

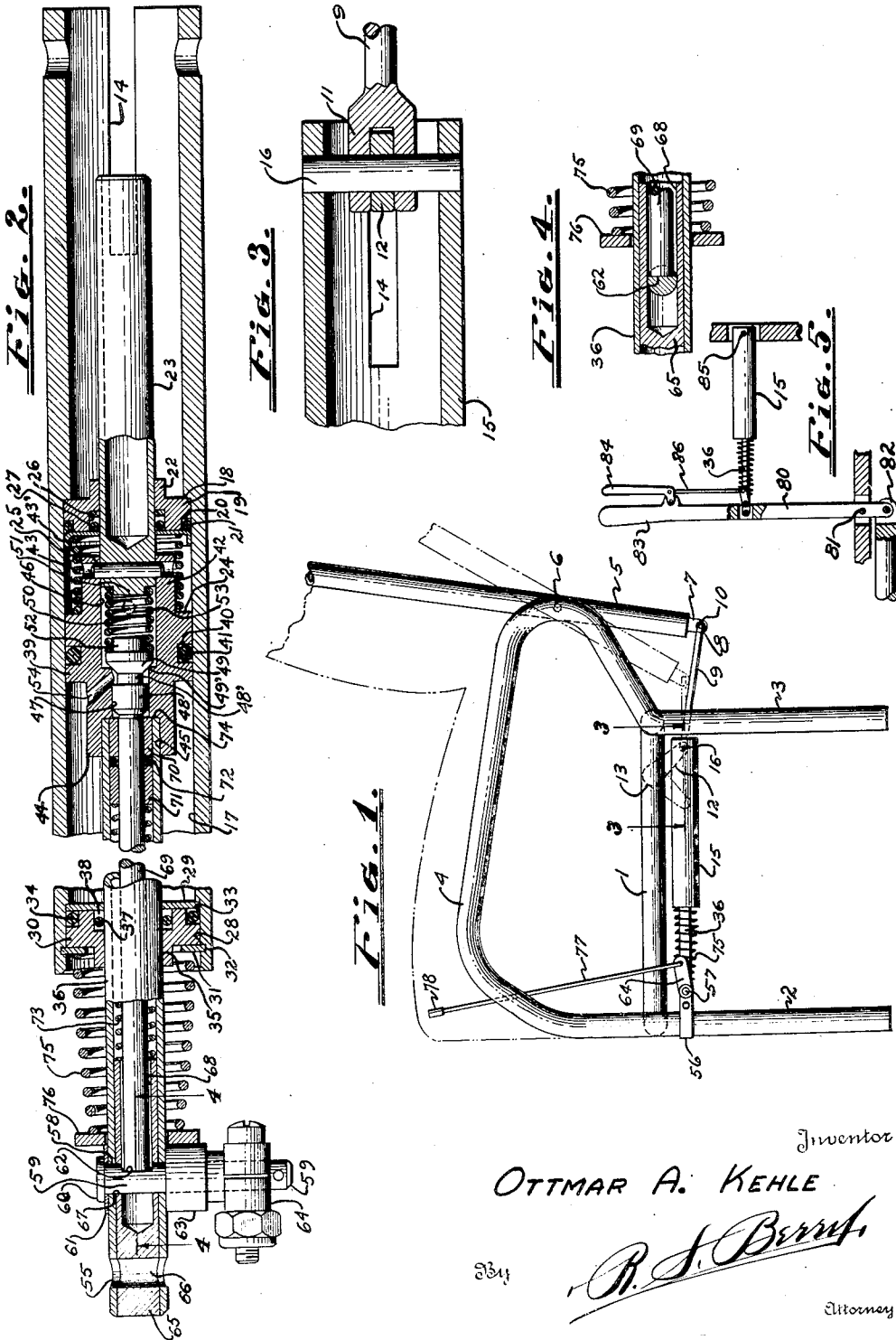
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HYDRAULIC LOCKING APPARATUS

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HYDRAULIC LOCKING APPARATUS

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1 Claim. (Cl. 188—96)

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This invention relates to locking and unlocking means for relatively movable elements of mechanism and more particularly to a device of that character in which the shifting of one element relative to another is permitted by the transfer of fluid from one side of a double-acting piston movable in a closed cylinder to the other incident to the movement of the piston and in which, upon the prevention of such fluid flow, the relative movement of the piston and cylinder is prevented with incident locking of the elements against further movement. In the illustrated embodiment the invention is shown as applied as an adjustment-permitting means for chair backs, but as will be appreciated in the light of the detailed specification, the principles of the invention may be applied wherever it is desired to connect two relatively movable elements of mechanism together with provision for rapid relative adjustment therebetween, and the invention in its broadest aspect may be considered as a hydraulic equivalent of a ratchet.

It is an object of the invention to provide a self-contained, hydraulically responsive device which may be employed to interconnect two relatively movable elements of mechanism with capacity for infinite degrees of adjustment between said elements.

A further object of the invention is to provide a device of the above character which includes means for unlocking it and which upon release of said means will automatically lock itself in its adjusted position.

A further object of the invention is to provide in a device of the above character means whereby the fluid contained therein may be maintained under a constant initial pressure.

A still further object of the invention is the provision in a device of the above character of means whereby volumetric changes in the fluid contents incident to thermal changes are compensated for automatically.

Still another object of the invention is the use in a device of the above character of the means for maintaining an initial pressure on the fluid as the means for accommodating volumetric changes in the fluid.

A still further object of the invention is to provide a device of the above character comprising a double acting piston reciprocable in a closed cylinder with exteriorly operable means for permitting fluid flow from one side of said piston to the other incident to relative movement of the piston within the cylinder.

A still further object of the invention is to pro-

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vide a device of the above character in which interiorly disposed devices are operable automatically to prevent fluid flow from one side of the piston to the other when the manually operable means is released.

A still further object of the invention is to provide a device of the above character in which a valve means located in the piston is operable exteriorly of the device to permit or prevent fluid flow from one side of the piston to the other.

A still further object of the invention is to provide a device of the above character in which the valve operating means extends through the piston rod to the exterior of the device.

Still another object of the invention is to provide a hydraulic locking and unlocking device for the adjustment of the backs of chairs.

A still further object of the invention is to provide a hydraulic locking and unlocking device for the backs of chairs which is so constructed and arranged as to be operable by the occupier of the chair without the necessity of getting up out of the chair.

Still another object of the invention is to provide a device of the above character which is simple in construction, light in weight, reliable in operation and economical to manufacture.

A still further object of the invention is to provide a chair having an adjustable back and hydraulic means for locking the back in adjusted position operable by an occupier of the chair.

A still further object of the invention is to provide a chair having an adjustable inclinable back element with hydraulic means for locking the back in various degrees of inclination which means is so constructed and arranged as to permit restoration of the chair back from a more inclined to a less inclined position without the necessity of unlocking said hydraulic means.

Still another object of the invention is to provide a hydraulic locking means for the inclinable backs of chairs which may be manipulated by the occupier to increase or decrease the inclination of the chair back to any desired degree and to lock it in such position and which additionally has capacity to permit restoration of the chair back to a less inclined position without resort to the unlocking means.

With the foregoing objects in view, together with such other objects and advantages as may subsequently appear, the invention resides in the parts and in the combination, construction and arrangement of parts hereinafter described and claimed, and illustrated by way of example in the accompanying drawing, in which:

Fig. 1 is a fragmentary illustration of a mode of application of the invention to an adjustable back for a chair of the type commonly used in aircraft and other vehicles for the transportation of persons,

Fig. 2 is a longitudinal sectional view of an embodiment of the invention particularly adapted for use as a locking means for adjustable backs for chairs,

Fig. 3 is a fragmentary top plan sectional view taken on the line 3—3 of Fig. 1 to show more clearly the mode of connection of one end of the device to a chair, and

Fig. 4 is a fragmentary sectional view taken on the line 4—4 of Fig. 2 showing the construction of a portion of the valve operating means.

Referring to Fig. 1 there is shown a chair construction comprising a base portion 1 having legs 2 and 3 which legs at their upper ends support an arm rest 4 to the rear end of which a chair back 5 is pivotally mounted at 6. It will be understood that the other side of the chair is provided with a similar leg and arm rest structure suitably connected to the one shown by suitable cross members and to which the other side of the chair back is similarly pivotally attached.

The lower end of the chair back 5 at one side thereof is provided with a depending ear portion 7 which is embraced by the yoke end 8 of a link 9 connected to the ear 7 by a pivot pin 10. The other end of the link 9 is also formed as a yoke 11 to straddle the depending end of a lazy bar link 12 attached to a rock shaft 13 extending between the spaced pairs of leg members comprising the base structure of the chair base. The link 12 extends through a clearance slot 14 in the cylinder element 15 and is simultaneously pivotally connected to the cylinder element and to the end 11 of the link 9 by a pivot pin 16 carried by the cylinder element 15 as clearly shown in Fig. 3. If desired, the rock shaft 13 at its other end may be connected to the other side of the chair back by a link and arm corresponding to the link 11 and arm 12.

The cylinder element 15 at the end opposite the attachment to the link 11 and arm 12 is provided with a cylinder bore 17 which terminates in a shoulder 18 against which is seated a cylinder head member 19 provided with a peripheral groove 20 in which is seated a resilient sealing ring 21. The cylinder head 19 is provided with an axial bore 22 in which a piston rod 23 is mounted for reciprocation which rod within the cylinder bore is connected to one end of the piston 24 by any suitable means such as the cross pin 25. The bore 22 is further provided with an annular groove 26 in which is housed a resilient sealing ring 27 operable to prevent the escape of fluid between the piston rod 23 and the bore 22.

The other end of the cylinder bore 17 terminates in a counterbore 28 in which is disposed a washer 29 and a cylinder head member 30 held therein by a snap ring 31 engageable with a groove 32 in the wall of the counterbore 28. The cylinder head 30 is provided with a peripheral groove 33 to accommodate a resilient sealing ring 34 to prevent leakage of fluid therefrom and is further provided with an axial bore 35 to provide guidance for a hollow piston rod element 36 which rod within the cylinder is rigidly attached to the piston 24 preferably by welding or brazing or the like. A resilient sealing ring 37 housed in a groove 38 concentric with bore 35 provides a seal against the escape of fluid from

the cylinder between the piston rod 36 and the bore 35.

The piston 24 exteriorly thereof comprises a center portion 39 closely fitting the bore 17 which portion is provided with a peripheral groove 40 housing a resilient sealing ring 41. The end 42 of the piston adjacent the cylinder head 19 is reduced in diameter and is encircled and engaged by one end of a compression spring 43 whereof the other end engages a washer 43' engaging the inner face of the cylinder head 18. The spring 43 is of sufficient elasticity to remain in engagement with the piston during the entire extent of its movement and operates to keep the cylinder head seated on the shoulder 19. The other end of the piston is reduced as at 44 and is provided with a bore 45 in which the piston rod 36 is secured as above described. The end 42 of the piston is provided with an axial bore 46 in which the end of the piston rod 23 is received and secured by the cross pin 24 and the bore 46 continues into the central portion 39 of the piston and terminates in a smaller coaxially disposed bore 47 which in turn communicates with bore 45. The bore 47 serves as a guiding means for a valve stem 48 of a valve 48' the valve seat portion 49 of which engages the shoulder 49' formed by the juncture of the bores 46 and 47. Within the bore 47 a compression spring 50 reacts between the ends of the valve 48 and the piston rod 23 to normally maintain the valve in engagement with the valve seat shoulder 49'. Bosses 51 and 52 and the piston rod 23 and the valve seat portion 49 serve to hold the spring 50 in position. The piston is further provided with a port 53 extending from the outside of the reduced diameter portion 42 to the bore 46 and with a second port 54 extending from the exterior of the reduced diameter portion 44 to the bore 47 at a point between the guiding and seating portions of the valve 48'. Thus it is that the ports 53 and 54 together with the bores 46 and 47 constitute a fluid passage extending from one side of the piston to the other.

The piston rod 36 adjacent its outer end is provided with a transverse bore 55 by which it may be attached to the chair leg 2 by any suitable means such as a clamp 56 and bolt 57 with provision for a slight amount of pivotal movement to accommodate the arcuate path of the arm 12 incident to the movement of the cylinder 15 on the piston. Adjacent the transverse bore 55, the piston rod 36 is provided with a second transverse bore 58 in which a valve operating shaft 59 is journaled for oscillation. The shaft 59 at one end is provided with a head portion 60 which bears against a washer 61 at one side of the piston rod and the shaft within the rod is provided with a cut-away flattened portion 62 which operates as a cam surface in a manner and for a purpose presently to be described. The shaft 59 passes out the other side of the piston rod thence through a spacing collar 63 and beyond the spacing collar the shaft 59 has clamped thereto an operating lever 64 which preferably may be clamped to the shaft in any desired radial position. Closely but removably fitted within the outer end of the piston rod 36 is a plug element 65 having cross bores 66 and 67 which correspond respectively in size and location with the bores 55 and 58 in the piston rod 36.

The plug element 65 at the end within the piston rod 36 is further provided with an axial bore 68 which intersects the cross bore 67 and affords guidance for one end of a valve operating

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rod 69 which extends through the piston rod 36 from the cam face 62 of the operating shaft 59 to the end of the valve 43'. Adjacent the valve 48' the rod 69 is guided in a pair of bushings 70 and 71 slidably mounted in the piston rod 36 with a resilient sealing ring 72 interposed between the adjacent ends of the bushings and engaging both the inner wall of the piston rod 36 and the periphery of the valve operating rod 69 so that the escape of fluid at either point is effectually prevented. Surrounding the valve operating rod 69 and extending between the inner end of the plug member 65 and the adjacent end of the bushing 71 is a compression spring 73 which is constantly operative to urge the bushing 70 and 71 together with the interposed sealing ring 72 to the right as viewed in Fig. 2 with resultant seating of the bushing 71 on the shoulder 74 formed by the juncture of the bores 45 and 47.

The purpose of thus mounting the bushings 70 and 71 to yield is to provide compensation for thermal expansion of the fluid. The cylinder is filled with fluid in assembly after the piston and piston rod assembly have been inserted and before the cylinder head 28 has been assembled. If there were no compensation the pressures created by thermal expansion might lead either to the loss of fluid or the rupture of the cylinder or other damage. With the construction here shown, thermal expansion will cause the piston to move slightly to the left compressing the fluid between the piston and the cylinder head 28 and excess fluid will then pass through the port 54, past the valve guide 48 and shift the bushings slightly to the left as shown in Fig. 2 against the pressure exerted by the spring 73, to accommodate the expansion of the fluid. The capacities of the cylinder on opposite sides of the piston are the same due to the two piston rods 23 and 26 and the construction of opposite ends of the piston. In other words, the piston with the two rods has the same displacement in opposite ends of the cylinder and therefore no volumetric change will take place due to the movement of the piston.

Additionally, the device includes a compression spring 75 surrounding the piston rod 36 and extending between the outer end of the cylinder head 28 and a washer 76 surrounding the piston rod 36 and bearing against the collar 63 and washer 61 and tending constantly to urge the piston rod and piston to the left as viewed in Figs. 1 and 2. This spring may be of sufficient strength to effect extension of the piston rod when the valve is opened and therefore as applied to a chair in the manner shown upon opening the valve the chair back will automatically move to a more nearly vertical position. Alternatively it may be of lesser strength and operate to assist in the movement of the interconnected elements incident to a corresponding movement of the piston and cylinder. The operating lever 64 is preferably connected by suitable means such as the push rod 77 to a button 78 located in a position convenient for the occupant of a chair. When it is desired to change the inclination of the chair back in either direction it is necessary only to manipulate the button 78 to rock the valve operating shaft whereupon the cam face 52 thereof will engage the valve rod 69 and cause it to open the valve 43' upon which the fluid may flow into or out of the port 53, past the valve seat 43' and into or out of the port 54 according to the direction of relative movement of the piston and cylinder incident to the direction of movement of the chair back. When

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the desired adjustment is achieved and the button 78 is released, the spring 50 will close the valve and the chair back will be hydraulically locked against further movement. It will be noted that the piston rods 36 and 23 are of the same diameter and that therefore the displacement from one side of the piston to the other will be uniform and that any possibility of cavitation is avoided.

It is particularly to be noted that the design is characterized by an assembly of parts not requiring particularly close tolerances and that except for the clamp screw 79 which secures the lever 64 to the shaft 59, the necessity of screw threads is entirely dispensed with.

In the illustrated embodiment, a poppet type valve is shown which is so seated that upon movement of the piston to the left or rather of the cylinder to the right as actually occurs in the illustrated application of the device to a chair, under sufficient pressure the valve will be unseated permitting flow of fluid into the port 54 past the valve and out of port 53. The purpose of this is to enable an attendant in an airplane or other vehicle to restore chair backs from inclined position to upright position without the necessity of unseating the valve. This is possible because the pivotal attachment of the chair back to the base structure is so located as to give a considerable leverage when the chair back is grasped at the upper end thereof. This operation is enhanced by the spring 75 which is of considerable strength. It will be understood by those skilled in the art that if the locking by the valve is desired to be fixed in all events it is merely necessary to vary the diameter of the valve seat 43' or to increase the strength of the spring 50 or both to an extent that will prevent the unseating of the valve by any normally expected force applied to the device when the valve is seated.

In Fig. 5 there is shown by way of example another use of the device. In this figure there is shown a lever 80 pivoted at 81 and adapted to be connected at one end to mechanism to be adjusted by any suitable means such as the link 82. At its other end the lever is provided with a hand piece 83 and a pivotally mounted valve-releasing member 84. Adjacent the hand piece, the lever is pivotally connected to the piston rod 36 of the locking device, the cylinder portion 15 of which is connected at 85 to a stationary part of the apparatus with which the lever is associated. A link 86 connects the operating lever 64 with valve releasing member 84. Thus upon simultaneously grasping the hand piece 83 and valve releasing member 84 the valve will be unseated after which the lever can be moved in either direction and upon release the spring 50 will reseat the valve 48' and prevent further movement of the lever. While the illustration shows a lever of the first order it will be appreciated that levers of other orders may be substituted. Also while the device is shown associated with members which are pivotally connected it is equally applicable to installations wherein the interconnected members are otherwise connected as by sliding connections or in any relation other than pivotal without departure from the invention.

While I have shown and described a specific embodiment of my invention, I do not limit myself to the exact details of construction set forth, and the invention embraces such changes, modifications and equivalents of the parts and their formation and arrangement as come within the purview of the appended claim.

I claim:

In an adjustment-permitting and locking means adapted to adjustably interconnect two relatively movable elements of mechanism, the combination of a fluid filled cylinder adapted to be connected to one of said elements, a double acting piston in said cylinder, a piston rod connected to said piston and adapted to be connected to the other of said elements, a fluid passage extending through said piston from one side to the other, a valve in said passage, devices in said cylinder constantly operable to compensate for volumetric expansion and contraction of fluid in said cylinder, and manually operable means constructed and arranged to effect the opening of said valve including a push rod carried by said piston rod, said volume compensating devices serving additionally to guide said push rod.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,176,244	Redlich -----	Mar. 21, 1916
1,438,696	Cinquini -----	Dec. 12, 1922
1,643,262	Steiner -----	Sept. 20, 1927
1,714,528	Stagg -----	May 28, 1929
1,856,691	Carter -----	May 3, 1932
2,205,508	Williams -----	June 25, 1940
2,357,278	O'Connor -----	Aug. 29, 1944
2,410,176	Magrum -----	Oct. 29, 1946
2,422,767	Anderson -----	June 24, 1947