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Kristensson et al.

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[54] **CHAIR HAVING LEG AND FOOT SUPPORTING MEANS**

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[52] **U.S. Cl.** **297/429**, 297/68, 297/433

[51] **Int. Cl.** **A47c 7/50**, A47c 1/02

[58] **Field of Search** 297/71, 75, 88, 330, 297/340–342, 429, 433, 68; 280/34

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[57] **ABSTRACT**

There is provided a chair having a frame supported by two front chair legs and two rear chair legs and having a back support a seat and a leg supporting means arranged at the front end of the seat and capable of being swung from a substantially vertical starting position to a substantially horizontal supporting position. The leg supporting means comprises an upper and a lower portion capable of being moved longitudinally relative each other between fixed limits, and the lower portion of the leg support means has a foot support connected adjustably thereto. The lower portion of the leg supporting means is freely displaceably connected with the upper portion of said means such that it can move longitudinally relative said upper portion and its pivot point between determined movement limits. Longitudinal displacement of the lower portion relative to the upper portion is guided by a link arrangement adapted to actuate the lower portion during movement of the leg supporting means from its starting position to the support position in a manner such that said lower portion is displaced relative to the upper portion to an outer limit position, thereby providing an extension of the leg supporting means so that the foot support does not impede stretching of the legs of a person sitting in the chair.

4 Claims, 5 Drawing Figures

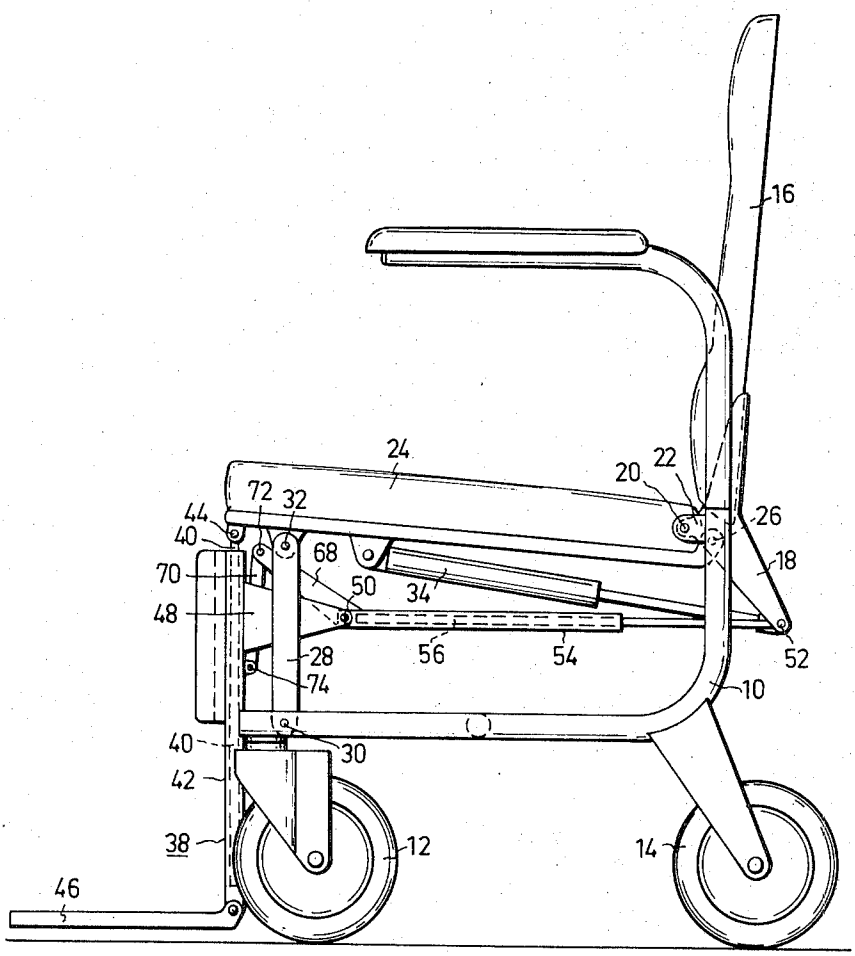

FIG.1

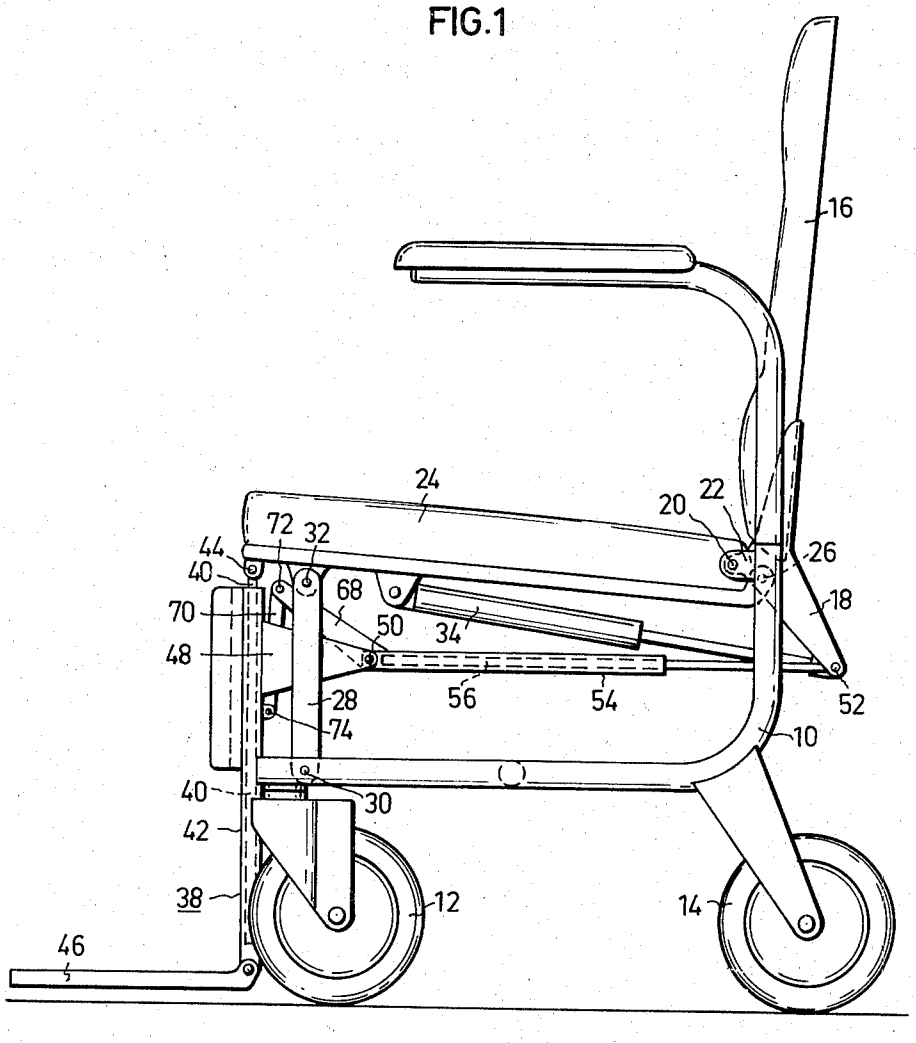
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FIG. 2

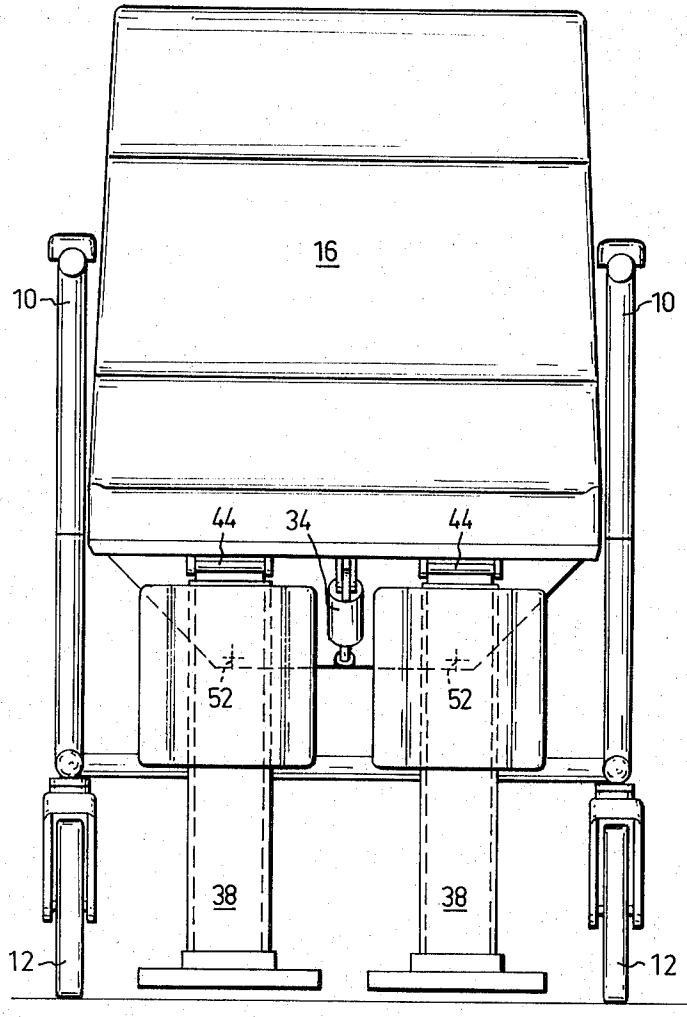


FIG.3

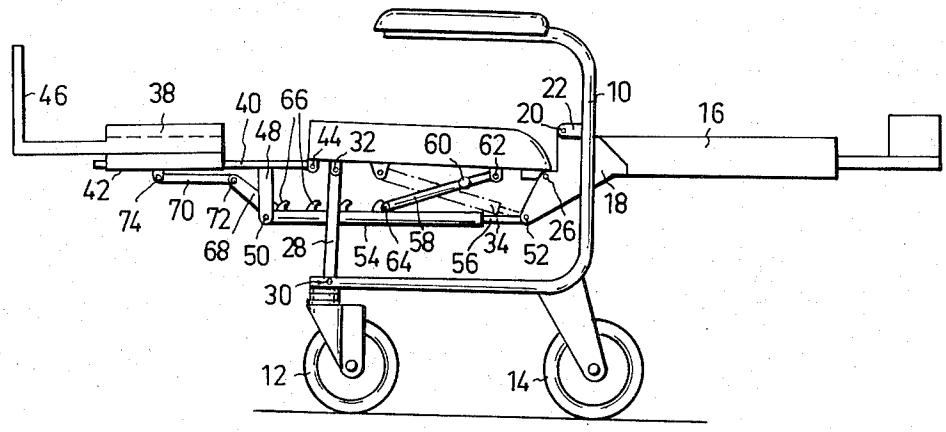


FIG.4

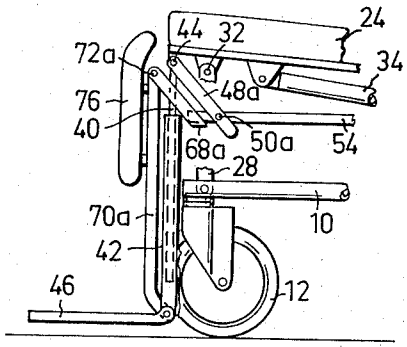
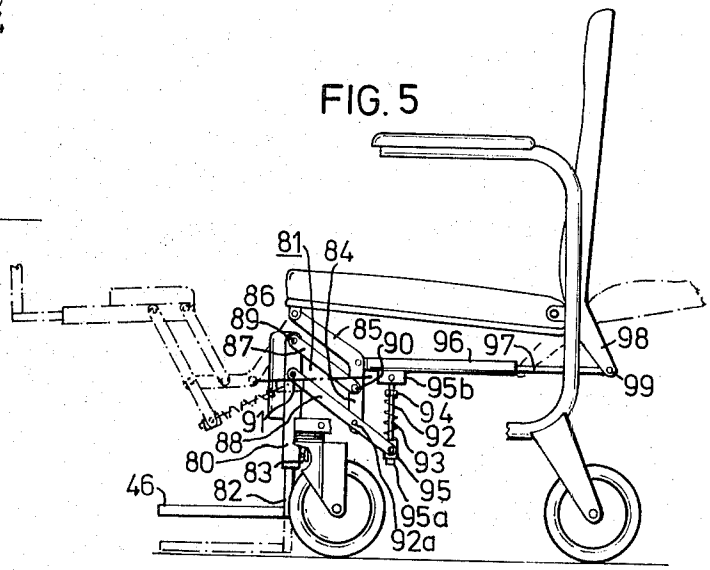


FIG. 5



CHAIR HAVING LEG AND FOOT SUPPORTING MEANS

The present invention relates to a chair having a frame supported by two front chair legs and two rear chair legs and provided with a back support, a seat and a leg supporting means arranged at the front end of the seat and capable of being swung from a substantially vertical starting position to a substantially horizontal supporting position, and having a foot support adjustably connected thereto.

A necessary feature of chairs fitted with leg and foot supports of the aforementioned type is that the pivoting axis of the leg support means must coincide with the axis of the persons's knee joint sitting in the chair, to ensure that the distance from the knee joint to the foot support is not changed to any appreciable extent when raising the leg support. This necessary feature can be ensured by placing the pivoting axis of the leg support means on the side of the chair, level with the knee joint. This solution to the problem, however, impairs the overall aesthetic appearance of the chair. The object of the present invention is therefore to provide a chair having a collapsible leg supporting means whose pivot or journalling points are located inwardly of the confines of the chair frame and are thus relatively well hidden from view at the same time as the distance between the knee joint of a person sitting in the chair and the foot support is not shortened when raising the leg supporting means. This object is obtained with a chair constructed in accordance with the present invention, which is mainly characterized in that the leg supporting means has an upper and a lower portion of which the lower portion of the leg supporting means is freely displaceably connected with the upper portion of said means such that it can move longitudinally relative said upper portion and its pivot point between determined movement limits, and that longitudinal displacement of the lower portion relative to the upper portion is guided by a link arrangement adapted to actuate the lower portion during movement of the leg supporting means from its starting position to the support position in a manner such that said lower portion is displaced relative to the upper portion to an outer limit position, thereby providing an extension of the leg supporting means so that the foot support does not impede stretching of the legs of a person sitting in the chair. Thus, in accordance with the invention the leg supporting means is divided into two portions capable of being moved axially in relation to each other, means being provided for moving said portions away from each other to lengthen the leg supporting means when said means is raised, so that the foot support is moved outwardly to enable the legs of the person using the chair to be stretched when the leg supporting means is raised to an obliquely outwardly extending position or a horizontal position. In this way, it is possible to place the pivoting axis of the leg supporting means beneath the seat and inwardly of the sides of the seats without incurring discomfit to the occupant of the chair in the above indicated manner, and while retaining stability of the chair when extended.

These and other features of the invention will be apparent from the following description, which is made with reference to an embodiment of a chair constructed in accordance with theh invention illustrated in the accompanying drawing.

FIG. 1 is a side view of one embodiment of a chair according to the invention,

FIG. 2 is a front view of the chair in FIG. 1,

FIG. 3 is a diagrammatic side view of the chair in FIG. 1, showing the leg supporting means in a horizontal position and the back support also in a horizontal position,

FIG. 4 illustrates a further embodiment of a chair according to the invention, and FIG. 5 illustrates diagrammatically another embodiment of a chair according to the invention and shows in chain lines a raised position of the leg supporting means and a depressed position of the footrest.

The chair illustrated in the drawing has a chair frame comprising steel pipes **10** and supported by four chair legs, each of which has fitted at the bottom thereof a wheel **12, 14** to enable the chair to be moved smoothly over the floor.

Since the two sides of the chair are of identical construction, the following description will only be given with reference to one side of the chair.

The chair is provided with a collapsible back support **16** cooperating with a bracket or arm **18** and capable of pivoting around a pivot point **20** located on a bracket structure **22** attached to the frame **10.** When seen in the direction in which the chair is normally moved, the pivot point **20** is located in front of a vertical line passing through the point of contact of the rear wheel with the floor.

The chair is also provided with a seat **24,** the rear end of which is pivotally connected with a pivot point **26** on the arm **18** of the back support. The pivot point **26** of the seat is located behind a vertical line passing through the back support pivot point **20** and on a lower level than said point, when the back support occupies its raised position as shown in Fig. **1.**

The front end portion of the seat is supported by bearing means which enable the seat to be moved backwards and forwards. In the illustrated embodiment, the bearing means have the form of upstanding links **28,** the lower ends of which are pivotally connected with the frame **10** at **30,** and the upper ends at **32.** which are pivotally connected with the frame of the seat at**32.**

A gas spring **34** is arranged to assist in raising and lowering the back support **16,** the gas spring being operable by means of a handle **36** (FIG. 3) which in a first position disconnects the gas spring to permit the back support to be laid flat, and a second postion in which the gas spring is made operative for raising the back support. The gas spring may optionally be replaced with a system of links capable of being operated by means of a lever placed on the side of the chair.

When the back support is collapsed rearwardly from the position shown in FIG. **1,** the seat pivot point **26** will be moved downwardly and forwardly, causing the rear end of the seat **24** to be lowered and the seat to be moved forward. To this end, the bearing means at the front end of the seat are arranged so that the seat takes a relatively pronounced rearwardly inclined position when the back support **16** is collapsed to an intermediate position, between its raised position as shown in FIG. **1** and its horizontal position as shown in FIG. **3.** With this arrangement, the person occupying the chair is seated more firmly when the back support is dropped rearwardly than would be the case if the seat were permitted to retain its horizontal or slightly rearwardly inclined position as shown in FIG. **1.**

Owing to the fact that the seat is simultaneously moved forward as the back support is lowered, the centre of gravity of the person sitting in the chair is also moved forward to a point located further inwardly of the rear wheels **14**, whereby the chair retains its stability to a greater extent than would be the case if the centre of gravity of the occupant was not moved.

The chair illustrated in FIG. **1** is provided with two pivotable leg supports **38** which are of identical construction and hence of which only one will be described hereinafter. In FIG. **1** the leg support is shown collapsed to a substantially vertical position, while FIG. **3** illustrates the leg support raised to a horizontal position.

The leg support **38** is divided into portions, comprising an upper portion **40** and a lower portion **42** capable of being moved axially in relation to the upper portion **40** in the longitudinal direction of the leg of the occupant. The upper portion **40** is pivotally connected at the upper end thereof with the seat frame at **44.** The upper portion **40** comprises a bar or rod extending downwardly in a sleeve forming the lower portion **42.** Pivotally mounted at the lower end of the sleeve **42** is a foot support **46.**

When the leg support is raised to its horizontal position, as shown in FIG. **3,** a system of links causes the lower portion **42** to be slightly moved axially away from the upper portion, to increase the distance between the pivot point **44** of the upper portion and the foot support **46.** Thus, in this way there is obtained an increase in the length of the leg support in a particularly simple manner. The knees of a person sitting in the chair with the back support and leg support occupying the position illustrated in FIG. **1** will be level with the upper side of the seat and slightly in front of its leading edge. Since the occupant's legs swing around a pivot point which does not coincide with the pivot point **44** of the upper section, the seat, subsequent to being swung to the horizontal position, will extend beyond the extremities of the foot support **46** in FIG. **1** if the foot support **46** with its lower portion should be securely connected to the upper section **40.** With the described arrangement, however, the foot support is automatically extended by an amount sufficient to hold the legs of the person sitting in the chair straight with the feet resting on the foot support. The manner in which this can be accomplished simply but effectively will be evident from the illustrated example of the link system.

Mounted on the rear side of the upper portion **40** is a bracket arm **48** having a pivot point **50** lying behind a vertical line passing through the pivot point **44** of the upper portion when the leg support occupies its collapsed position. Between the pivot point **50** and the pivotable arm **18** of the back support is mounted at **52** a telescopic link, comprising a tube **54** attached at pivot point **50,** and a rod **56** capable of moving axially in the tube **54,** the inner end of the rod **56** engaging the bottom of the tube **54** at its inner end in the position illustrated in FIGS. **1** and **3,** and the outer end of which rod is connected with the back support bracket at the point **52.** When the back support is collapsed rearwardly to the position shown in FIG. **3,** the leg support **38** is swung up to its horizontal position, FIG. **3.** The leg support can be latched in this position by a latching arm **58** capable of being operated by a handle **60** and pivotably mounted in the seat frame at **62.** The lower end **64** of the latching arm **58** can be brought into engagement with one of a number of raised members **66** (FIG. **5**) arranged on the tube **54,** the selected raised member corresponding to the desired angle of the leg support in its extended position. In FIG. **3,** the leg support is shown to occupy a horizontal position. If desired, the back support can now be raised by means of the gas spring **34** to the desired angle, this being enabled by virture of the fact that the rod **56** is freely displaceable in the sleeve **54.**

To provide for outward movement of the lower portion **42** of the leg support when lifting said support there is provided an obliquely upwardly extending arm **68** at the end of the tube **54.** The arm **68** is moved forward by the telescopic link arrangement **54, 56** from the position shown in FIG. **1** to the position shown in FIG. **3.** This movement is transmitted to the lower portion **42** by means of a link **70,** one end of which is pivotally connected to the arm **68** at **72,** and the other end of which is pivotally connected at a point **74** on the lower section **42.**

The chair illustrated in FIG. **1** is constructed as a wheel chair and may be used to advantage by handicapped persons. By providing the chair with a seat which can be moved forward when the back support is lowered, and with a leg support which can be extended when raising said support, as shown in FIG. **3,** there is obtained a particularly comfortable and safe wheel chair which can be readily converted to a horizontal and stable bed-like structure with sufficient room for the legs, as with FIG. **3,** when so desired.

FIG. **4** illustrates a modification of the embodiment illustrated in FIG. **1.** The embodiment of FIG. **6** also includes an upper portion **40** pivotally mounted at **44.** The design of the rearwardly directed bracket or arm **48***a*, anchored to the upper section **40,** is somewhat changed, but operates in principle in the same manner as the arm **48** in FIG. **1,** owing to the fact that its rear end is pivotally connected with the operating means, i.e. the tube **54,** at a point **50***a*. The embodiment of FIG. **6** also includes a lug or an obliquely, outwardly extending arm **68***a* attached to the front end of the tube **54** and pivotally connected at its upper, free end **72***a* with the upper end of a link arm **70***a*, the lower end of which link arm **70**a is pivotally connected with the lower portion **42.** With the embodiment of FIG. **4,** the link arm **70***a* is located in front of the upper and the lower section and extends down to the proximity of the foot support. By means of this arrangement, the link arm will be extended slightly in relation to the lower portion **42** when the leg support is raised to an intermediate position. Supported by the link arm is a calf support member **76,** which is arranged to support the calf of the leg during practically the whole of the raising movement performed by the leg support. When the leg support occupies its horizontal position, the calf supporting member is approximately in register with the seat **24.**

FIG. **5** illustrates a further embodiment of a leg support means constructed in accordance with the concept of the invention. As with the embodiments of the chair illustrated in FIGS. **1–4,** the leg support means of this embodiment comprises an upper portion and a lower portion, the lower portion having a foot rest attached thereto and being connected to the upper portion in a manner to permit limited longitudinal movement thereof relative to the upper portion and to the pivot point of said upper portion.

With this embodiment, the lower portion of the leg support comprises an arm **80** forming part of a parallel linkage system, shown generally at **81**, so arranged that movement of the leg support means from its collapsed to its raised position can be effected without shortening the distance from the knee joint of a person occupying the chair to the foot rest. The foot rest, shown at **46**, is attached to the lower portion or arm **80** by means of a rod or the like **82**, the position of which relative the arm **80** can be locked by means of a latch pin **83**, for example. Extending generally parallel with the arm **80** when the leg supporting means occupies its collapsed position is a portion **84** of an arm forming the upper portion of the leg supporting means, the other portion **85** of which arm is pivotally attached to the underside of the seat frame at **86**. The longitudinal movement of the lower portion or arm **82** relative the upper portion or arm **84, 85** and its pivot point **86** is facilitated and controlled by two arms **87** and **88** which interconnect arms **82** and **84** and which are pivotally connected thereto at **89, 90** and **91, 92** respectively. The arms **82, 84, 87** and **88** form a generally parallel system of link arms when the leg supporting means occupies its collapsed position.

To maintain the parallel linkage system in equilibrium in the collapsed, vertically extending position of the leg support there is provided a spring **92**. In the illustrated embodiment the spring is a compression spring and extends over a rod **93** between an adjustable stop member **94** and a sleeve **95** arranged to move along the rod **93** to compress or relax the spring; a further stop member **95*a*** is arranged beneath the sleeve **95** on rod **93** to provide a bottom movement limit for the sleeve. The end of the rod remote from the sleeve **95** is pivotally attached at **95*b*** to a link arm actuating mechanism, hereinafter described, while an extension of arm **88** is attached to the sleeve **95** in the manner illustrated.

As will be obviius from the aforegoing and from the Figure, when a load is applied to the foot rest **46**, for example as an occupant of the chair prepares to leave the same, the downardly acting force on arm **82** will cause arm **88**, which is attached to the sleeve **95** of the spring means, to pivot about its pivot point **92a** against the force exerted by the spring **92**. The end of the rod **93** bearing the stop member **95a** may be threaded and the stop member, provided with a corresponding internal thread, to enable the distance between the upper and lower limits of movement for the sleeve **95** to be adjusted, and therewith also the degree of precompression of the spring **92**.

In addition to providing for a smooth and controlled vertical movement of the lower portion of the leg support means and the foot rest when a load is applied to the latter, the restraining force of the spring will also counteract forward tilting movement of the chair as the occupant stands on the foot rest when climbing into and out of the chair.

As with the embodiments previously described, movement of the leg supporting means from its collapsed position to its raised position is accomplished by means of a telescopic link, comprising a hollow tube **96** and a rod **97** arranged to move axially in the tube. The telescopic link **96, 97** is constructed and operates in the same manneras the telescopic link **54, 56** of FIG. **1**, and the outer end of the rod **97** is therefore connected to a back support bracket **98** at **99**. The end of the tube remote from the bracket **98** is connected to the upper portion or arm **54, 85** and as will be seen from FIG. **5**, the tube **96** also carries the attachment point **95*b*** for the spring **92**. The aforedescribed telescopic link arrangement may be emobdied both when the leg support means shall be capable of being raised independently of the back rest and when lifting or lowering of the leg support means is effected simultaneously with corresponding movements of said back rest. In this latter instance, however, the telescopic link may be replaced withh any suitable form of drive means, such as a triangular rod-like structure arranged to respond to movement of the back rest so as to move the leg support means in a corresponding manner.

When wishing to raise the leg support means from its collapsed position, pressure is applied to the rod **97**, which bears against the closed end of the tube **96**. Movement of the rod **97** will then cause the arm **84** to swing outwardly and upwardly about its pivot **86**, the arms **88** and **89** connected to the arm **84, 85** and to the arm **80** transferring the movement of arm **84, 85** to arm **80**, whereupon the arm or lower portion **80** of the leg support means also swings outwardly and upwardly to the desired position.

As before mentioned, the arrangement of arms **80, 84 85, 87** and **88** is such that as the lower portion of the leg support means is moved outwardly and upwardly under the influence of a similar movement of arm **84, 85**, the arm **80** is moved longitudinally relative to the arm portion **84** to a determined extent, thereby ensuring that the distance from the knee joint of the chair occupant to the foot rest **46** is not shortened as the leg support is raised.

As the arm **80** moves upwardly and outwardly in the manner described, the spring **92** will accompany the movement of arm **88** while pivoting about pivot point **95*b***, to serve as a locking link in the raised position of the leg support means, through the telescopic link **96, 97**, which is suitably locked in its extended position by appropriate means, such as by the latching arm arrangement described in connection with the embodiment of FIG. **1**.

Although the concept of the present invention has been illustrated by a number of embodiments in which the concept is applied, it will be obvious that many alternatives are possible by which the lower portion of the leg supporting means can be made to automatically move longitudinally relative the upper portion as the leg supporting means is raised from its vertical collapsed position. Further, the spring means **62** can be replaced by any suitable means capable of permitting controlled depression of the foot rest in the vertical and extended position of the leg support means and of serving as a locking arm in said extended position of said means. If the feature of the depressible foot rest is not required, the spring means may be replaced by a rigid link arm. The invention is therefore not restricted to the described and illustrated embodiments, but can be modified within the scope of the following claims.

What is claimed is:

1. A chair having a frame supported by two front chair legs and two rear chair legs and provided with a back support, a seat and a leg supporting means, the latter being arranged at the front end of the seat and capable of being pivoted from a substantially vertical starting position to a substantially horizontal supporting position, the leg support means having a foot sup-

port adjustably connected thereto, characterized in that the leg supporting means has an upper and a lower portion, said lower portion being freely displaceably connected with said upper portion so that it can be displaced longitudinally relative to said upper portion and its pivot point between determined movement limits, said leg support having attached to the upper portion thereof a rearwardly extending arm, operating means arranged beneath the seat, the rear end of said arm being pivotally connected to said operating means, said operating means being capable of being moved axially forwards and backwards to raise and lower the leg support respectively between its vertical and horizontal positions, said operatiang means having an outwardly projecting arm having a pivot point, a substantially vertical link having one end connected to said pivot point, the other end of said link being pivotally connected to a point on the lower portion of the leg support, whereby raising of the leg support causes the first named end of the link to be moved with the operating means and cause axial movement of the lower portion away from the upper portion, said back support of said chair being pivotally mounted at its lower end and collapsible rearwardly, the lower end of the back support having a bracket forming a pivot arm relative to the pivot point of the back support, a telescopic connector joining said bracket with the pivot point of the arm attached to the upper portion, whereby collapsing movement of the back support causes the leg support to be raised to its support position, and during movement of the leg supporting means from its starting position to the support position said lower portion will be displaced relative to the upper portion to an outer limit position, thereby providing an extension of the leg supporting means so that the foot support does not impede stretching of the legs of a person sitting in the chair.

2. A chair according to claim **1,** characterized in that the telescopic connector comprises a tube with a rod capable of moving axially therein, the forward end of the tube being connected with the arm on the upper portion of the leg support, while the rear end of the rod is pivotally connected with the bracket on the back support, whereby when the back support is in its raised position and the leg support is in its starting position, the rod is inserted to a bottom portion in the tube so that lowering of the back support causes pressure forces to be transferred by the inner end of the rod to the tube and to the arm on the upper portion of the leg support for raising said leg support.

3. A chair according to claim **2,** characterized in that the tube is provided with a plurality of sequentially arranged latching means a latching arm is pivotally mounted on the frame of the chair and is movable to cooperate with any one of said latching means to lock the leg support in an angular position corresponding to the latching position of said latching means, and that the arrangement of said back support permits it to be sequentially raised to the desired angular position and latched in said position.

4. A chair according to claim **1,** characterized in that the leg first, means has the form of a parallel system of arms, of which arms a first forms the lower portion of said means and a second extending generally parallel with said first arm in the collapsed position of said means and hinged to a fixed seat structure, forms the upper portion of said means, said first and said second arms being connected together by further arms in said parallel system in a manner to permit relative longitudinal movement of the first arm to the second arm and its pivot point, and in that the parallel system of arms is held in equilibrium in the collapsed position of the leg support means by a spring means arranged to act on at least one of said further arms, said first, arm, when disposed in a vertical position, being shiftable downwardly by the biasing forces exerted by said spring means responsive to the application of downward forces against said foot support, whereby the spacing of said support from a ground surface may be varied.

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