed more than a predetermined amount by forward-tilting forces for relieving the force urging said brake means together whereby said brake mechanism is released to permit rotation of said nut when said forward-tilting force exceeds a corresponding relatively low predetermined value.

10. An adjustable chair as defined in claim 9 including means controllable by the chair occupant for urging said springs apart to disengage said two brake means.

11. In an adjustable chair comprising a support member and a tiltable back member, the improvement which comprises: an adjustable positioning device comprising a body member and a rod member interconnecting said support member and said back member for holding said back member set in a predetermined tilt position, said adjustable positioning device comprising a brake mechanism including canting means having apertured walls frictionally engageable with the surface of said rod member, means including a first preloaded spring for urging said walls against said surface to resist forward-tilting forces, a first element engageable with one end of said canting means in response to forward-tilting forces exceeding a predetermined relatively low value for relieving the force urging said walls against said surface, whereby said back member is tilted forwardly by forward-tilting forces exceeding said predetermined low value, means including a second preloaded spring for urging said walls against said surface to resist backward-tilting forces, and a second element engageable with the opposite end of said canting means in response to rearward-tilting forces exceeding a predetermined relatively high value for relieving the force urging said walls against said surface, whereby said back member is tilted rearwardly by rearward-tilting forces exceeding a predetermined relatively high value.

12. An adjustable chair as defined in claim 11 comprising means controllable by the chair occupant for forcing said elements in opposite directions against said canting means to disengage said walls from said surface, whereby said back member is easily tilted in either direction.

13. In an adjustable structure including two relatively movable structural members, the improvement which comprises a position-adjusting mechanism including a body member and a rod member interconnecting said structural members, said body member and said rod member being mutually movable in opposite directions to various relative positions in an extended range in response to forces applied in corresponding opposite directions between said structural members, the improvement which comprises: a brake

mechanism including brake means interconnecting said body member and said rod member, said brake means having frictionally engageable braking surfaces that are mutually slidable, first and second springs for urging said braking surfaces into engagement to resist relative movement of said structural members at various positions in said range, said first spring acting to permit sliding movement between said braking surfaces only while the forces acting to move said structural members in one direction exceed a relatively large predetermined value, said second spring acting in opposition to a force acting to move said structural members in the opposite direction, and means including a pair of relatively movable elements normally unengaged when said second spring is compressed less than a predetermined amount and becoming engaged when said second spring is compressed more than a predetermined amount by a force applied in said opposite direction for relieving the force urging said braking surfaces together whereby said brake mechanism is released to permit sliding movement of said braking surfaces only when said latter force exceeds a relatively low predetermined value.

14. An adjustable structure as defined in claim 13 including manually controllable means operative to urge said springs apart to disengage said two braking surfaces at any part of said range.

15. In an adjustable structure including two structural members arranged for relative movement by forces applied therebetween, the improvement which comprises: an adjustable positioning device comprising a body member and a rod member interconnecting said structural members for setting said structural members in predetermined relative positions, said adjustable positioning device comprising a brake mechanism including canting means having apertured walls frictionally engageable with the surface of said rod member, means including a preloaded spring for urging said walls against said surface to resist relative movement of said structural members in one direction, a first element engageable with one end of said canting means in response to such forces applied in said one direction and exceeding a first predetermined value for relieving the force urging said walls against said surface, whereby said structural members are moved in said one direction by forces exceeding said first predetermined value, and a second element engageable with the opposite end of said canting means in response to forces applied in said opposite direction, means including a second preloaded spring acting on said second element for relieving the force urging said walls against said surface, whereby said structural members are free to move in said opposite direction by forces exceeding second predetermined value.

16. An adjustable structure as defined in claim 15 including manually controllable means including a lever for effecting relative movement of said elements and comprising means including a third spring connected to said lever for urging said elements apart and away from said canting means.

17. An adjustable structure as defined in claim 15 wherein said elements are located on opposite sides of said canting means and are spaced from said canting means when no force is applied between said structural members, and means for adjusting the relative positions of said elements in the direction parallel to the axis of said rod.

18. An adjustable structure as described in claim 15 including auxiliary springs urging said ends toward the respective elements for main-

taining said walls in engagement with the surface of said rod member.

19. In a position-adjusting mechanism including a body member and a rod member which are mutually movable over an extended range by a thrust applied therebetween in a predetermined direction, the improvement which comprises: a brake mechanism comprising first and second brake means interconnecting said body member and said rod member, said brake means having braking surfaces adapted to be slidably engaged throughout said range and adapted when engaged to frictionally oppose relative movement of said members in said direction at any part of said range, a preloaded spring opposing such thrust and arranged to urge said braking surfaces into engagement throughout said range to produce a frictional force along said surfaces which resists relative movement of said members by such thrust, and means including a pair of normally unengaged elements engageable during relative movement of said members for relieving the force exerted by said preloaded spring in urging said braking surfaces into engagement, whereby said frictional force is maintained substantially constant irrespective of variations in the coefficient of friction between said surfaces.

20. In a position-adjusting mechanism including a body member and a rod member which are mutually movable over an extended range, the improvement which comprises: a brake mechanism comprising first and second brake means respectively associated with said body member and said rod member, said brake means having braking surfaces adapted to be slidably engaged throughout said range and adapted when engaged to frictionally oppose relative movement of said members at any part of said range, means including a preloaded spring opposing thrust applied in a predetermined direction between said body member and said rod member, said means urging said braking surfaces into engagement while such thrust is applied at any part of said range, and means including a pair of relatively movable elements that are normally unengaged with each other but are engageable in response to such thrust in excess of a predetermined value for relieving the force urging said braking surfaces into engagement whereby said rod member moves relative to said body member.

21. A position-adjusting mechanism as defined in claim 20 comprising means including an adjustable element engaging said spring for adjusting the preloading force exerted by said spring to vary the predetermined value of thrust required to move said rod member relative to said body member from one relative position to another in said range.

22. A position-adjusting mechanism as defined in claim 21 in which said elements are spaced apart to define a small gap when no thrust is applied between said members, and comprising means for moving one of said elements while said body member and rod member are in a fixed relative position for adjusting the size of said gap.

23. A position-adjusting mechanism as defined in claim 20 comprising: brake release means for forcing said elements into engagement irrespective of such thrust for disengaging said braking surfaces, whereby free relative movement of said members is permitted.

24. In a position-adjusting mechanism, the combination which comprises: a body member and a rod member which are mutually movable over an extended range, a brake mechanism

comprising first and second brake means operatively associated with said body member and said rod member respectively, said brake means having braking surfaces adapted to be slidably engaged throughout said range and adapted when engaged to frictionally oppose relative movement of said members at any part of said range, means including a preloaded spring for urging said braking surfaces together into such engagement while such thrust is applied at any part of said range, said spring acting in opposition to a thrust applied in a predetermined direction between said rod member and said body member, first stop means carried on said body member, and second stop means movable with said second brake means, said two stop means being normally spaced apart when said spring is compressed less than a predetermined amount but being engageable when said spring is compressed more than said predetermined amount by such thrust for relieving the force urging said braking surfaces into engagement, whereby said brake mechanism is released to permit movement of said rod member relative to said body member when said thrust exceeds a corresponding predetermined value.

25. In a position-adjusting mechanism including a body member and a rod member which are mutually movable over an extended range, the improvement which comprises: a brake mechanism comprising first and second brake means respectively associated with said body member and said rod member, said brake means having braking surfaces adapted to be slidably engaged throughout said range and adapted when engaged to frictionally oppose relative movement of said members at any part of said range, a preloaded spring opposing thrust applied in a predetermined direction between said body member and said rod member, said spring urging said braking surfaces into engagement while such thrust is applied at any part of said range, and a pair of elements normally urged into spaced apart position by said spring and urged together by said thrust, said elements engaging when said spring is compressed a predetermined amount, said elements acting when engaged to relieve the force exerted between said braking surfaces whereby said rod member moves relative to said body member.

26. In a position-adjusting mechanism including a body member and a rod member which are mutually movable from a predetermined position within an extended range in a predetermined direction in response to thrust applied therebetween in said direction, the improvement which comprises: a braking mechanism comprising a pair of brake means associated with said respective members, said brake means having braking surfaces adapted to be slidably engaged throughout said range means including a preloaded spring working in opposition to said thrust for exerting a force urging said braking surfaces into engagement while such thrust is applied at any part of said range, and a pair of normally spaced apart elements respectively associated with one of said brake means and one of said members and engageable when a predetermined small amount of movement occurs between said members in said direction, said elements acting when engaged to relieve the frictional force exerted between said braking surfaces, whereby said brake mechanism is released to permit large relative movement of said members from one position to another within said range when said thrust exceeds a predetermined amount.

27. In a position-adjusting mechanism including a body member and a rod member which are mutually movable over an extended range in a predetermined direction in response to thrust applied therebetween in said direction, the improvement which comprises: a brake mechanism comprising first and second brake means respectively associated with said body member and said rod member, said brake means having braking surfaces adapted to be slidably engaged throughout said range, means including a preloaded spring working in opposition to said thrust for exerting a force urging said braking surfaces into engagement while such thrust is applied at any part of said range, a first element mounted on said body member, and a second element movable with said first brake means, said elements being spaced apart when no thrust is applied between said members, said elements being engageable with increasing force as said thrust is increased whereby the force therebetween operates to relieve the force exerted between said braking surfaces.

28. A position-adjusting mechanism as defined in claim 27 comprising: brake release means for moving said first element into engagement with said second element irrespective of such thrust, whereby said braking surfaces becomes disengaged thereby permitting free relative movement of said members.

29. A position-adjusting mechanism as defined in claim 28 wherein said brake release means includes a pivoted lever arm, and which comprises: a spring urging said lever arm in a direction to draw said first element away from said second element, and stop means for limiting the movement of said lever arm in the last-mentioned direction.

30. In a position-adjusting mechanism the combination which comprises: a body member and a rod member which are mutually movable over an extended range, a brake mechanism comprising first and second brake means operatively associated with said body member and said rod member respectively, said brake means having braking surfaces adapted to be slidably engaged throughout said range and adapted when engaged to frictionally oppose relative movement of said members at any part of said range, means including first and second springs for urging said braking surfaces together into frictional engagement at any part of said range, said springs acting to create frictional forces which oppose thrusts applied in corresponding opposite directions between said rod member and said body member, and means engageable only when said first spring is compressed more than a predetermined amount by thrust in one such direction for relieving the force urging said braking surfaces together whereby said brake mechanism is released to permit movement of said rod member relative to said body member when the thrust in said direction exceeds a corresponding predetermined value.

31. In an adjustable positioning device, the improvement which comprises: a body member and a rod member for interconnecting two structural members for setting said structural members in predetermined relative positions, said adjustable positioning device comprising a brake mechanism including canting means having apertured walls frictionally engageable with the surface of said rod member, means acting on said canting means at opposite ends thereof to urge the apertured walls of said canting means into

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frictional engagement with the surface of said rod member, said means including a spring acting on at least one end of said canting means, and a release element carried by said body member and engageable by said canting means only when said spring is compressed more than a predetermined amount by thrust applied to said rod in one direction for reducing the torque urging said apertured walls into engagement with the surface of said rod member, whereby the frictional force resisting such thrust is reduced to permit sliding movement of said rod member relative to said apertured walls when the thrust in said direction exceeds a predetermined amount.

32. In an adjustable positioning device, the improvement which comprises: a body member and a rod member for interconnecting two structural members for setting said structural members in predetermined relative positions, said adjustable positioning device comprising a brake mechanism including canting means having apertured walls frictionally engageable with the surface of said rod member, means including a first spring acting on one end of said canting means to urge it in one direction, means including a second spring acting on the opposite end of said canting means to urge it in the opposite direction, said means thus applying a torque to urge the apertured walls of said canting means into frictional engagement with the surface of said rod member, and a release element carried by said body member and engageable by said canting means only when said first spring is compressed more than a predetermined amount by thrust applied to said rod in one direction for reducing the torque urging said apertured walls into engagement with the surface of said rod member, whereby the frictional force resisting such thrust is reduced to permit sliding movement of said rod member relative to said apertured walls when the thrust in said direction exceeds a predetermined amount.

33. In an adjustable positioning device, the improvement which comprises: a body member and a rod member for interconnecting two structural

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members for setting said structural members in predetermined relative positions, said adjustable positioning device comprising a brake mechanism including canting means having apertured walls frictionally engageable with the surface of said rod member, means including a first spring acting on one end of said canting means to urge it in one direction, means acting on the opposite end of said canting means to resist movement of said canting means in said direction, said means thus applying a torque to urge the apertured walls of said canting means into frictional engagement with the surface of said rod member, a stop element engageable by said one end of said canting means when said first spring has been compressed a predetermined amount by thrust applied to said rod in one direction, and a release element carried by said body member and engageable by said canting means only when said first spring is compressed more than said predetermined amount by such thrust for reducing the torque urging said apertured walls into engagement with the surface of said rod member whereby said frictional force resisting such thrust is reduced to permit sliding movement of said rod member relative to said apertured walls when the thrust in said direction exceeds a predetermined amount.

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