Jan. 26, 1960 P. L. PORTER 2,922,497

HYDRAULIC LOCKING DEVICE

Filed Nov. 19, 1956 3 Sheets-Sheet 1

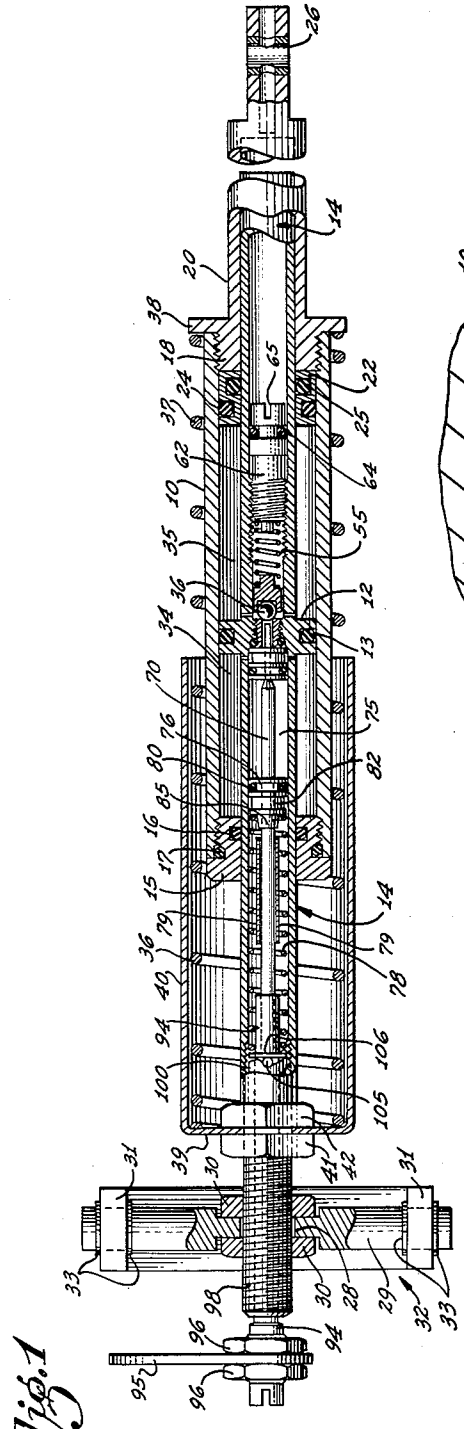


Fig. 1

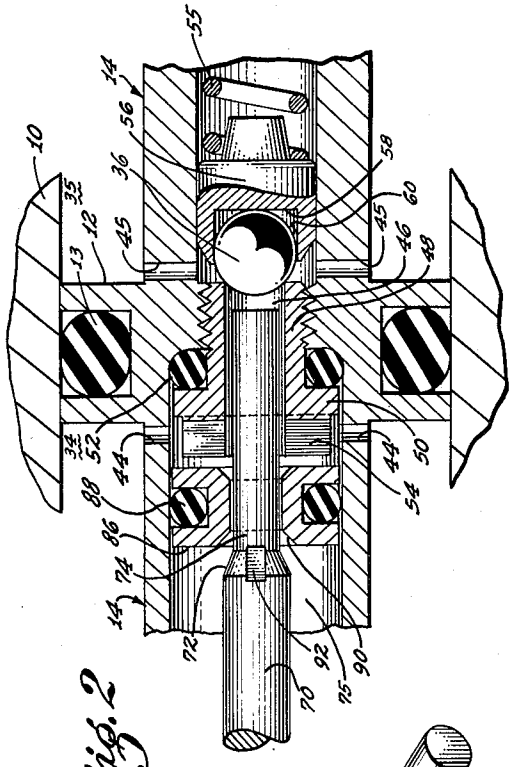


Fig. 2

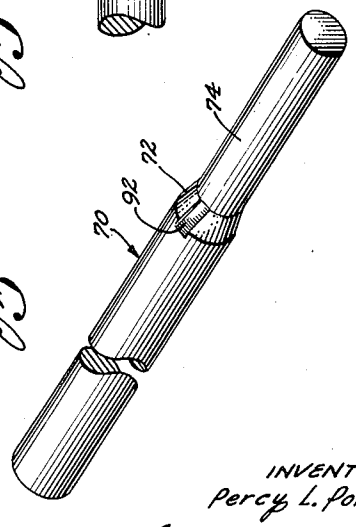


Fig. 4

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Fig. 3

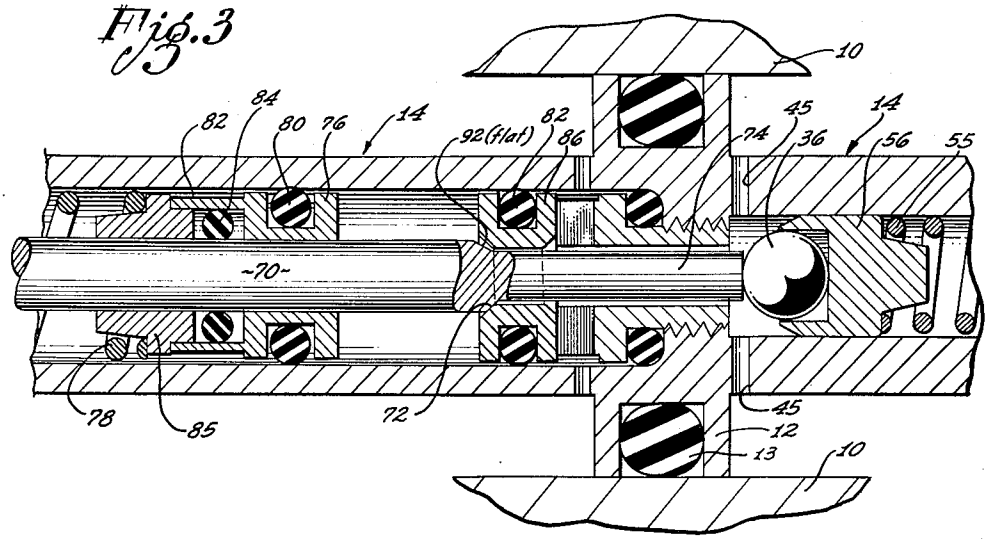
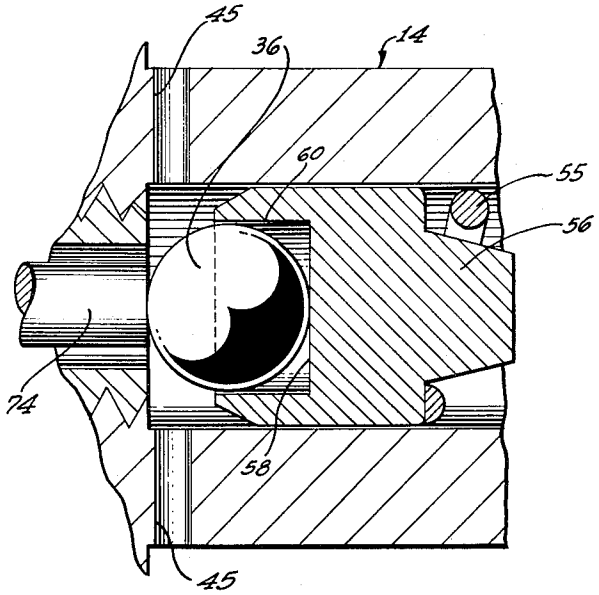


Fig. 5



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HYDRAULIC LOCKING DEVICE

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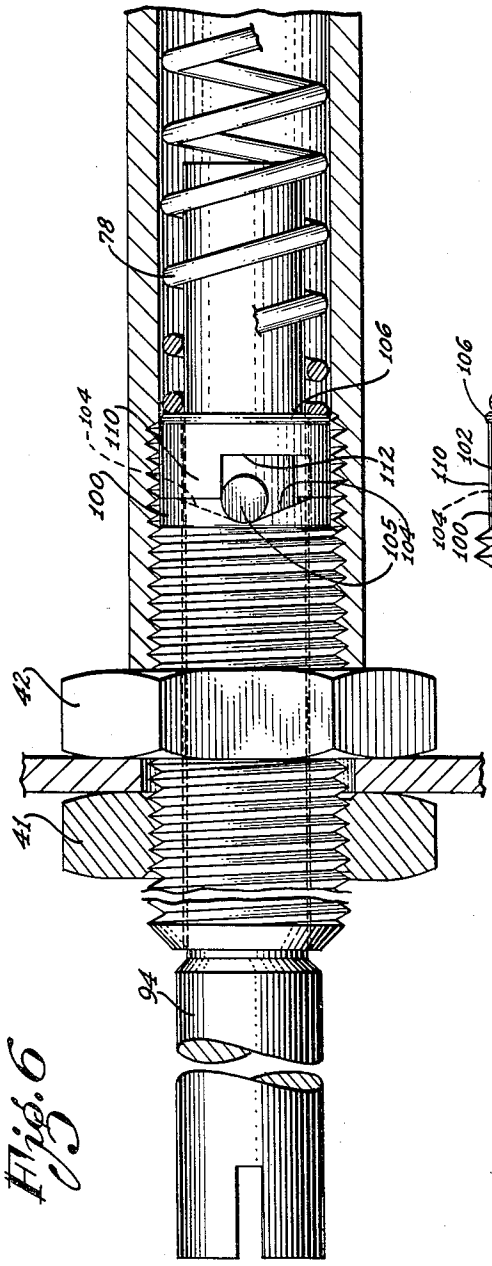


Fig. 6

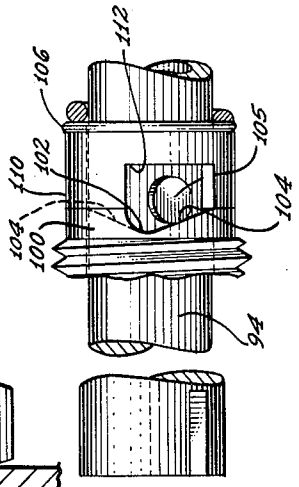


Fig. 7

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United States Patent Office

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HYDRAULIC LOCKING DEVICE

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Application November 19, 1956, Serial No. 623,192

14 Claims. (Cl. 188—96)

This invention relates to a hydraulic locking device that is adapted to extend and contract to hold two relatively movable members at selected positions with respect to each other.

A hydraulic locking device of the type to which the invention pertains comprises a cylinder confining a quantity of hydraulic fluid and a piston dividing the cylinder into two hydraulic chambers. What may be termed a locking valve controls communication between the two chambers and is normally closed to immobilize the piston. Space is also provided to function as a reservoir in communication with at least one of the two hydraulic chambers to hold a reserve supply of the fluid, the reservoir being adapted to expand and contract to accommodate thermal expansion and contraction of the fluid in the two hydraulic chambers.

A device of this type is disclosed in the Porter et al. Patent 2,559,047, issued July 3, 1951, and the application of such a device to the control of a tiltable back rest of a reclining chair is set forth in the Armstrong Patent 2,522,246, issued September 12, 1950. These two prior disclosures are hereby incorporated into the present disclosure by reference.

The purpose of the present invention is to provide special features that meet certain problems and difficulties that arise in the installation and operation of a hydraulic locking device of this character. These features have special utility in locking devices that are incorporated in the construction of reclining chairs for use on passenger airplanes. A locking device for this special purpose is selected for the present disclosure and will provide adequate guidance for those skilled in the art who may have occasion to apply the same principles to other specific purposes.

One of the problems to which the invention is directed is to provide correct adjustment of the valve-operating mechanism. This problem has been especially troublesome because the adjustment is critical. The valve-releasing mechanism on a typical airplane reclining chair is actuated by a push button having a range of movement of only 3/8 inch. A certain amount of lost motion is necessary to make sure that the locking valve is permitted to close fully when the push button is relaxed. Less than 3/8 inch of movement is available, then, to actuate the locking valve.

The heretofore prevailing type of locking device, such as described in the above mentioned Porter patent, incorporates a valve-actuating member in the form of a screw extending longitudinally into one end of the device and it is necessary to make the actual final adjustment of this actuating screw when the locking device is installed in the reclining chair. As will be explained, the present invention provides a built-in cam mechanism that may be accurately adjusted at the factory bench. This feature not only simplifies the subsequent installation operation, but also assures expert adjustment of the actuating mechanism.

Another problem arises from the fact that, in some

instances where a relatively great operating force is available for the valve opening operation, it is desirable to provide substantial operating resistance on the part of the valve mechanism; whereas, in other instances, the available operating force is relatively weak and much weaker operating resistance should be provided. The invention meets this problem by providing both a valve spring and a booster spring to resist the operating force and by providing a simple optional spacer that may be inserted to cut off the pressure from the booster spring in those installations where a relatively weak operating force is available. In this regard, a further feature of the preferred practice of the invention is that the booster spring is present in the mechanism primarily for an entirely different purpose, its primary function being to keep the reserve supply of liquid under adequate pressure.

Still another problem is to provide a degree of communication into and out of the hydraulic reservoir that is adequate for compensating flow when the fluid in the system expands and contracts thermally and yet prevents excessive fluid displacement into the reservoir whenever an unusual pressure rise occurs in the hydraulic system. Such an unusual pressure rise may occur, for example, when the hydraulic locking device is subjected to an overriding mechanical pressure in the direction to open the locking valve. This problem is solved by providing the equivalent of a check valve to oppose fluid displacement into the reservoir and by further providing a suitable restricted bypass or bleeder passage for fluid flow independently of the check valve.

A further difficulty that has been encountered is the development of leakage through the locking valve. It has been found that such leakage commonly arises from uneven spring pressure against the valve ball, the uneven pressure permitting erosion of the valve seat to occur. As will be explained, this difficulty is solved by interposing what may be termed a floating ball guide between the valve ball and the spring.

A further feature of the invention is that it permits the whole locking valve assembly to be replaced without the necessity of dismantling the whole structure. For this purpose, the piston that separates the two hydraulic chambers is mounted on a hollow piston rod that is open at both ends. The locking valve seat is in the form of a removable insert that is accessible for replacement through one end of the hollow piston rod. The valve ball, ball guide, valve spring and spring follower are accessible for replacement through the other end of the hollow piston rod. In addition, the spring follower is accessible for adjustment to permit the pressure of the valve spring to be varied.

The various features and advantages of the invention may be understood from the following detailed description considered with the accompanying drawings.

In the drawings, which are to be regarded as merely illustrative:

Fig. 1 is a longitudinal sectional view of the presently preferred embodiment of the invention as designed for control of the back rest of a reclining airplane seat;

Fig. 2 is a greatly enlarged fragment of Fig. 1, showing the construction of the locking valve, the locking valve being shown in its normal closed position;

Fig. 3 is a similar sectional view showing how the locking valve opens and the check valve closes in response to an overriding pressure;

Fig. 4 is a perspective view of the push rod that opens the valve;

Fig. 5 is a greatly enlarged fragmentary sectional view showing how the push rod opens the locking valve;

Fig. 6 is a fragmentary, longitudinal sectional view showing how a spacer member may be inserted to isolate

the pressure of the reservoir spring from the valve-actuating mechanism. This view also shows the valve-opening cam mechanism in its normal inoperative position; and

Fig. 7 is a fragmentary view similar to Fig. 6, showing the cam mechanism in its operating position.

The principal parts of the embodiment of the invention shown in Fig. 1 include a cylinder 10 and a piston assembly inside the cylinder, the piston assembly comprising a piston 12 on a tubular piston rod 14 that extends outward through both ends of the cylinder. The piston 12 is provided with a suitable O-ring 13. One end wall of the cylinder 10 is formed by a bushing 15 which is provided with O-rings 16 and 17 for sealing contact with the tubular piston rod 14. This end wall may be integral with the cylinder 10, if desired.

The other end wall of the cylinder 10 is provided by a threaded boss 18 of a tubular extension 20, which extension is removable for access to the interior of the cylinder. This second end of the cylinder 10 is sealed by a gland 22 that carries an O-ring 24 in sealing contact with the cylinder wall and a second O-ring 25 in sealing contact with the piston rod 14.

The tubular extension 20 houses the corresponding end of the tubular piston rod 14 and is of ample length to accommodate the full range of movement of the piston rod. This tubular extension 20 is connected to the fixed structure of the reclining seat at a point towards the front of the seat, and for this purpose may be provided with a transverse sleeve insert 26 to receive and journal a suitable connecting pin (not shown). The sleeve insert 26 is centrally bored, as shown, to vent the interior of the tubular extension 20 to prevent compression of air therein by movement of the piston rod 14.

The opposite end of the piston rod 14 is suitably adapted for pivotal connection to the tiltable back rest of the chair at a point below the tilt axis. For this purpose, the piston rod 14 may extend through a central bore 28 of a cross pin 29 for anchorage thereto by a pair of nuts 30, and the two ends of the cross pin may be journaled in the corresponding arms 31 of a U-shaped bracket 32. The two ends of the cross pin 29 function as trunnions and are held against an axial movement by suitable spit retainer rings 33 on opposite sides of the bracket arms 31. The U-shaped bracket 32 is adapted to be fixedly attached to the tiltable back rest of the seat.

When the back rest of the chair is at its nearly vertical forward position, the described hydraulic structure is at its maximum extension with the piston 12 near the left end of the cylinder 10 as viewed in Fig. 1. On the other hand, when the back rest is inclined backward to its limit position, the described hydraulic structure is contracted in length with the piston 12 near the right end of the cylinder 10. It is apparent that changes in degree of extension of the hydraulic structure involves flow of the hydraulic fluid between a hydraulic chamber 34 on the left side of the piston and a hydraulic chamber 35 on the right side of the piston, and it is further apparent that the structure may be immobilized with respect to extension and contraction by cutting off fluid communication between these two hydraulic chambers. What may be termed a locking valve including a ball valve member 36 serves this purpose.

It is usually desirable to provide an outer spring 37 to act in compression between the cylinder 10 and the piston rod 14 to tend to extend the hydraulic structure. In the construction shown, the spring 37 is compressed between a flange 38 of the cylinder and an end wall 39 of a cylindrical guard 40. The guard 40 is anchored to the piston rod 14 by two nuts 41 and 42.

As best shown in Figure 2, the passageway for fluid communication between the two hydraulic chambers 34 and 35 includes radial bores 44 in the tubular piston rod 14 on the left side of the piston 12, similar radial bores 45 on the right side of the piston and an axial passage 46 through the piston 12. The axial passage 46 is formed by a valve seat member 48 that is in the form of a threaded bushing. This valve seat member has a circumferential flange 50 to confine a circumferential O-ring 52 and is formed with a diametrical end slot 54 to permit the valve seat member to be rotated by a screw driver.

The ball member 36 is normally held seated in its closed position by a coiled valve spring 55 and a feature of the invention is the use of a floating ball guide 56 to transmit the spring pressure to the ball as a solely axial force. The ball guide 56 is a cup-shaped member having a transverse wall 58 in pressure abutment against the ball 36 and having a cylindrical wall 60 that surrounds the ball with adesuate clearance to prevent any possible binding action on the ball. A clearance of .003" has been found to be adequate. The clearance between the ball guide 56 and the surrounding wall of the piston rod 14 is adequate for a free sliding fit. Any nonaxial force component transmitted to the ball guide 56 by the valve spring 55 merely tends to cant the ball guide to a limited extent without affecting the ball member 36. With the ball member 36 subject only to purely axial force, the locking valve will maintain its efficiency over a long service life.

The second end of the valve spring 55 seats against an over-ride adjusting screw 62 in the form of a plug threaded into the tubular piston rod 14. The over-ride adjusting screw 62 is provided with an O-ring 64 and has a diametrical slot 65 at its outer end to permit rotational adjustment by means of a screw driver.

In the present embodiment of the invention, the locking valve is operated by a push rod 70 of the configuration shown in Fig. 4. The push rod 70 is formed with a tapered circumferential shoulder 72 and a reduced end portion 74. The reduced end portion 74 of the push rod extends into the interior of the valve seat member 48 and may be advanced against the ball member 36 to open the locking valve as shown in Fig. 5.

The interior of the tubular piston rod 14 in the region of the push rod 70 serves as a reservoir 75 for a reserve portion of the hydraulic fluid. The reservoir 75 has a movable end wall in the form of an auxiliary piston 76, and what may be termed a reservoir spring 78 acts against this auxiliary piston to maintain the hydraulic fluid under a desirable degree of pressure. Preferably a short guide sleeve 79 floats inside the spring 78 and keeps the spring from being compressed to a solid state.

As best shown in Fig. 3, the auxiliary piston 76 slidingly embraces the push rod 70 and is provided with a circumferential O-ring 80 for sealing contact with the inner wall of the tubular piston rod 14. The auxiliary piston 76 is also formed with a cylindrical end skirt 82 to confine an O-ring 84 in sealing contact with the push rod 70. An annular follower 85 for seating the end of the reservoir spring 78 fits into the end skirt 82 with a pressed fit.

Since backward movement of the back rest of the reclining seat involves rightward movement of the piston 12 as viewed in Fig. 1, it is apparent that the locking valve functions in a positive manner to prevent rearward tilt of the back rest regardless of the force exerted against the back rest by the seat occupant. On the other hand, return movement of the back rest towards its forward position involves leftward movement of the piston 12 as viewed in Fig. 1.

A feature of the invention in this regard is that the back rest may be restored to its normal forward position manually without taking the trouble to open the locking valve by means of the push rod 70. Thus, the back rest may be pushed forward manually, the pressure in the hydraulic chamber 34 being raised sufficiently by the manual effort to cause the ball member 36 to be unseated for fluid flow from the hydraulic chamber 34 into the hydraulic chamber 35. Unfortunately, however, such a pressure rise sufficient to override the locking valve is also

sufficient to compress the reservoir spring 78, with consequent displacement of fluid from the hydraulic chamber 34 into the reservoir 75 instead of through the locking valve into the hydraulic chamber 35. As heretofore stated, a feature of the invention is the provision of a check valve to prevent such a surge of hydraulic fluid into the reservoir.

As best shown in Figs. 3 and 4, the check valve for this purpose of preventing surge into the reservoir may be in the form of a floating ring or annular piston 86 carrying a circumferential O-ring 88 in sealing contact with the surrounding wall of the tubular piston rod. The inner diameter of the check valve member 86 is somewhat larger in diameter than the reduced end portion 74 of the push rod 70 that it surrounds, there being adequate clearance for fluid flow from one side of the check valve member to the other. In the event a pressure surge tends to displace hydraulic fluid into the reservoir 75, the check valve member 86 is forced against the tapered shoulder 72 of the push rod 70 and a tapered seat 90 formed in the check valve member makes sealing contact with the tapered shoulder. It is desirable, however, to provide a bypass for fluid flow at the closed position of the check valve member 86 to permit minor flow from the hydraulic chamber 34 into the reservoir 75 to compensate for thermal expansion and contraction of the fluid in the system. Instead of forming such a bypass in the check valve member itself, the bypass may be formed by cutting away a portion of the tapered shoulder 72 of the push rod 70, as indicated at 92 in Fig. 4.

With the locking valve closed, thermal expansion of the hydraulic fluid trapped in the hydraulic chamber 35 results in slight leftward displacement of the piston 12, as viewed in Figure 1, and this piston displacement together with thermal expansion of the hydraulic fluid in the hydraulic chamber 34 causes fluid displacement from the hydraulic chamber 34 into the reservoir 75 in opposition to the reservoir spring 78. On the other hand, thermal contraction of the hydraulic fluid in the system results in corresponding fluid flow from the reservoir 75 into the hydraulic chamber 34 with slight rightward shift of the piston 12.

The reservoir spring 78 should have an effective force at least as great as the effective force of the outer spring 37 for static balance between the two springs. In other words the spring 78 should produce a fluid pressure at least equal to the varying back pressure created in the reservoir 75 and in the hydraulic chamber 34 by the spring 37.

The push rod 70 may be actuated in various ways in various practices of the invention. In this instance, a cam arrangement is provided to cause the push rod 70 to be shifted longitudinally in response to oscillation of a rotary operating member 94 (Figures 1, 6 and 7). As shown in Figure 7, the operating member 94 carries an operating arm 95 that is adjustably fixed thereto by a pair of cooperating nuts 96. The usual push button on the reclining chair for opening operation of the locking valve may be operatively connected to the operating arm 95 in any suitable manner, for example, by means of a cable as disclosed in the previously mentioned Armstrong patent.

The rotary operating member 94 is journaled in an externally threaded sleeve 98 that is threaded into the end of the tubular piston rod 14, the sleeve extending beyond the end of the tubular piston rod and the rotary operating member extending beyond the end of the sleeve. The previously mentioned nuts 41 and 42 are threaded onto the sleeve 98 and as shown in Fig. 6, the nut 42 is tightened against the outer end of the tubular piston rod 14 to releasably fix the sleeve relative to the piston rod. Thus, the two nuts 41 and 42 may be loosened to permit adjustment of the sleeve 98 as desired. The sleeve 98 serves, in effect, as an extension of the tubular piston rod and carries the cross pin 29 for connection with the tiltable back rest of the chair as heretofore described.

The inner end of the sleeve 98 forms a cam 100 with a circumferentially extending cam surface. As best shown in Fig. 7, the cam 100 has a valley 102 and a sloping cam surface 104. Preferably, there are two diametrically opposite valleys 102 and two diametrically opposite sloping shoulders 104. The rotary operating member 94 is provided with a cam follower in the form of a cross pin 105 which is in continuous contact with the cam 100. Adjacent the cross pin 105, the rotary operating member 94 is formed with a circumferential flange 106 and the inner end of the rotary operating member is bored to form a socket for the butt end of the previously mentioned push rod 70. The previously mentioned reservoir spring 78 seats against the circumferential flange 106 of the rotary operating member, thereby continuously pressing the follower or cross pin 105 against the cam 100 to cause the cross pin to seek the two cam valleys 102. It is to be further noted that the valve spring 55 also applies pressure in the same direction through the push rod 70 whenever the push rod is advanced against the resistance of the valve spring. The pressure of the cross pin 105 against the sloping shoulders 104 of the cam tends to return the rotary operating member 94 and its operating arm 95 to their normal inoperative positions whenever the operating push button on the reclining chair is relaxed.

The manner in which the invention serves its purpose may be readily understood from the foregoing description. It is readily apparent that the two nuts 41 and 42 may be loosened to permit adjustment of the sleeve 98 at the factory to eliminate the need for any such adjustment during the installation of the device in a reclining chair. With the two nuts 41 and 42 loose, the sleeve 98 may be rotated with the cross pin 105 in the cam valleys 102 until the reduced end 74 of the push pin 70 unseats the ball member 36. The sleeve 98 is then retracted slightly to make sure that the push rod 70 is normally slightly retracted from the ball 36 to avoid interfering with the normal seating of the ball.

Whenever depressions of the push button on the reclining chair swings the operating arm 95 to shift the cross pin 105 up the two sloping cam shoulders 104, the consequent inward longitudinal shift of the rotary operating member 94 in opposition to the reservoir spring 78 is transmitted to the push rod 70 to cause the ball member 36 to be unseated. With the locking valve held open in this manner, the back rest of the reclining chair may be freely adjusted to any desired angle of inclination, with consequent fluid flow through the locking valve and then the push button may be released to cause the locking valve to close for immobilizing the back rest at the selected angle.

The locking valve prevents backward movement of the back rest in a positive manner, but will open in response to pressure sufficient to override the valve spring 55 whenever substantial force is applied manually to the inclined back rest in a direction to restore the back rest to its normal forward position. Whenever such overriding fluid pressure is created in the hydraulic chamber 34, the check valve 86 functions in the manner heretofore described to keep the hydraulic fluid from surging into the reservoir 75.

In some instances, where the mechanism of the reclining chair provides relatively light operating force for opening the locking valve, the pressure of the reservoir spring 78 may be isolated from the rotary operating member 94 so that only the relatively light valve spring 55 resists the applied operating force. Figs. 6 and 7 show how a spacer member 110 may be added for the purpose of isolating the pressure of the reservoir spring 78.

The spacer 110 is in the form of a collar that is slidingly mounted on the rotary operating member 94 between the cross pin 105 and the circumferential flange

106. The spacer collar 110 receives the spring pressure from the circumferential flange 106 and transmits the pressure to the cam 100, the spacer collar having a recess 112 to avoid pressing against the cross pin 105 and to permit freedom for movement of the cross pin along the sloping shoulders 104 of the cam. The two cam shoulders 104 are each of approximately 90° extent circumferentially, but in all instances, the range of operating rotation of the rotary operating member 94 is substantially less than 90° and usually is less than 60°.

My description in specific detail of the preferred embodiment of the invention will suggest various changes, substitutions and other departures from my disclosure within the spirit and scope of the appended claims.

I claim as my invention:

1. In a locking device of the character described having a cylinder, a piston assembly including a piston rod and a piston dividing the cylinder into two hydraulic chambers, a fluid passage in said piston assembly for fluid flow between said chambers, and a normally closed locking valve in said passage to control flow therethrough, the combination therewith of a mechanism for opening said locking valve, said mechanism comprising: a push rod to operate the locking valve, said push rod being slidingly mounted inside said piston rod at a position spaced inwardly from one end of the piston rod; a rotary operating member slidingly journaled in said one end of the piston rod coaxially thereof; a cam element in said piston rod comprising an annular member surrounding said push rod and shaped with a cam edge at one end; and a radial follower element in said piston rod for cooperation with said cam edge to shift said push rod, one of said two elements being stationary relative to the piston rod, the other of the two elements being a rotary element and being operatively connected to said rotary operating member for rotation therewith for cam action between said cam and said follower to shift said rotary operating member axially against said push rod to shift said push rod towards the locking valve.

2. A combination as set forth in claim 1, in which said stationary element is adjustable to various rotary positions relative to the rotary element to vary the responsiveness of said push rod to rotation of said rotary operating member.

3. A combination as set forth in claim 1, in which said cam element is the stationary element and is in the form of a threaded sleeve screwed into said piston rod for rotary adjustment therein, said operating member extending through said sleeve.

4. A combination as set forth in claim 3, in which said sleeve extends out of the end of the piston rod for convenience of manual adjustment; and which includes means also outside the piston rod to releasably engage both the sleeve and the piston rod to immobilize said sleeve relative to the piston rod.

5. A combination as set forth in claim 1, which includes an auxiliary piston inside said piston rod and slidingly embracing said push rod to serve as a movable end wall of a hydraulic fluid reservoir; and in which a coil spring surrounds said push rod, one end of the spring pressing against said auxiliary piston to keep the hydraulic fluid under pressure, the other end of the spring exerting pressure against said rotary element to hold the rotary element against the stationary element and to resist operating rotation of the rotary element.

6. A combination as set forth in claim 1, which includes: an auxiliary piston inside said piston rod and slidingly embracing said push rod to serve as a movable end wall of a hydraulic fluid reservoir; a coil spring surrounding said push rod, one end of said spring pressing against said auxiliary piston to keep the hydraulic fluid under pressure, the other end of the spring being in the region of said rotary element; and a spacer collar receiving the pressure of the other end of said spring and bridging the range of movement of said rotary element to keep the spring pressure away from the rotary element.

7. In a locking device of the character described having a cylinder, a piston assembly including a piston rod and a piston dividing the cylinder into two hydraulic chambers, a fluid passage in said piston assembly for fluid flow between said chambers, and a locking valve in said passage to control flow therethrough, the combination therewith of a mechanism for opening said locking valve, said mechanism comprising: spring means normally holding said locking valve closed; a push rod to open said locking valve in opposition to said spring means, said push rod being slidingly mounted inside said piston rod at a position spaced away from one end of the piston rod; a sleeve mounted in said one end of the piston rod, the inner edge of said sleeve forming a cam, said sleeve being threaded into the piston rod for rotary adjustment of said cam; means to releasably lock said sleeve at selected positions of adjustment; and a rotary operating member having a radial follower in cooperating contact with said cam edge whereby rotation of the operating member causes longitudinal displacement thereof for valve opening displacement of the push rod.

8. A combination as set forth in claim 7, which includes: an auxiliary piston inside said piston rod and slidingly embracing said push rod to define with said piston rod a reservoir for the hydraulic fluid; a coil spring inside the piston rod having one of its ends pressing against said auxiliary piston to keep the hydraulic fluid under pressure, the other end of said spring exerting pressure against said follower to resist valve-opening operation thereof.

9. In a locking device of the character described having a cylinder, a piston assembly including a hollow piston rod and a piston in said cylinder carried by said piston rod and dividing the cylinder into two hydraulic chambers, and a fluid passage in said piston assembly for fluid flow between said chambers, the combination therewith of means to control flow through said passage, said control means comprising: an annular valve seat in said passage; a valve member for cooperation with said seat; a valve spring urging said valve member towards said seat; and a push rod slidingly mounted in said piston rod for longitudinal displacement through said valve seat to shift said valve member to open position, said push rod being removable through one end of the piston rod, said valve seat being threaded into said piston assembly and being removable for replacement through the same end of the piston rod.

10. A combination as set forth in claim 9, in which said valve seat has a diametrical slot for engagement by a screw driver.

11. In a locking device of the character described having a cylinder, a piston assembly including a piston rod and a piston in said cylinder dividing the cylinder into two hydraulic chambers and a fluid passage in said piston assembly for fluid flow between said chambers, the combination therewith of means to control flow through said passage, said control means comprising: an annular valve seat in said passage; a valve ball for cooperation with said seat; a valve spring urging said ball to closed position; a guide for said ball interposed between the ball and the spring to receive the pressure of the spring and to transmit the pressure to the ball, said ball guide being slidingly mounted in said piston assembly in abutment with the ball and loosely surrounding the ball to keep the ball out of contact with surrounding stationary structure of the piston assembly; and means to unseat said ball in opposition to said spring, said unseating means including a member positioned to extend through the valve seat into contact with the valve ball.

12. In a locking device of the character described having a cylinder, a piston assembly including a tubular piston rod and a piston dividing the cylinder into two hydraulic chambers, a fluid passage in said piston as-

sembly for fluid flow between said two chambers, a normally closed locking valve in said passage to control flow therethrough, and means to open said valve including a longitudinally movable push rod inside said piston rod, reservoir means inside said piston rod for containing hydraulic fluid, said reservoir means including: an auxiliary piston slidingly mounted inside said piston rod and slidingly embracing said longitudinally movable push rod to serve as an end wall of the reservoir; a shoulder on said longitudinally movable rod; an annular check valve member surrounding said longitudinally movable rod in sliding sealing contact with the inner wall surface of the piston rod between said auxiliary piston and said locking valve with clearance between the annular check valve member and the longitudinally movable push rod for fluid flow into and out of the reservoir, said check valve member being movable by fluid pressure to a closed position against said shoulder to prevent a surge of pressure against the auxiliary piston; and a bypass for fluid flow through said check valve member at its closed position.

13. A combination as set forth in claim 12, in which said shoulder is an annular shoulder on said longitudinally movable push rod for abutment against said check valve member to restrict flow through the check valve member.

14. A combination as set forth in claim 13, in which said shoulder is recessed to form said bypass.

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