

SPECIFICATION

Improvements in or relating to a chair

- 5 The invention relates to a chair having a seat and a back whose inclinations can be adjusted continuously.

The aim of chairs of this kind is to give support for the backs of persons sitting on them, as is desirable for medical and ergonomic reasons. German Utility Model 7,331,431 describes a simple construction of an adjustable chair in which the seat and the back of the chair are rigidly interconnected and pivot about a horizontal axis in the base of the seat, the axis passing through the point of intersection of the seat with a central column which supports the chair. This has the disadvantage that the front edge of the seat rises or falls quite considerably when the inclination of the chair is adjusted, so that the legs of the chair user may no longer be supported at the correct height from the ground. This chair does not provide for vertical adjustment. This would require additional constructional complications, and would also require the user to make simultaneous coordinated adjustments of seat height and inclination.

An office chair disclosed by Swiss Patent Specification 524,982 is concerned with this problem. Inclination is adjusted by means of a gas compression spring which extends substantially parallel to the seat on the underside thereof. The axis of pivoting of the seat is near its front edge. The advantage of this feature is that the chair front edge makes little, if any vertical movement when the inclination is adjusted. The gas compression spring is operated by horizontal movement of a lever on the bottom of the seat. This is ergonomically unsatisfactory. Also, it is impracticable to rock in this chair - i.e. to tilt the chair continuously to and fro; for this purpose the lever which operates the gas compression spring would have to be pulled all the time, which is difficult or impossible.

When the front part of the seat is loaded, the chair back remains in its original position despite operation of the gas spring to alter the inclination of the seat.

It is an object of the invention particularly to provide a chair which it is possible to rock. It is desired to retain, at least in some embodiments, the advantages of the seat being pivoted near its front edge and having continuous adjustability of inclination. Another preferred feature is that when the chair is loaded in the front part of the seat, it should be possible for the chair back to pivot forward automatically with the seat.

According to the present invention there is provided a chair having a seat and a back which are both pivotally mounted so that their inclinations are steplessly adjustable simultaneously in the same rotational sense, and means for controlling said adjustment including: a gas spring and a mechanical compression spring, said gas spring having a valve which is lockable in an open configuration in which the gas spring is resiliently extensible and compressible so that said inclinations are adjustable; continuous adjustment of the inclinations in alternating

senses to permit a rocking motion being possible when said valve is locked open; the valve in a closed configuration causing the gas spring to offer substantial resistance to extension and compression and thus effectively to lock the seat and back in any of the particular inclinations achievable by said stepless adjustment; said springs being constructed and arranged so that at least respective components of their resilient forces combine to provide resilience

in one sense so that adjustment of said inclinations in opposition to said resilience causes said springs to provide a progressively increasing restoring force, whereby said rocking motion is possible when said valve is locked open. Preferably, the seat pivots about an axis at or near its front edge. The mechanical compression spring may be a helical spring.

This paralleling of the gas compression spring and mechanical compression spring - e.g. a helical spring - leads to the spring rates of the two spring so cumulating that the invention achieves its aim. While with the valve open the gas spring produces a force tending to extend the spring, which force remains substantially constant irrespective of actual inclination, the pressure applied by the mechanical compression spring increases with increasing compression thereof - i.e., with increasing inclination. The combined effect of the two springs is such that a pleasant rocking motion is possible. The lever can be locked with the gas pressure valve in its open position - i.e., the user does not need to hold the lever all the time that he is rocking or adjusting the seat. To lock the seat and back in any particular inclined position, all that is necessary is to release the locking of the lever so that the gas spring valve closes. Preferably operation of the lever is effected by generally vertical movement of a grip portion. This is better ergonomically than the prior art horizontal operation. Preferably the force applied by the mechanical spring for any given inclination is adjustable.

According to another desirable feature of the invention the chair back is pivotally mounted and so arranged that if a downward vertical force is applied to the front of the seat, the chair-back tends to pivot forwards until it abuts the back of the chair user.

A simple form of construction by which this may be achieved comprises a double-armed lever fulcrumed on the chair frame, one arm thereof being pivotally secured adjacent the front of the seat; the other arm being pivotally connected to the front end of a rod which extends substantially from the front to the back of the seat. The rear end of the rod is pivotally connected to a lever arm fast with the chair back.

Thus, downward movement of the front of the chair causes the lever to pivot about its fulcrum on the frame. This causes the rod to move towards the rear of the chair, whereby the lever arm fast with the chair back causes the back to pivot forwards.

For strength and stability, it is preferred that there are two double-armed levers, rods and lever arms fast with the chair back, the members of each pair being laterally spaced-apart.

In a preferred form the gas compression spring and the mechanical compression spring are con-

connected at one end with the pivot which connects the rod or rods and the lever arm or arms fast with the chair back, while the other ends of the springs are connected to a shaft fast with the seat.

- 5 Conveniently, the shaft is connected via links to the chair frame. Other components of the chair, such as levers controlling adjustment of the inclination of the chair back and chair seat and for controlling vertical adjustment of the chair, can be connected to
- 10 the links.

An embodiment of the invention will now be described by way of example with reference to the accompanying drawings. In the drawings:

- 15 *Figure 1* is a partly sectioned general side view of an office chair according to the invention, the seat and the chair back being shown in two positions;

Figure 2 is a detail view of an enlarged scale to illustrate the operation of the means providing adjustment of the chair seat and chair back in the

- 20 same direction;

Figure 3 is a plan view corresponding to *Figure 2* without retaining means for the chair back;

Figure 4 is a detail view on a much enlarged scale; and

- 25 *Figure 5* is a plan view of a detail of *Figure 4*.

In the illustrated chair, a frame 2 is mounted for rotation and vertical adjustment on an underframe 1 supported on castors. The frame 2 carries an upholstered (3) seat 4 and an upholstered (5) chair back 6.

- 30 Arm rests 7 are secured to the seat 4. The seat 4, back 6 and arm rests 7 are shown in *Figure 1* in solid lines at one extreme of inclination and in chain lines in their other extreme position. The seat 4 and rests 7, on the one hand, and the chair back 6, on the other hand, can be tiltingly adjusted in the same direction simultaneously and move together though by differing amounts.

To control this tilting movement, a spring mechanism, to be described in greater detail hereinafter is

- 40 disposed below and substantially parallel to the seat 4. As can be seen in *Figure 3*, there is a mechanical compression spring 9 parallel to a gas spring 8. The two springs 8, 9 have their rear ends connected to a common rod 10 pivotally connected to the arms 11 of a generally Y-shaped lever 11, 11a. The body 11a of the lever is screwed to the shell or frame of chair back 6. The lever 11, 11a is rotatable about a pivot 12.

The front ends of the two springs 8, 9 are connected via pivots 26 to respective generally triangular flanges 13 each of which is pivotally connected adjacent one vertex to the frame 2 by way of bearings 44 and adjacent another vertex to a rod 43 whose ends are connected to plates 42 secured to the seat 4.

- 55 Two levers 14 are each pivotally secured adjacent one end to a bearing 15 near the front of seat 4. Each lever 14 is pivotally mounted on the frame 2 by way of a bearing 16. The other end 14a of each lever 14 is secured by way of a pivot 17 to a rod 18. The rods 18 extend to near the rear of the seat where their ends are pivotally connected by way of rod 10 to the arms 11 of the Y-shaped lever 11, 11a. For the sake of clarity in the drawing, the rods 18 are represented in *Figure 2* merely by their ends.

- 65 The seat frame 4 is thus supported on the frame 2

by the levers 13, 14. Tilting of the seat frame 4 is accompanied by concerted movement of the levers 13, 14; thus the path of tilting of the seat frame is predetermined. Movement of the levers 14 when the seat frame 4 tilts causes concerted movement of the rods 18 and consequently concerted movement of the lever 11. Thus the seat back 6 is constrained to move in concert with the seat frame 4; for each position of the seat 4, there is only one position of the seat back 6, and the relative inclination of the back 6 and seat 4 varies as the seat 4 tilts.

- 70 Control of the tilting of the seat 4 and back 6 is achieved by means of the gas piston-and-cylinder unit 8, which will be described in more detail below and is herein referred to as a "gas spring". It contains a valve 21 which when open allows gas flow from one side of the piston to the other and when closed prevents such gas flow.

- The spring 8 is part of a link between the pivots 10 and 26. When the seat tilts these pivots 10 and 26 move relatively, i.e. the piston and cylinder of the spring 8 must also move relatively to each other. When the valve 21 is open, such movement is freely possible (opposed or assisted by the relatively small spring force of the spring 8), and adjustment of the tilt of the seat and back may be carried out. When the valve 21 is closed, relative movement of the piston and cylinder of the spring 8 is only possible against the resilience of the gas in the spring. This means that for normal forces the spring is virtually locked; thus tilt adjustment is not possible.

The mechanical spring 9 is connected in parallel with the gas spring 8 and is effective to provide resilience in one direction when the valve 21 is open, i.e. the chair may be rocked when the valve is open.

- The gas spring 8 is of a conventional type (see *Figure 2*). Its piston 19 has a continuous central axial passage through which a rod 20 passes. The rod is of smaller diameter than the passage, except at its rear end which is formed as a cone 21. In the position shown in *Figure 2*, cone 21 is in sealing-tight engagement with a seating in the passage through piston 19. In this configuration the gas spring 8 is locked, the piston 19 being substantially immobile in the cylinder. When the rod 20 moves rearwardly relative to the piston, the cone 21 moves out of its seating and unblocks the passage. The pressures in the rear chamber 22 and front chamber 23 of the gas spring 8 therefore continuously tend to equalize, so that the piston can move in the cylinder. Movement of the piston leftwards in the direction indicated by an arrow 25 (in *Figure 2*) reduces the volume of the rod 20 which is within the cylinder, and consequently increases the effective volume of the cylinder available to the gas. Thus the pressure of the gas urges the piston leftwards to allow expansion of the gas.

A tubular rod 24, whose diameter is too great for it to pass through the passage in the piston 19, is located around the rod 20. Its rear end abuts the piston 19. When piston 19 moves forwards in the gas spring, force is transmitted through the tubular rod 24 to flange 13 which is connected to the frame 2. Thus, tubular rod 24 cannot move forwards. Instead, the gas spring 8 moves rearwards, causing the lever

arms 11 to turn about the pivots 12. This causes the chair back to move from the position shown in chain lines in Figure 1 to that shown in solid lines. During this movement the distance between the pivots 10 and 26 increases; consequently the levers 14 and rods 18 move to become collinear, and the seat 4 moves into its solid-line position. The pivoting axis of the seat 4 is thus the pivot 15; this is very near the front of the seat, which therefore undergoes little vertical displacement. The pivoting axis of the chair back 6 is the pivot 12.

The gas pressure valve is operated by means of a lever 27 which extends in the transverse direction of the chair. It has a handle 28 at one end (Figures 4 and 5). The other (inner) end of lever 27 acts on a member 29 pivotally mounted on a shaft 30. When the handle 28 is pulled up, the other end of lever 27 moves member 29 down so that, as seen in Figure 2, it pivots rearwardly and anticlockwise. The bottom end of member 29 engages with the free end 31 of rod 20 so that rod 20 moves to the right to open the passage in the gas spring 8.

The spring rate of the mechanical spring 9, which is a helical spring, can be adjusted by means of nut 35.

If it is desired to lock handle 28 in its raised position so that the gas spring valve is open and the chair can rock, a slide 36 on the handle 28 is operated (see Figure 4). For this purpose, the slide 36 is moved forwards manually in the direction indicated by an arrow 37, so that its surface 38 abuts a matching surface 39 rigidly secured to the seat 4. The surface 39 is the base or cross-arm of a U section member rigidly secured to the seat 4. To facilitate operation the member 36 has a fluted underside. The travel of the slide 36 is limited by a screw 40 screwed into the handle 28. If the handle 28 is raised and the slide is moved in the direction of arrow 37, abutment of surfaces 38 and 39 prevents downward movement of handle 28 and the valve of the gas spring 8 is thus kept open.

In a particular embodiment the mechanical spring 9 was a helical spring having a spring travel of 13 mm and a spring force of 123 kp at a length of 23 mm. The spring force at 10 mm length was 54 kp. The preloading or biasing was 10 mm.

With the valve of the gas spring 8 open, the chair back 6 automatically pivots forwards under the weight of a chair user sitting at the front of the seat 4, for in this position the user's weight acts via the front of the seat 4 on the two parallel levers arms 14 and pivots them anticlockwise (in Figure 2) together with the arms 14a. The members 14, 14a, 18 move towards the linear position and the arm 11 with the member 11a also pivots anticlockwise, so that the chair back 6 pivots forwards.

It is important for the mechanical spring 9 to be able to boost the effect of the gas spring 8. This is why the two springs 8, 9 of the embodiment shown are in parallel with one another.

However, they could be at an angle to one another, so long as they have force vectors which are additive. The two springs need not be placed one beside another as they are so placed in the drawings. Reasons of space may make it preferable for the

mechanical spring 9 to be located around the gas spring 8. Alternatively, the two springs can be disposed in line. The skilled addressee may make use of any arrangement of the two springs such that they have at least components acting in parallel.

The seat 4 is connected to a flexible cover by screws 32.

The chair is also adjustable vertically. For this purpose, a second gas compression spring, generally similar in construction and operation to spring 8, is provided in a tubular pillar 33 of the underframe 1. This second gas spring is operated by a lever 34 by means of which its valve may be opened to permit adjustment of the height of the chair.

CLAIMS

1. A chair having a seat and a back which are both pivotally mounted so that their inclinations are steplessly adjustable simultaneously in the same rotational sense, and means for controlling said adjustment including: a gas spring and a mechanical compression spring, said gas spring having a valve which is lockable in an open configuration in which the gas spring is resiliently extensible and compressible so that said inclinations are adjustable, continuous adjustment of the inclinations in alternating senses to permit a rocking motion being possible when said valve is locked open; the valve in a closed configuration causing the gas spring to offer substantial resistance to extension and compression and thus effectively to lock the seat and back in any of the particular inclinations achievable by said stepless adjustment; said springs being constructed and arranged so that at least respective components of their resilient forces combine to provide resilience in one sense so that adjustment of said inclinations in opposition to said resilience causes said springs to provide a progressively increasing restoring force, whereby said rocking motion is possible when said valve is locked open.

2. A chair according to claim 1 wherein said mechanical compression spring is a helical spring.

3. A chair according to claim 1 or claim 2 wherein the seat pivots about an axis at or near its front edge.

4. A chair according to any one of the preceding claims wherein the valve is operated by moving a lever substantially vertically.

5. A chair according to any one of the preceding claims wherein the resilience of the mechanical compression spring is adjustable.

6. A chair according to any one of the preceding claims wherein when the valve is open and a downward force is applied to the seat adjacent its front, the chair back tends to pivot forward.

7. A chair according to claim 6 wherein the seat is pivotally connected adjacent its front to the front end of a lever, the lever being pivotally connected at its rear end to one end of a rod, and pivotally mounted in an intermediate region on a frame of the chair, the other end of the rod being connected with the chair back.

8. A chair according to claim 7 wherein the springs are connected at their front ends to the seat and at their rear ends to the chair back and the said



arms 11 to turn about the pivots 12. This causes the chair back to move from the position shown in chain lines in Figure 1 to that shown in solid lines. During this movement the distance between the pivots 10 and 26 increases; consequently the levers 14 and rods 18 move to become collinear, and the seat 4 moves into its solid-line position. The pivoting axis of the seat 4 is thus the pivot 15; this is very near the front of the seat, which therefore undergoes little vertical displacement. The pivoting axis of the chair back 6 is the pivot 12.

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3. A chair according to claim 1 or claim 2 wherein the seat pivots about an axis at or near its front edge.

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8. A chair according to claim 7 wherein the springs are connected at their front ends to the seat and at their rear ends to the chair back and the said

other end of the rod.

9. A chair according to claim 8 wherein rearwardly of the front end of the said lever, the seat is mounted pivotally on links which are themselves
5 pivotally mounted on the chair frame, the springs being connected at their front ends to the links.

10. A chair substantially as described herein with reference to the accompanying drawings.

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