Sept. 15, 1970 E. D. MOSKOW 3,528,532

HYDRAULIC LOCKING DEVICE

Filed Aug. 21, 1968 3 Sheets-Sheet 1

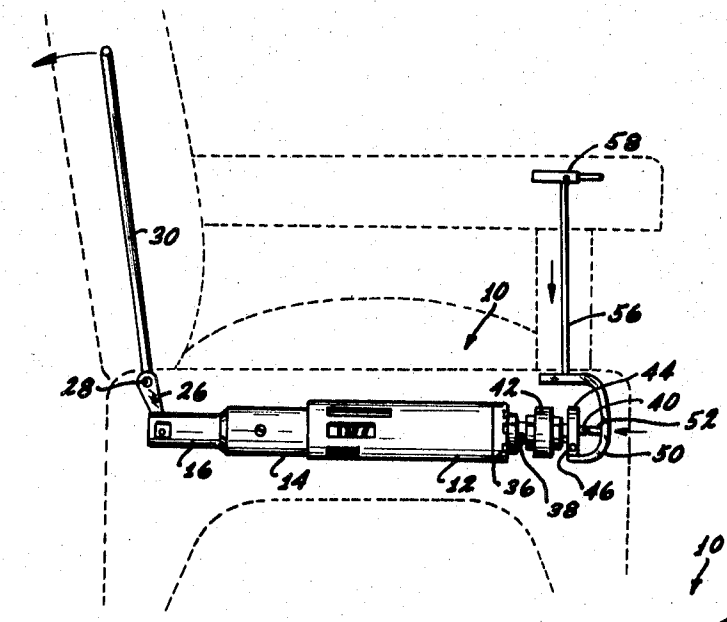


Fig. 1

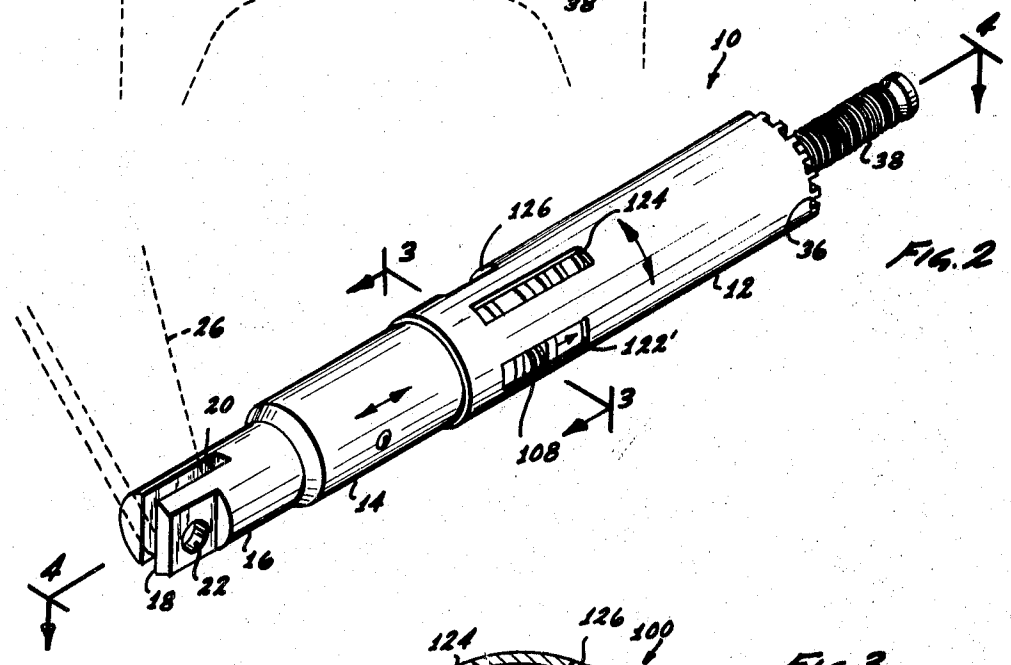


Fig. 2

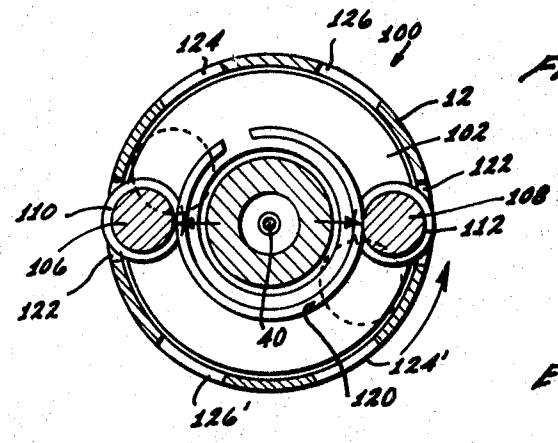


Fig. 3

INVENTOR
EUGENE D. MOSKOW

BY Hurwig + Walsh
ATTORNEYS

Sept. 15, 1970 E. D. MOSKOW 3,528,532

HYDRAULIC LOCKING DEVICE

Filed Aug. 21, 1968 3 Sheets-Sheet 2

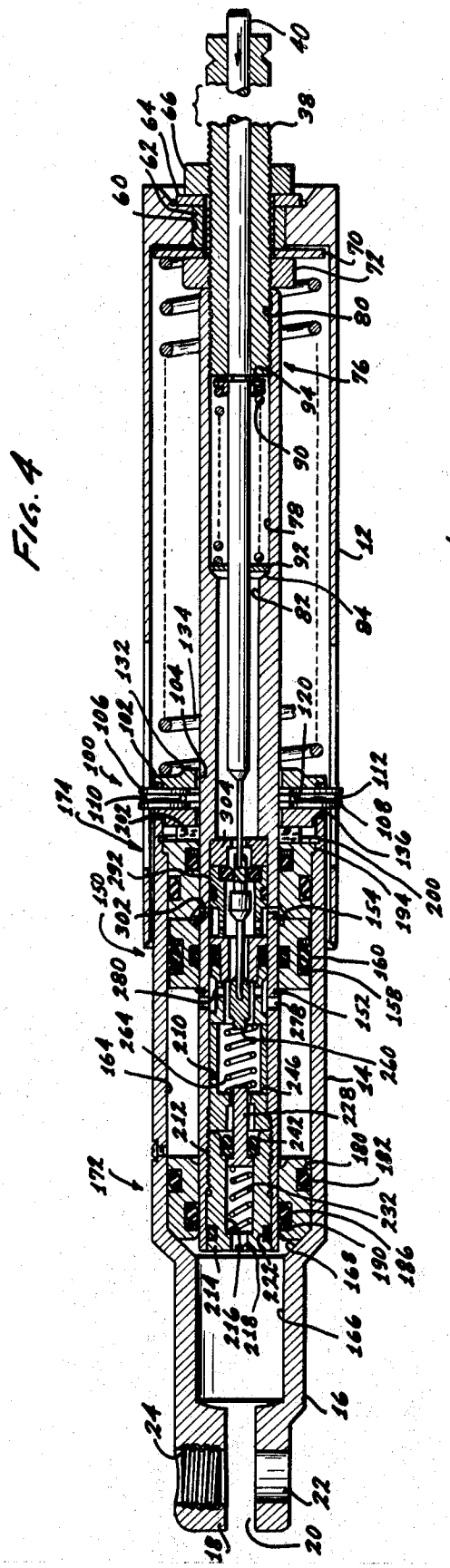


FIG. 4

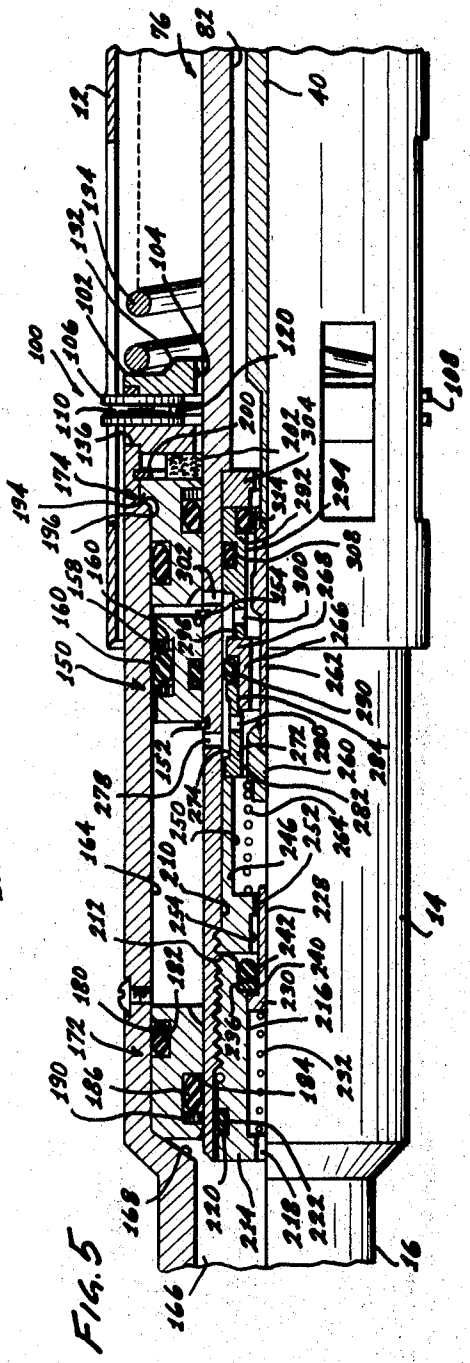


FIG. 5

INVENTOR
EUGENE D. MOSKOW

BY Herzig & Walsh
ATTORNEYS

Sept. 15, 1970 E. D. MOSKOW 3,528,532

HYDRAULIC LOCKING DEVICE

Filed Aug. 21, 1968 3 Sheets-Sheet 3

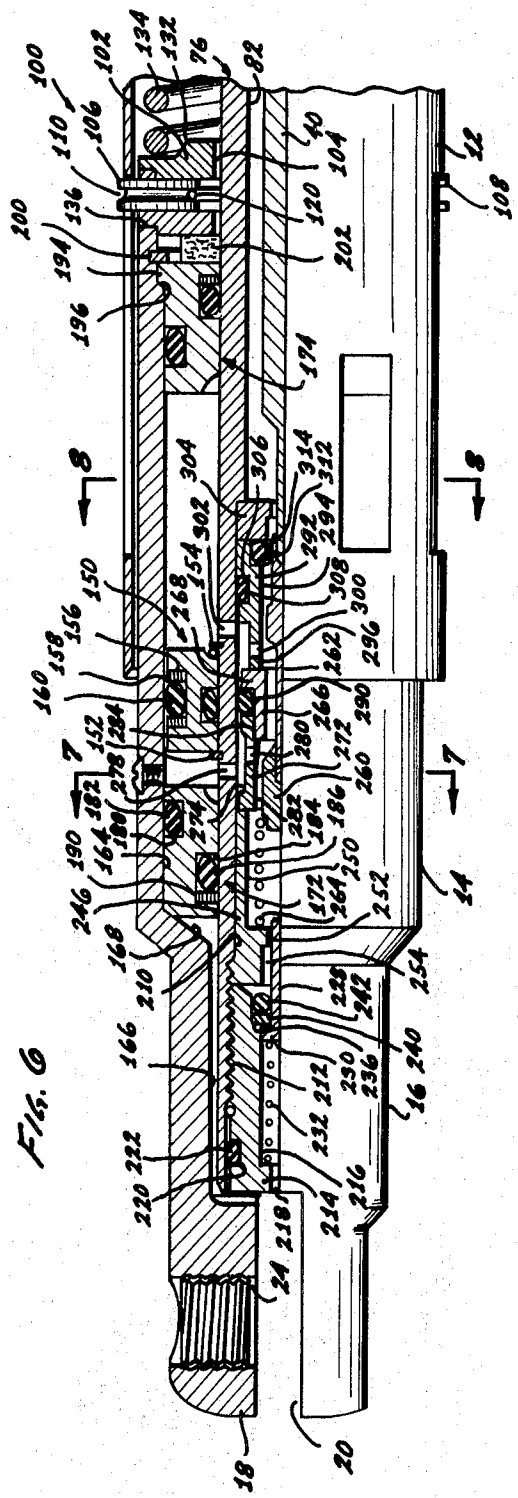


FIG. 6

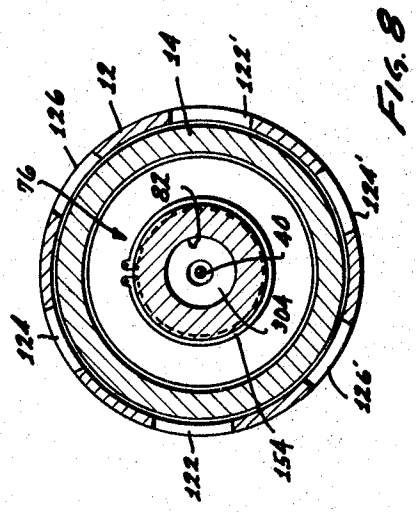


FIG. 8

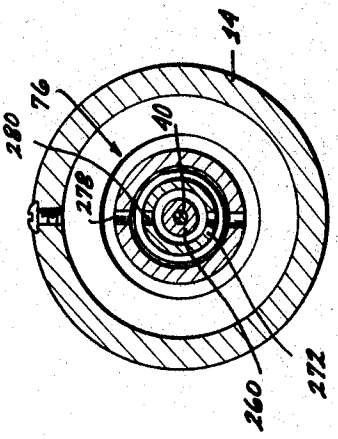


FIG. 7

INVENTOR
EUGENE D. MOSKOW

BY Herzig & Walsh
ATTORNEYS

United States Patent Office 3,528,532
Patented Sept. 15, 1970

3,528,532

HYDRAULIC LOCKING DEVICE

Eugene D. Moskow, 13916 Cordary Ave.,
Hawthorne, Calif. 90250

Filed Aug. 21, 1968, Ser. No. 754,385
Int. Cl. F16f 9/342
U.S. Cl. 188—96 6 Claims

ABSTRACT OF THE DISCLOSURE

The invention is a hydraulic locking device in the form of a locking cylinder having a piston in it with hydraulic chambers on opposite sides of the piston. Communication is provided for between the hydraulic chambers through a locking valve which is manually operable so that the cylinder can be unlocked and locked in various desired positions. The locking valve has a check side and a relief side. A variable volume compensation chamber is provided normally in communication with one of the hydraulic chambers and with the relief or downstream side of the locking valve. The compensation chamber provides for variation in pressure or volume due to temperature and the like. The other hydraulic chamber can be relieved into the compensation chamber by way of the locking valve which opens when there is relief of pressure in one hydraulic chamber producing a differential in pressure between the chambers. The locking valve is within a hollow piston rod or cylinder which is within the locking cylinder, the compensation chamber also being within the piston rod on the downstream side of the locking valve.

SUMMARY OF THE INVENTION

The invention is an improvement in hydraulic locking devices for locking cylinders which normally are utilized for controlling the position of an element. Typically locking cylinders of this type are employed for controlling and holding the tilting back of a reclining chair or the like although the device may be utilized in many similar and comparable applications and environments.

Devices of this general type are known in the prior art. Typically they comprise an hydraulic cylinder reciprocable or slidable in a sleeve. Within the cylinder and sleeve and concentric with it is a hollow cylinder in the form of a piston rod having a piston secured to it. Glands or seals are provided within the moving locking cylinder so as to provide hydraulic chambers on opposite sides of the piston which is fixed in position. Communication is provided for between the two hydraulic chambers and the locking cylinder by way of a locking valve which typically is provided within the inner cylinder, that is, the hollow piston rod and the locking valve is normally manually operable by an operating stem or probe whereby the locking cylinder can be allowed to adjust to different positions and then locked in the desired position.

A compensation chamber is provided to accommodate to changes in pressure in the hydraulic fluid resulting from changes in temperature or otherwise. One of the major deficiencies in the prior art has been the inability of the compensation chamber to accommodate itself to relieving excess hydraulic pressure in both of the hydraulic chambers. Whereas the prior art devices have been so constructed as to be operable to relieve the pressure in one of the hydraulic chambers to the compensation chamber, they have not been capable effectively to relieve the pressure in both chambers. It is accordingly a primary object of the invention to overcome these deficiencies by providing a simplified but effective and positive acting device capable of effectively acting to relieve excess pressure in both of the hydraulic chambers to the compensation chamber. In the exemplary form of the invention as described herein the compensation chamber is provided within the hollow cylinder, that is, the piston rod on the relief or downstream side of the locking valve. One of the hydraulic chambers in the hydraulic cylinder is in free communication with the compensation chamber whereby to relieve excess pressure. The compensation chamber is, of course, expansible so as to accommodate the excess pressure. The other hydraulic chamber can communicate with the compensation chamber through the lock valve which typically is a poppet valve. Thus, upon excess pressure being relieved in the one hydraulic chamber to the compensation chamber this produces a differential in pressure between the two hydraulic chambers. The difference in pressure in the other hydraulic chamber is itself sufficient to cause opening or unseating of the locking valve placing the other hydraulic chamber in communication with the compensation chamber whereby its excess pressure is relieved. Accordingly, it is another object of the invention to provide an improved device of the character described wherein the compensation chamber is on the downstream or relief side of the locking valve and the locking valve is able to unseat and open in response to a differential or excess pressure in one of the hydraulic chambers after pressure has been relieved in the other to the compensation chamber. The placing of the compensation chamber within the hollow piston rod on the downstream side of the locking valve and on the opposite side of it from the operating stem or probe is one of the features of the invention.

In devices of the type described it is desirable that adjustable limits be provided with respect to relative motion as between the locking cylinder and the sleeve or cylinder in which it operates. In the exemplary form of the invention described herein improved manually adjustable detent means are provided whereby a convenient manual adjustment may be made in the locking device to adjust the limits of travel of the device, that is, the travel of the locking cylinder relative to the sleeve in which it moves. Preferably this adjustment is made simply by an angular movement of or rotation of the sleeve which may be made by means of a screw driver. The limits are provided by way of pairs of angularly spaced axial slots in the said sleeve with stops in the form of roller members that fit into the axial slots and which can readily be set to engage with different pairs of slots merely by angular rotation of the sleeve as described. It is accordingly a further object of the invention to provide an improved form of detent of this type and for this purpose wherein the limits of movement are provided for simply by rotation of a sleeve through an angle.

Further objects and additional advantages of the invention will become apparent from the following detailed description and annexed drawings, wherein:

FIG. 1 is a view of a reclining chair with the locking cylinder of the invention applied thereto;

FIG. 2 is a perspective view of the locking cylinder;

FIG. 3 is a sectional view taken along the line 3—3 of FIG. 2;

FIG. 4 is a longitudinal sectional view of the locking cylinder;

FIG. 5 is an enlarged partial sectional view illustrating flow through the locking valve when open;

FIG. 6 is a partial sectional view similar to FIG. 5 illustrating movement of the actuated cylinder to the right;

FIG. 7 is a sectional view taken along line 7—7 of FIG. 6;

FIG. 8 is a sectional view taken along line 8—8 of FIG. 6.

Referring now to FIG. 1 of the drawing there is shown in outline a chair of the type having arms and a reclining back, the chair shown being exemplary of a type such as

may be used in aircraft and the like. The locking cylinder of the invention is identified at **10** being in a position along one side of the seat of the chair. The complete device is shown in FIG. 2. Numeral **12** designates an outer sleeve within which is movable a cylinder or cylinder assembly **14**. The cylinder **14** has an extending part **16** of smaller diameter which is bifurcated as shown at **18** there being a slot **20** between the bifurcations. The bifurcations have apertures therein one of which is shown at **22** and the other of which is threaded being shown at **24**. See FIG. 4. Engaged between the bifurcations is a crankarm **26** on a crankshaft **28** to which is attached a rod or stem **38** that is attached to the reclining back of the chair so that the back is positioned at positions determined by the crankarm **26**.

The cylinder assembly **14** is adjustable or movable to various positions relative to the sleeve **12** by means of a locking valve as will be described in detail presently. The end of the sleeve **12** is notched or castellated as may be seen at **36** so that it can be adjusted to various angular positions by means of a screw driver for purposes that will be described. There is a co-axial cylinder within the cylinder **14** and sleeve **12** and extending from it is a threaded stem **38** within which is a rod or stem **40** as shown in FIG. 1 which is moved axially to actuate the locking valve as will be described. The locking cylinder or device is mounted by way of a mounting bracket or member **42** which is attached to the chair and through which the threaded stem **38** extends. Numeral **44** designates a bracket nut that is on the threaded stem **38** and pivotally attached to it on a pivot **46** is an actuating yoke **50** carrying a set screw **52** which is engageable with the end of the stem **40**. The actuating yoke or bracket **50** is operable by a vertical stem **56** having a handle **58** at the upper end for manual actuation of the locking valve that controls the locking device and to allow the back of the chair to be positioned in and held in various reclining positions as will be described presently.

By adjusting the sleeve **12** to various angular positions by means of a screw driver engaging the notches or castellations **36** the relative positions that the cylinder **14** and sleeve **12** can be adjusted or can be moved to, can be set thus determining the positions that the back of the chair is held in.

Details of the mechanism of the locking device are shown in FIGS. 3 through 8 and these details will next be described. The cylinder assembly **14** slides or reciprocates within the sleeve **12** within limiting positions of travel. In the right end of the sleeve **12** there is a bore **60** having in it bushing **62** through which the threaded stem **38** passes. See FIG. 4. The stem is held in position by a washer **64** and nut **66** on one side and a washer **70** and nut **72** on the other side. Within the cylinder **14** and sleeve **12** is an elongated cylinder **76** having a bore **78** and a threaded end bore **80**. The stem **38** is threaded into the end bore **80**. The cylinder **76** has another bore **82** of smaller size with a shoulder **84** between this bore and the bore **78**. In the bore **78** is a coil spring **90** bearing against a washer **92** at one end and a spring retainer **94** at the other end. This spring is a return spring for the lock valve operating stem or probe **40**.

It is pointed out that the cylinder assembly **14** slides within the sleeve **12**. The limits of relative movement of the cylinder **14** and sleeve **12** are controlled by a detent assembly **100**. This assembly comprises a detent case **102** which is a cylindrical member having a bore **104** through which the cylinder **76** extends. See FIG. 4. The detent assembly is shown in cross-section in FIG. 3. The detent case or member **102** has diametrically opposed circular cutouts which receive detent members or rotors **106** and **108** each of which has a circumferential groove as may be seen at **110** and **112**. The detent member **102** has an inner bore larger than the bore **104** and within this bore is an expander detent spring **120** and diametrical parts of it engage in the circumferential grooves **110** and **112** in the detent rollers **106** and **108** forcing them outwardly into pairs of elongated slots in the sleeve **10**. There are three pairs of these elongated slots as designated at **122** and **122'**; **124** and **124'**; and **126** and **126'**. The pairs of slots are of different lengths. The detent rollers **106** and **108** engage in oppositely disposed slots as may be seen in FIGS. 2 and 3 and slide axially in the slots as the cylinder **14** moves axially relative to the sleeve **12**. As may be seen, the pairs of slots limit the movement and thereby establish the reclining positions to which the back of the chair may be adjusted. As previously explained the sleeve **12** is rotatable by engaging the castellations **36** with a screw driver to adjust it to angular positions in which the detent rollers **106** and **108** engage in different pairs of elongated slots of different lengths. Angular positioning of the sleeve **12** is permitted since it can ride over the outer peripheries of the detent rollers **106** and **108** which can push in against the expander spring **120** allowing angular movement.

The detent case **102** has a beveled shoulder **132** at its right end as shown in FIG. 4 and engaged between the detent case and the washer **70** is the coiled actuator return spring **134** which normally urges the cylinder assembly **14** to the left.

At the other end or side of the detent case **102** it has a square angular shoulder **136** and the end of the cylinder **14** interfits with this shoulder.

The cylinder **76** is actually a piston rod relative to which the cylinder **14** moves. On the piston rod is a piston **150** which is held in position by snap rings **152** and **154**. The piston member has an annular groove **156** in which are sealing rings including the ring **158** and O-ring **160**.

The cylinder **14** has a bore **164** and a smaller bore **166** and a slanting bore **168** between these bores. In the bore **164** at its ends, are glands one of which is designated at **172** and the other at **174**. These glands which move with the cylinder **14** provide hydraulic locking chambers on opposite sides of the piston **152**. The gland **172** is a cylindrical member having an external annular groove **180** in which is a sealing O-ring **182**. It has an internal annular groove **184** in which is a sealing O-ring **186** and additional sealing ring **190**. The gland **174** is like the gland **172** and will not be described in detail. However, it has an annular end shoulder **194** that engages in an annular groove **196** or counterbore in the end of the cylinder **14** and it is held in position by a snap ring **200** and between the gland **174** and detent case **102** is a pad or disc **202**.

The piston rod **76** has a bore **210** of slightly smaller diameter than the bore **82** at the left end which is threaded as shown at **212**. See FIG. 5. Threaded into the end of the piston rod is a screw plug or cylinder **214** which has a bore **216** providing a compensation chamber as will be described, there being a counterbore **218** closed by the end plug. The screw plug **214** has an external annular groove **220** in which is a sealing O-ring **222**.

Numeral **228** designates a compensation cylinder having an enlarged end part **230** that forms a piston that moves in the bore **216** against a spring **232** that normally urges it to the right. In the end of the screw plug **214** there is a counterbore **236** having in it a washer **240** and a sealing O-ring **242**.

Numeral **246** designates a cylindrical spring cage that moves within the bore **210**. It has a bore **250** and counterbores **252** and **254**. The compensation piston **230** extends through the bore **252**. The lock valve member itself is designated at **260**, it being a poppet valve which is on a poppet valve stem **262** which is an extension of the actuator stem or probe **40** previously described. Within the bore **250** of the spring cage **246** is a coil spring **264** that normally urges the poppet valve **260** to the right, that is, in seating direction. The valve seat is designated at **266**, being a cylindrical member having an end flange **268**. FIG. 4 shows the valve closed and FIG. 5 shows it in open position, FIG. 6 also showing it in open position. Numeral

272 designates a cylindrical guide which is between the end of the spring cage 246 and the valve seat member 266. It has an external circumferential groove 274 to provide an annular space between itself and the wall of the piston rod 76. In this wall adjacent to the gland 174 is an aperture or port 278 providing communication of hydraulic fluid through a port 280 in the guile 274 thus providing communication of hydraulic fluid from the hydraulic chamber on the left side of the piston 174 to the interior of the compensation chamber which is the chamber formed by the bore 50 and the spring cage 246. As may be seen this pressure acts on the end of the compensation piston 230 tending to urge it to the left against the spring 232.

The sleeve 274 has a bore 282 which is slightly larger than the outer diameter of the poppet 260 to allow passage of fluid and at its other end it has a counterbore 284 which engages the valve seat 262, and between the end of the guide 274 and the flange 268 on the seat member 266 is a sealing O-ring 290.

Numeral 292 designates a manifold member which is a cylindrical member having a bore 294 through which the poppet plunger stem 262 passes. Its left end part 296 is of smaller diameter as shown, leaving an annular space between it and the interior bore 210 and in this part of the manifold is the port 300 that provides a communication with the port 302 in the side wall of the piston 76, these ports providing communication of hydraulic fluid from the chamber on the right hand side of the piston 174 to the interior of the valve seat member 290. When the pressure in this hydraulic chamber exceeds the pressure in the hydraulic chamber on the left side of the piston 174 this pressure is able to open the poppet valve, that is, to unseat it to allow flow from this hydraulic chamber to the compensation chamber 250 as will be described in detail presently.

Numeral 304 designates a spacer ring which engages against the square shoulder between bores 82 and 210 in the piston rod 76, the manifold 294 seating against this spacer ring. The manifold 292 has an external annular groove 306 in which is a sealing O-ring 308. It has an internal annular end groove in which is a sealing O-ring 314.

Next will be summarized the operation of the locking device.

OPERATION

The locking device will hold the back of the reclining chair in any adjusted position as illustrated in FIG. 1. FIG. 1 shows the full upright position with the locking device extended, the parts being in the positions as shown in detail in FIGS. 4 and 5, that is, the cylinder 14 is extended relative to the sleeve 12 with return spring 134 expanded.

If now the occupant wishes to tilt the back of the chair to reclined position, the handle 58 is operated to manipulate the pivoted yoke 50 bringing the screw 52 into engagement with the end of the operating stem or probe that operates the poppet shaft or stem 40 to open the locking poppet valve 260, that is, to unseat it from the seat 266. This allows the transfer of hydraulic fluid from the hydraulic chamber in cylinder 14 on the left side of piston 174 to the chamber on the opposite side of this piston as illustrated by the arrows in FIGS. 5 and 6. That is, the flow is through the ports 278 and 280, through the bore in the valve seat 266, and the ports 300 and 302 to the other chamber. As long as the poppet is held open the cylinder 14 can move to the right as illustrated in FIG. 6, the back of the chair tilting to a more reclined position in which it is held whenever the poppet 260 is allowed to close blocking off any further transfer of hydraulic fluid from one side of piston 174 to the other.

As previously explained the detent 100 provides limiting positions for the back of the chair by limiting the movement of the cylinder 14 relative to the sleeve 12. As explained the sleeve 12 can be rotated to various angular positions by applying a screw driver to the castellations 36 to bring various of the pairs of elongated slots 122, 124 and 126 into cooperation with detent rotors 106 and 108, the sleeve riding over these detent rotors when it is rotated.

The hydraulic fluid in the locking cylinder is subject to changes in pressure depending on changes in temperature and, of course, the device may be exposed to various environments including environments in which there is a wide range of change of temperature. Subjection to this type of environment has been the occasion of difficulties and problems with prior known devices of this type. In the device as described an increase in pressure in the hydraulic chamber in cylinder 14 to the left of piston 174 will be the occasion of a flow of fluid through the ports 278 and 280 into the compensation chamber provided by the bore 250, this pressure acting on the compensation piston 230 to move it and compress the spring 232 sufficiently to accommodate the increase in pressure. In the event of such increase in pressure which is accommodated by the compensation chamber as described, the increase is, of course, relieved by the additional volume provided by movement of the piston 230, so that a differential now exists between the hydraulic chamber on the left side of piston 174 and that on the right side. In other words whereas the excess pressure in the chamber on the left side of piston 174 has been relieved, relief will now be provided from the chamber on the right hand side of the piston, this pressure being communicated through the ports 300 and 302 and acting on poppet 260 to unseat it so that the relief is provided for from this chamber into the compensation chamber through the lock valve itself. It will be observed from the figures that the compensation chamber is on the relief side of the poppet 260, that is, on the side of the poppet opposite from the poppet actuating stem. The compensation chamber is adjustable by adjustment of the compensation chamber screw plug 214.

When the cylinder 14 moves to the right it compresses the return spring 134 and when it moves to the left this spring expands.

The back of the chair may be tilted upwardly from a reclining position without manipulating the operating handle 58, this action causing the cylinder 14 to be drawn out of the sleeve 12, this action overriding the manual control of the locking valve. As may be observed when the cylinder 14 is drawn to the left in this manner, the pressure in the hydraulic chamber on the right hand side of the piston 174 is increased and the pressure becomes sufficient to unseat the poppet 260 to allow transfer of hydraulic fluid from the hydraulic chamber on the right hand side of the piston to the chamber on the other side. The tension of springs 264 and 232, is, of course, made appropriate to the hydraulic pressures for which the device is designed and to accommodate manual opening of the poppet 260 in the manner described, an automatic opening for compensation purposes and for purposes of override as described.

From the foregoing, those skilled in the art will readily understand and appreciate the nature and construction of the invention and the manner in which it achieves and realizes all of the objects as set forth in the foregoing as well as the many additional advantages that are apparent from the detailed description.

The foregoing disclosure is representative of a preferred form of the invention and is to be interpreted in an illustrative rather than a limiting sense.

What is claimed is:

1. In a locking device of the type described comprising a cylinder, a piston in said cylinder providing hydraulic chambers on opposite sides of the piston, a locking valve providing for communication between the hydraulic chambers to allow relative movement of the piston and cylinder, a compensation chamber separate from said chambers for accommodating increases in hydraulic pressure the improvements comprising the compensation chamber

being positioned on the relief side of the locking valve and in communication with one of the said hydraulic chambers, the locking valve being constructed to open in response to a differential in pressure between the hydraulic chambers and to provide for communication from the other hydraulic chamber to the compensation chamber.

2. A device as in claim 1 wherein the said one hydraulic chamber is in unrestricted communication with the compensation chamber.

3. A device as in claim 1 including a manually operable stem on one side of the locking valve, the compensation chamber being positioned on the opposite side of the locking valve.

4. A device as in claim 1 including a concentric hollow piston rod within the hydraulic cylinder to which the piston is attached, the said locking valve and compensation chamber being within the said piston rod.

5. A device as in claim 1 including a sleeve in which said cylinder reciprocates, means providing stops to limit the relative travel of the said cylinder and sleeve, comprising the sleeve having axial slots provided in it, spring detent means engageable in the slots and cooperable with the ends of the slots to limit relative movement of the sleeve.

6. A device as in claim 5 wherein the said sleeve has a plurality of pairs of said axial slots and said spring detent means comprises diametrically opposed detent members engageable in said slots, said detent members being movable whereby to allow angular positioning of the said sleeve whereby to cause the detent members to engage in different pairs of the said axial slots.

References Cited

UNITED STATES PATENTS

2,365,247	12/1944	Carlton.
2,671,680	3/1954	Stevens.
3,051,274	8/1962	Porter.
3,223,206	12/1965	Bainbridge et al.
2,559,047	7/1951	Porter et al.

GEORGE A. HALVOSA, Primary Examiner

U.S. Cl. X.R.

188—100; 248—354; 285—302, 303; 287—58; 297—355