SUPPORT APPARATUS FOR A MOVABLE CHAIR

Support apparatus for a movable chair including: a support base arranged for support by a supporting surface; two or more mounting arms, one of which is pivotally mounted to the support base about an axis substantially normal to the support surface and one or another of which is pivotally mountable to a seat about an axis substantially parallel to the first-mentioned axis, each mounting arm being pivotally connected to one another in substantially end-to-end relationship, the pivot axes of each arm being arranged such that the pivot axis at or near one end is spaced from and substantially to the other pivot axis at or near the other end.
SUPPORT APPARATUS FOR A MOVABLE CHAIR

FIELD OF INVENTION

THIS INVENTION relates to support apparatus for a movable chair. The invention has particular application to support apparatus for movable chairs used in an office or plant control-room environment. However, the invention is not limited to this field of use.

BACKGROUND ART

Chairs, seats, stools and the like may be provided with wheels in order to permit locomotion of the same. Typically, the movability of the chair is to enable ready access to several work points in a workstation without the user having to stand up. Some limitations inherent in chairs provided with, for example, castors, include the considerable lateral force which may be required to move the chair. Whilst not normally, a significant problem, it has long been the case that if chairs were easier to move, users could reduce or eliminate bending over or reaching over to access something because the effort to move their chair is too great. Moreover, users having a condition or disability can be more limited than able bodied people in their ability to reach required parts of a workspace in spite of being provided with a movable chair.

An ergonomic base and chair providing constrained lateral movement is taught in our Australian Patent No. 748898 which addresses or alleviates one or more of the aforementioned problems. However, it has been found that the ergonomic base disclosed therein requires a considerable amount of floor space, even though the apparatus itself provides excellent results for mobility impaired users.

The present invention aims to alleviate one or more of the above disadvantages. Other aims and advantages may become apparent from the following description.

DISCLOSURE OF THE INVENTION

With the foregoing in view, this invention in one aspect resides broadly in support apparatus for a movable chair including:-

- a support base arranged for support by a supporting surface;
- two or more mounting arms, one of which is pivotally mounted to the support base about an axis substantially normal to the support surface and one or another of which is pivotally mountable to a seat about an axis substantially parallel to the first-mentioned axis, each mounting arm being pivotally connected to one another in substantially end-to-end relationship, the pivot axes of each arm being arranged such that the pivot axis at or near one end is spaced from and substantially to the other pivot axis at or near the other end.
In another aspect, the present invention resides broadly in a method of moving a chair including:

connecting two or more mounting arms to one another in substantially end-to-end relationship for pivotal movement about respective axes each spaced from and substantially parallel to the or each other axis of each adjacent connection;

mounting an end one of the mounting arms by its end remote from its connection to the or another mounting arm to a support base adapted for support on a supporting surface, the mounting being for pivotal movement of the mounting arm about an axis substantially normal to the mounting surface and spaced from and substantially parallel to the other axis or axes; and

providing mounting means for mounting the other end of the or one of the mounting arms by its end remote from its connection to the or another mounting arm to a seat support for pivotal movement about an axis spaced from and substantially parallel to the adjacent connection.

In a typical arrangement, the support surface is substantially horizontal such as an office or workstation floor, whereby the respective pivot axes are substantially vertical. Preferably, there are two mounting arms, a lower mounting arm mounted to the support base by, at or near its lower end. By, at or near the upper end of the lower mounting arm is provided n upper mounting arm, mounted thereto by, at or near lower end of the upper arm. In such form, it is preferred that the spaced parallel arrangement of the axes is provided by two or more complementary crooks or bends formed into each arm. It is also preferred that where two arms are provided, the lower arm extend laterally with substantially reduced elevation compared to the upper arm extending laterally substantially the same amount as the lower arm, but providing substantially greater elevation. In an alternative preferred form, each arm is of substantially the same form so that the axis of the pivot connection to the support base can be made coincident with the axis of the pivot connection to the seat such as when the arms are made to substantially overly one another and each arm provides substantially the same amount of elevation above the supporting surface.

It is further preferred that the mounting between the upper and lower arms include provision for sliding motion normal to the pivot axis, the sliding motion constrained in direction and extent. In such form, the constraint of the direction of sliding is at an acute angle with respect to a notional flat plane coincident with all three axes of pivotal movement when the arms are so
aligned. It will be seen that such an arrangement substantially avoids the possibility of the arms becoming locked in a straight-line configuration. In a preferred form, the sliding motion is provided by arranging for the block or pivot pin to slide in one direction in the lower part of the joint, and for the block or pivot pin in the upper part of the joint to slide in another direction, preferably at 90° to the direction of sliding in the lower part.

Preferably, the mounting base includes mobility means such as wheels or castors. In such form, it is further preferred that the wheels or castors be retracted or otherwise rendered inoperable when desired. It is also preferred that the pivot connections include braking means for stopping the seat from moving when the seat is not occupied. Preferably, the braking means is in the form of a weight brake releasable upon application of at least a weight of a typical user to the seat.

It will be appreciated that in describing the movement of a chair or seat in the context of the present invention, such description relates to the movement of a chair support effective for so moving such a chair or seat. Preferably, the chair may be manoeuvred by use of one or more stepper motors. In such form, the stepper motors are preferably controlled by a controller, such as a computer or the like so that the locus of movement of the chair may be pre-programmed to respond to commands given by a user, usually being the person sitting in the chair. Moreover, the computer and/or controller may be programmed to provide several predetermined locations within the range of movement of the chair available for selection by the user, whereby the chair may be moved by the stepper motors once the computer and/or controller has calculated the locus of movement from a current position to the selected position.

**BRIEF DESCRIPTION OF THE DRAWINGS**

In order that this invention may be more readily understood and put into practical effect, reference will now be made to the accompanying drawings which illustrate a preferred embodiment of the invention, wherein:-

Fig. 1 is a diagrammatic pictorial view of a support apparatus for a movable chair and a chair supported thereby according to the invention; and
Fig. 2 is diagrammatic representation of actuation means for movement of the support apparatus according to the invention;
Figs. 3 to 6 are diagrammatic representations showing details of an alternative form of pivot connection between the upper and lower arms of the support apparatus of Figs. 1 and 2.

**DETAILED DESCRIPTION OF THE DRAWINGS**

The support apparatus 10 for a movable chair shown in Fig. 1 includes a base 11 having a substantially central pivot 22 by which is mounted a lower arm 12. The lower arm is pivotable in the direction of arrows 32 with respect to the base such as to a position shown in dotted outline at 12a, the pivotal connection including a lower bearing 42 extending into complementary sockets in the base and the lower end portion of the lower arm. The lower arm curves substantially 90° from end to end and is connected to an upper arm 13 which is also curved in a similar fashion substantially 90° from end to end.

The connection between the upper and lower arms - hereinafter referred to as the intermediate pivot — is also pivotable, but about an axis substantially parallel to and spaced from the axis about which the lower arm may pivot with respect to the base so that the upper arm can be moved to alternative positions, two of which are shown at 13a and 13b. The upper arm is movable to its alternative positions by pivotal movement with respect to the lower arm in the direction of arrows 33 or 33a.

The upper arm has an upper pivot connection 24 to a mounting 14 for a chair or seat 15. The chair or seat may pivot about the upper pivot in the direction of arrows 34, 34a and 34b. The mounting 14 for the chair or seat includes a gas lift mechanism actutable by a gas-lift lever 25, also shown in the alternative positions at 25a and 25b.

When the arms are aligned so as to be substantially co-planar as shown at 12a and 13b, a possible "locking" of the arms in such a configuration is avoided by providing a "lost" motion connection between the arms. The intermediate pivot axis for such a configuration is given reference numeral 35 and the alignment is represented by line 39. The lost motion is provided by an elongation of the socket shown diagrammatically at 37 whereby the intermediate pivot axis may be displaced angularly to the line 39 in the direction of arrow 38 which is an acute angle with respect to the line 39, thereby permitting the dead straight alignment of the arms to be avoided. If desired, the lost motion may be biased to a central position along the extent of the transverse elongation of the socket.
In the form shown, the arms are elongate about a curved axis substantially conforming to a quarter of a circle, the intermediate pivot being substantially coaxial with the curved axis, and the upper and lower pivots being substantially at 90° to the curved axis. The upper and lower arms have substantially the same dimensions with respect to their lengths, curvature and relative positions of the upper, lower and intermediate pivots. Thus it will be seen that when the upper and lower arms are pivoted such that their curved axes lie substantially in the same plane, the curved axes describe substantially a semicircle whereupon, in such a position, the upper and lower axes are substantially coincident with one another. The base also includes retractable castors 16 and a foot-rail attachment slot 17 for attachment of the base to a foot rail for movement of the base in the direction of arrows 36.

The actuation means 40 shown in Fig. 2 includes some of the elements similar in form and function to those shown in Fig. 1 and for which the same reference numerals have been used. In addition thereto, the actuation means a stepper motor 48 and a pulley or second stepper motor 49 spaced from the other stepper motor and linked to on another by a belt or cable 47. There is a chair rail 42 provided for lateral movement of the axle joint of the arrow 43 in the direction of arrows 41, the arms being able to move by virtue of being mounted by way of bearings permitting pivotal movement in the direction of arrows 43, 44 and 45. The stepper motor(s) are mounted to the base plate and may be actuated to effect movement of the belt or cable to draw the axle joint at the arrow 43 along the rail. The arms extend upwardly from the slideable axle joint at 43 in a similar fashion to that shown in Fig. 1, and a chair (not shown) is mounted to the axle joint 46 which is free to rotate. Stepper motors are also provided at the axle joints near the arrows at 43 and 44.

The stepper motors (being three or four in number) are electronically controlled, such as by a computer. The movement of the chair may be mapped in Cartesian co-ordinates using basic mensuration and/or trigonometric calculations, thus enabling computer controlled movement of the chair. Such control may be effected, for example, with a mouse or other pointing device, and software may be provided on the computer to shown the position of the chair relative to its extent of possible movement on a computer generated map on a computer screen. Alternatively, a footplate may be provided with switches or such like to generate movement commands to the stepper motors. Moreover, the computer may store preferred
positions to permit the user to return to such positions to perform different tasks at such positions.

The alternative form of pivot connection 50 shown in Figs. 3 to 6 includes a lower block 51 and an upper block 52 pivotally connected to one another by virtue of a pin 53. The pin is rotatable and slidable in slots in the upper and lower blocks, there being provided a lower slot 54 in the lower block and an upper slot, not shown, but represented by a dashed line 55. The upper and lower blocks are mounted in the upper and lower arms respectively at an angle such that when the arms are substantially in line with one another, the slots are angularly offset by 90° to one another, and generally at a non-right angle to the aligned axes of the arms.

In use, support apparatus for a movable chair according to the present invention may be provided to permit a user to move freely around a workstation, thereby reducing the risk of over-reaching, twisting and/or having to shift their body weight as is normally required when moving conventional office chairs (on castors). The base is designed to support the pedestal construction forming part of the support apparatus that will in turn support a swivel chair. The preferred form having two arms is arranged such that each arm can move independently about 360° substantially free of friction. The upper arm is connected to the lower arm at is upper extremity (that is, furthest away from the base) and is also free to rotate through 360°. The support apparatus also has a weight brake which will disengage the brake when a predetermined weight is placed on the chair to permit the user ease of use when getting into and out of the chair.

An adjustable footrest is preferably attached to the chair in a configuration which clears the arms irrespective of the position of the chair with respect to the base.

It will be understood that the above as has been given by way of illustrative example of the invention only all such modifications and variations thereto as would be apparent to persons skilled in the art are deemed to fall within the broad scope and ambit of the invention as defined by the following claims.
THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. Support apparatus for a movable chair including:-
   a support base arranged for support by a supporting surface;
   two or more mounting arms, one of which is pivotally mounted to the support base
   about an axis substantially normal to the support surface and one or another of which is pivotally
   mountable to a seat about an axis substantially parallel to the first-mentioned axis, each mounting
   arm being pivotally connected to one another in substantially end-to-end relationship, the pivot
   axes of each arm being arranged such that the pivot axis at or near one end is spaced from and
   substantially to the other pivot axis at or near the other end.

2. Support apparatus according to Claim 1, wherein two arms are provided in the form of a
   lower arm mounted to the support base and an upper arm mounted to the seat, the spaced parallel
   arrangement of the axes being provided by two or more complementary crooks or bends formed
   into each arm.

3. Support apparatus according to Claim 2, wherein the lower arm extends laterally with
   substantially reduced elevation compared to the upper arm extending laterally substantially the
   same amount as the lower arm, but providing substantially greater elevation.

4. Support apparatus according to Claim 2, wherein each arm is of substantially the same
   form so that the axis of the pivot connection to the support base can be made coincident with the
   axis of the pivot connection to the seat such as when the arms are made to substantially overly
   one another and each arm provides substantially the same amount of elevation above the
   supporting surface.

5. Support apparatus according to any one Claims 2 to 4, wherein the mounting between the
   upper and lower arms include provision for sliding motion normal to the pivot axis, the sliding
   motion constrained in direction and extent, the constraint of the direction of sliding being an
   acute angle with respect to a notional flat plane containing all axes of pivotal movement when the
   arms are so aligned.
6. A method of moving a chair including:

   connecting two or more mounting arms to one another in substantially end-to-end relationship for pivotal movement about respective axes each spaced from and substantially parallel to the or each other axis of each adjacent connection;

   mounting an end one of the mounting arms by its end remote from its connection to the or another mounting arm to a support base adapted for support on a supporting surface, the mounting being for pivotal movement of the mounting arm about an axis substantially normal to the mounting surface and spaced from and substantially parallel to the other axis or axes; and

   providing mounting means for mounting the other end of the or one of the mounting arms by its end remote from its connection to the or another mounting arm to a seat support for pivotal movement about an axis spaced from and substantially parallel to the adjacent connection.

   connecting two or more mounting arms to one another in substantially end-to-end relationship for pivotal movement about respective axes each spaced from and substantially parallel to the or each axis of each adjacent connection;

   mounting an end one of the mounting arms by its end remote from its connection to the or another mounting arm to a support base adapted for support on a support surface, the mounting being for pivotal movement of the mounting arm about an axis substantially normal to the mounting surface and spaced from and substantially parallel to the other axis or axes; and

   providing mounting means for mounting the other end of the or one of the mounting arms by its end remote from its connection to the or another mounting arm to a seat support for pivotal movement about an axis spaced from and substantially parallel to the adjacent connection.

7. Support apparatus for a moveable chair substantially as hereinbefore described with reference to the any one of the accompanying drawings.
**INTERNATIONAL SEARCH REPORT**

**A. CLASSIFICATION OF SUBJECT MATTER**

Int. Cl.

*A47C 7/00* (2006.01)  \( \)  *A47C 7/50* (2006.01)  \( \)  *A47C 9/02* (2006.01)

According to International Patent Classification (IPC) or both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

DWPI, A47C 7/00, 7/50, 9/02 key words PIVOT+, SWING-*, TURN+, TWIST+, ROTAT+, SPIN+.

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

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<td>A</td>
<td>US 4181281 A (KOSAK) 1 January 1980 Whole document</td>
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* Further documents are listed in the continuation of Box C  \( \)  X See patent family annex

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| K | document member of the same patent family |

**Date of the actual completion of the international search**  \( \)  **Date of mailing of the international search report**

08 June 2007  \( \)  15 JUN 2007

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Form PCT/ISA/210 (second sheet) (April 2007)
This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

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Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.

END OF ANNEX