Jan. 15, 1963 R. S. JOHNSON 3,073,648

TRANSVERSELY MOVABLE HINGE

Filed Nov. 2, 1959 4 Sheets-Sheet 1

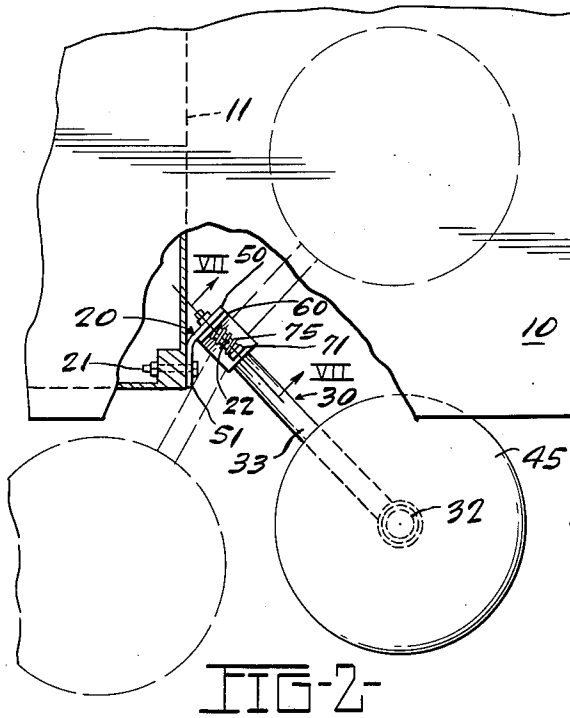


FIG-2-

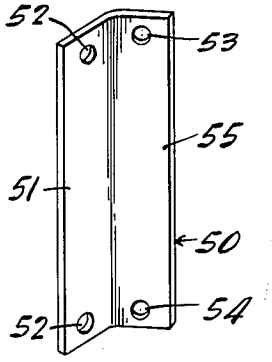


FIG-4-

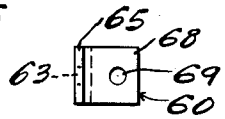


FIG-6-

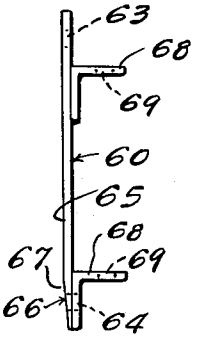


FIG-5-

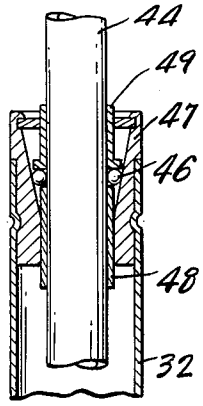


FIG-3-

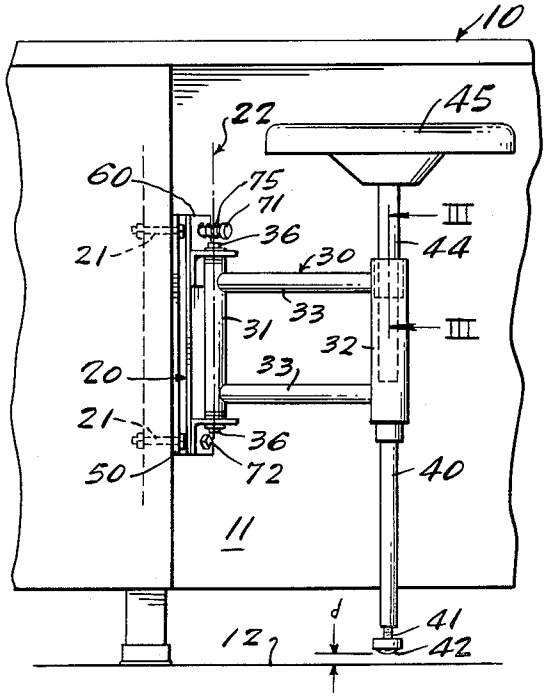


FIG-1-

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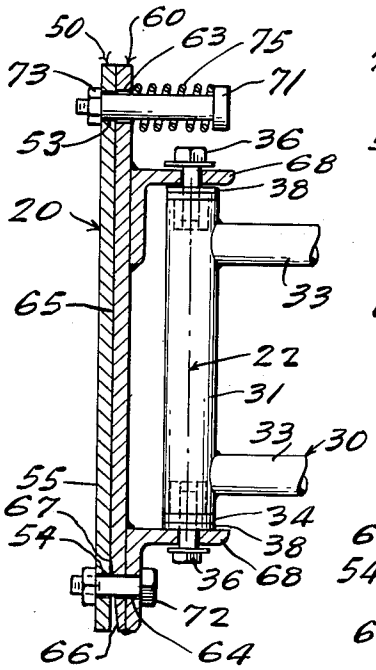


FIG-7-

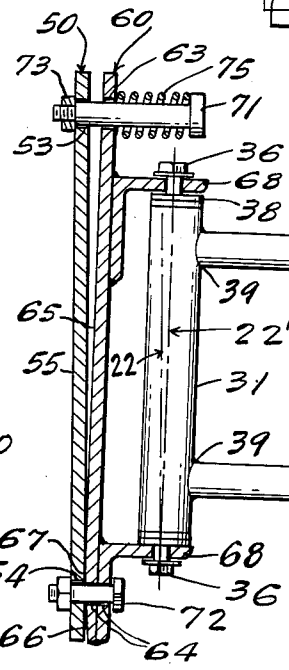
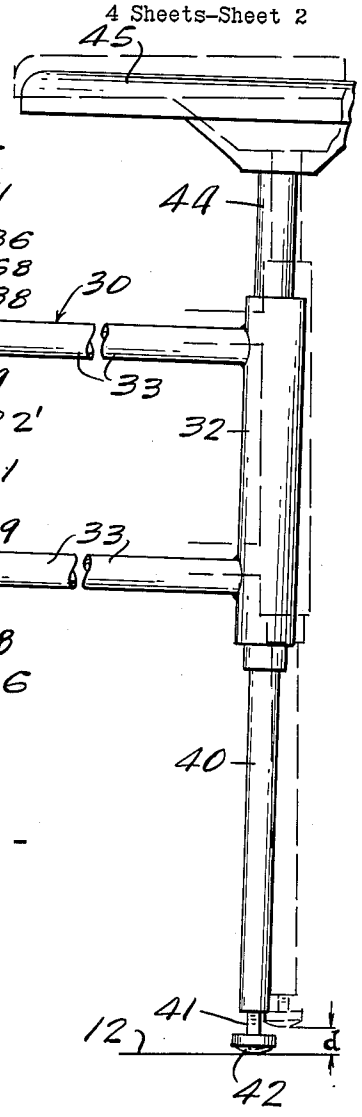


FIG-8-



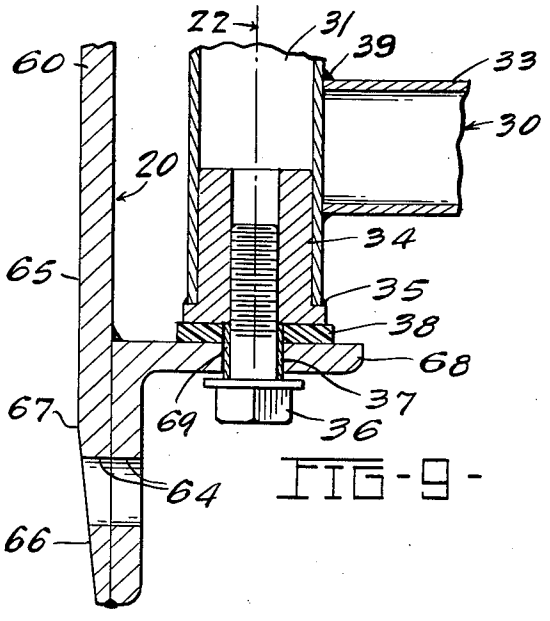


FIG-9-

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TRANSVERSELY MOVABLE HINGE

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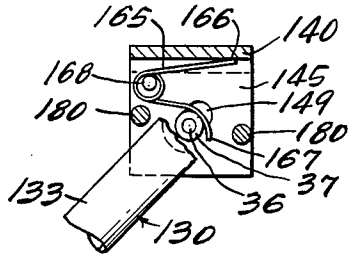


FIG-20-

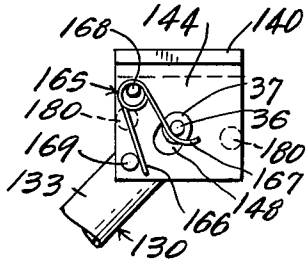


FIG-21-

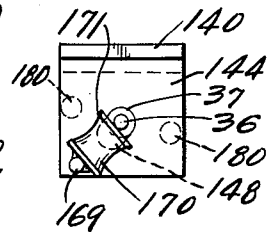


FIG-22-

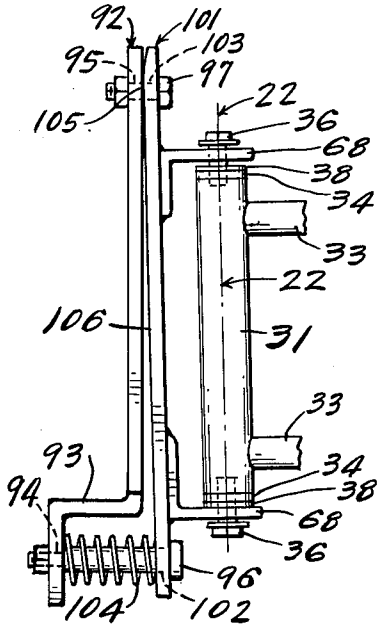


FIG-10-

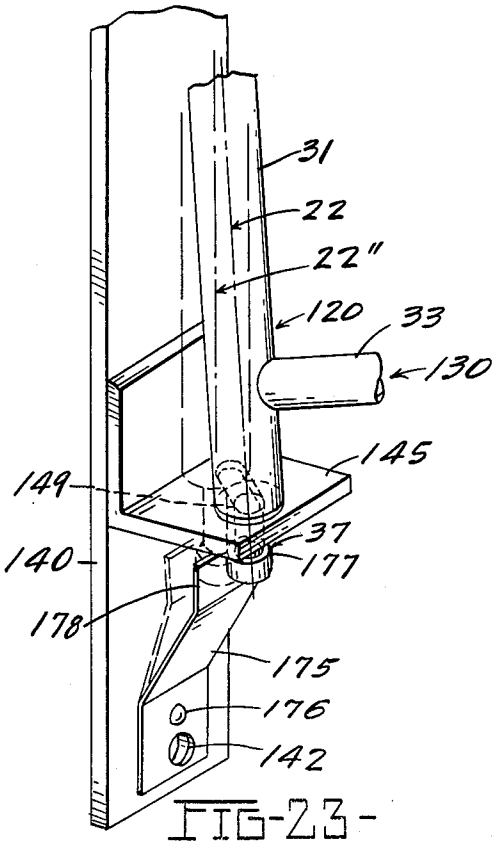


FIG-23-

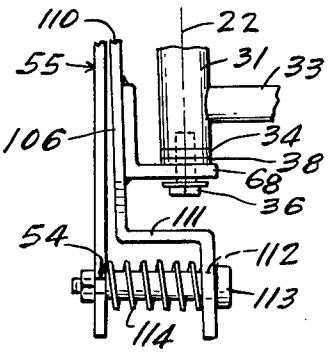


FIG-11-

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TRANSVERSELY MOVABLE HINGE

Filed Nov. 2, 1959 4 Sheets-Sheet 4

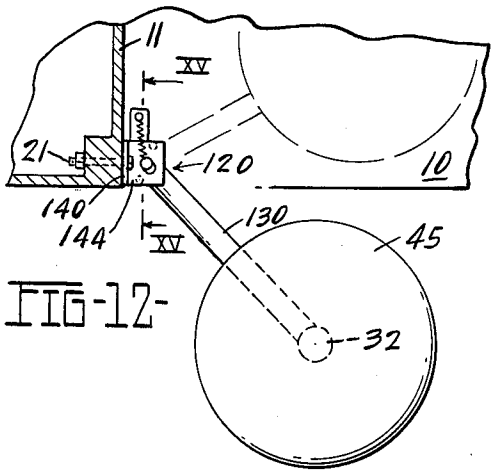


FIG-12-

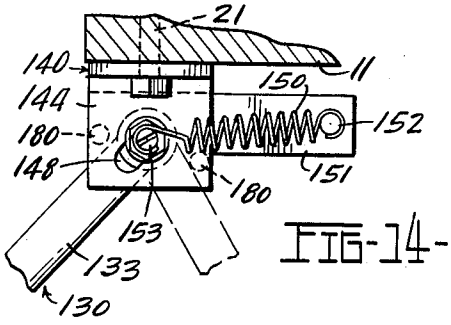


FIG-14-

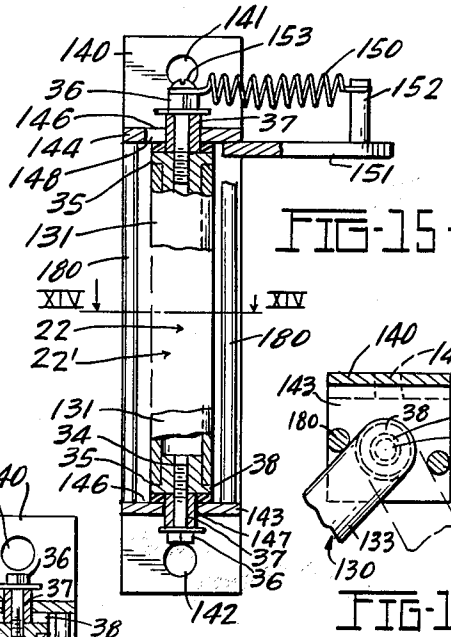


FIG-15-

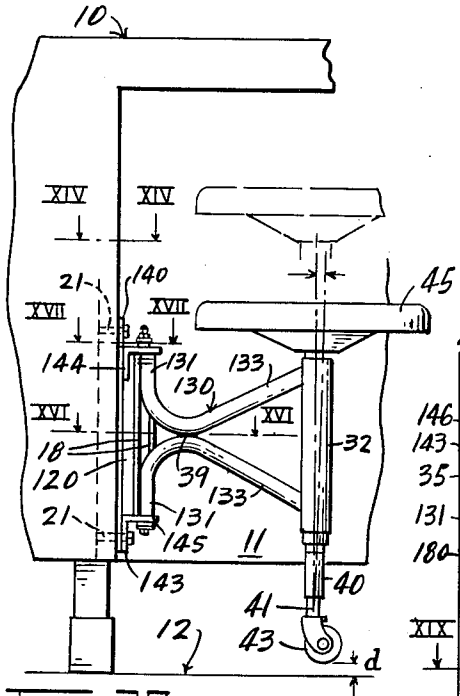


FIG-13-

FIG-16-

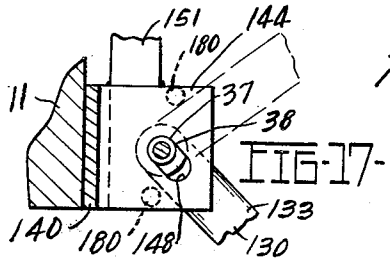


FIG-17-

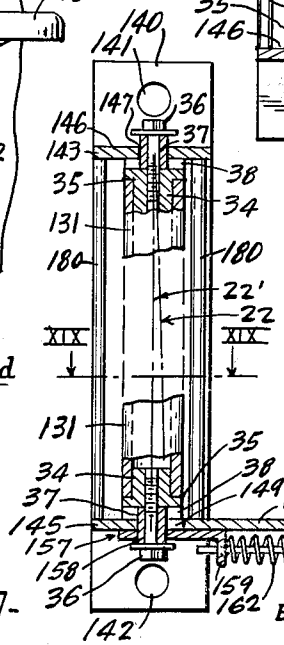


FIG-18-

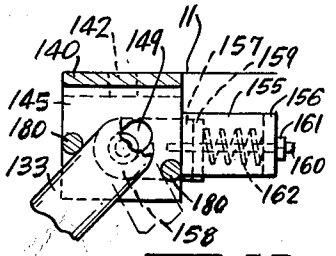


FIG-19-

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United States Patent Office 3,073,648 Patented Jan. 15, 1963

3,073,648

TRANSVERSELY MOVABLE HINGE

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Filed Nov. 2, 1959, Ser. No. 850,285
12 Claims. (Cl. 297—142)

This invention relates to a hinge which permits movement in two planes perpendicular to each other. More particularly, it deals with a hinge for a supporting bracket which permits movement when a weight is placed on said bracket to prevent stress and strain on the hinge. For example, such a hinge and bracket may be used for supporting a stool attached to the side of a table or desk, which stool when not in use may be readily swung in and out from under the table or desk, and when in use it will move transversely of its pivotal axis to permit a leg depending from said stool to rest on the floor thereby removing all strain due to the weight of the user from the side of the desk or table, as well as from the hinge and its bracket connected thereto.

Previously axially slidable hinges on their pivotal axes have been used for similar purposes for stools attached to the corners of desks, but these still created transverse torques on the hinges due to sliding friction of their pivots and correspondingly transfer strains to the hinges and the sides of the desks to which they are attached.

Accordingly it is an object of this invention to produce a simple, efficient, effective and economic transversely movable hinge which avoids the necessity of resisting large transverse torques applied thereto.

Another object is to produce such a hinge which can automatically compensate for any misalignment between its parts and forces applied thereto.

Another object is to produce such a hinge for mounting a stool on the side of a desk or table which automatically moves in response to more than a given transverse torque applied to the hinge, such as by the weight of a person supported on the stool, to remove the force of this torque from the hinge and desk or table to which it is connected.

Another object is to produce such a hinge support for a stool mounted on the corner of a desk, which stool normally may be freely swung in and out of the way in front of the desk when a person is not seated thereon, and which stool automatically engages the floor to support the major portion of the weight of the person as soon as the person's weight is placed on the stool, thereby removing the application of a large transverse torque from the hinge and the bracket anchoring it to the desk or table, and the necessity of having a strong and reinforced bracket and desk to which it is attached.

Another object is to provide such a swinging stool mounted on such a hinge support, which stool may be vertically adjustable both to suit the user and/or to compensate for the irregularities in the floor over which it moves and rests when weight is applied to the stool.

Generally speaking, this invention pertains to a two-degree of friction hinge which comprises: a pair of relatively movable connected members, a pair of pivot portions which are spaced apart from each other and are mounted on one of these movable members, and a pair of spaced bearing means for journalling the spaced pivot portions, which bearing means may be either rigidly attached to an intermediate member which is then rockably or loosely attached to the other of these movable members or may be directly attached through a loose connection to the other of these movable members. These loose connections permit more limited transverse movement of one of the above mentioned pivot portions than is permitted for the other, whereby one of the movable

members is movable rotatively in two planes perpendicular to each other with respect to the other of the movable members.

One example of one of these movable members may be a bracket for supporting a vertical post stool whereas the other movable member may be secured to a wall or the side of a desk so that the stool may be swung into a stored position inside the knee-hole of the desk when not in use.

Regarding the former form of the hinge having this intermediate member, this invention may comprise a pair of plates with cooperating rocking surfaces, means for connecting and guiding said plates in their movements, means for anchoring one of the plates to a relatively stationary support, and means for mounting a pivotal axis on the other of said plates, whereby one of said plates comprises said intermediate member and the rocking movement of the pivotal axis is in a plane perpendicular to the cooperating rocking surfaces of the plates.

The means for connecting and guiding the two plates together may comprise a pair of bolts extending through over-sized holes in at least one and preferably both of the plates, which bolts also limit the amount of rocking movement between the plates. Also, one of the bolts may have a resilient means, such as a compression spring around it, for normally urging the plates into one of their two limited rocking positions. The pivotal axis mounted on one of the rocking plates may journal a swinging bracket at the outer end of which a single vertical post stool may be mounted with a vertically adjustable lower or foot end to rest against the floor when weight is applied to the stool to rock the plates against the action of the spring, so that the weight on the stool will not transmit a transverse torque onto the mounting of the pivotal axis of the hinge and the support to which it is anchored. Thus with a hinge of this type for such a swingable stool, one of the two relatively rocking plates thereof may be anchored to the corner of a standard desk without reinforcement of the desk corner, in that it only needs to support the weight of the stool itself and not the added weight of any person who may sit on the stool.

Regarding the latter form of the hinge with the direct loose connection of the two relatively movable members, this invention comprises pivot means spaced apart from each other incorporated in one of said members facilitating rotational movement about an axis through said pivots, and a pair of spaced apart bearing and guiding means associated with the other of said members for cooperation with the said pivot means of said first member, wherein one of said bearing and guiding means permits greater lateral motion of its cooperating pivot means than is permitted by the other of said bearing and guiding means for its corresponding pivot means. One of the said members, preferably the member incorporating the guiding and bearing means, may be mounted to a fixed support or foundation, whereby the lateral movement of the pivotal axis is transmitted to the other of said members, so that it is rotatable in two planes perpendicular to each other with respect to the fixed member.

The pair of means for bearing and guiding the pivot means may comprise an elongated slot and a circular aperture spaced therefor, wherein the two spaced pivot means are correspondingly journalled. This arrangement incorporates the means for permitting greater lateral movement of one of the pivot means than is permitted the other of said pivot means. The slot may be limited in length to limit the amount of transverse movement permitted between the said pair of members, and may be oriented so as to fix the plane of said transverse movement. Resilient means such as a rubber block, or spring, may be installed between the members of said pair for normally maintaining the said pair of members in one

of the limiting positions of said transverse movement. The pivotal axis mounted on one of said members of said pair may be adapted so that said members form a swinging bracket at the outer end of which a single vertical post stool may be mounted in the same manner and to the same effect as previously mentioned.

The plate or fixed member anchored to the corner of a table or desk may project therefrom at such an angle that the rocking action caused by the weight of the person on the stool will generally be normal to rocking surfaces of the hinge. Furthermore, if desired, the leg post for the stool may comprise a pair of clutched telescopic sections or other means for vertically adjusting the height of the seat of the stool relative to the floor, such as disclosed in the Campbell United States Patent No. 2,364,191 issued December 4, 1944.

The above mentioned and other features and objects of this invention and the manner of attaining them will become more apparent and the invention itself will be best understood by reference to the following description of an embodiment of the invention taken in conjunction with the accompanying drawings, wherein:

FIG. 1 is a side elevation of a disappearing stool attached to the corner of the kneehole of a desk supported by one embodiment of a three member transversely movable hinge comprising a rockable plate according to this invention;

FIG. 2 is a plan view of FIG. 1 with a part of the desk broken away and showing in dotted lines other positions of the swingable stool;

FIG. 3 is an enlarged section taken along line III—III of FIG. 1 showing one embodiment of a clutch for the vertical adjustment of a telescoping post for the stool;

FIG. 4 is an enlarged perspective view of the hinge supporting plate which is attached to the desk shown in FIGS. 1 and 2;

FIG. 5 is an enlarged side elevation of the hinge pivot-supporting rocking plate which cooperates with the plate shown in FIG. 4;

FIG. 6 is a top plan view of the pivot supporting and rocking plate shown in FIG. 5;

FIG. 7 is an enlarged vertical sectional view taken along line VII—VII of FIG. 2, showing the transversely movable hinge in its normal stool bracket supporting position for swingable movement of the stool in and out of the kneehole of the desk shown in FIGS. 1 and 2;

FIG. 8 is a view similar to that shown in FIG. 7 but with the rocking plates in a separated position when the stool rests upon the floor as it would be when being occupied by a person seated on the seat of the stool; the dotted line position of the stool being that corresponding to the position for the rocking plates shown in FIG. 7;

FIG. 9 is a further enlarged vertical section of the lower end of the rocking plate and its adjacent pivot bearing of the hinge shown in FIGS. 7 and 8.

FIG. 10 is a side elevation view similar to FIG. 7 of another embodiment of a rockable plate type hinge according to this invention showing a method of installing the resilient means at the lower end of the hinge;

FIG. 11 is a partial side elevation view similar to FIG. 10 showing an alternate form of installing the resilient means therefor;

FIG. 12 is a plan view of a stool swingably mounted on a desk with a kneehole and supported by still another embodiment of a transversely movable hinge according to this invention, showing in dotted lines the stool swung into a retracted position under the cutaway desk surface;

FIG. 13 is a side elevation of the embodiment of hinge and stool shown in FIG. 12, showing in dotted lines another position of the stool;

FIG. 14 is an enlarged detail taken along line XIV—XIV of FIG. 13 showing one embodiment of the slotted aperture for guiding and bearing a cooperating pivot means and also showing one embodiment of the resilient means for maintaining a limiting position of the transverse movement;

FIG. 15 is an enlarged vertical partial cross-sectional view of the pivot means taken along line XV—XV of FIG. 12 showing the resilient means as disclosed in FIG. 14.

FIG. 16 is an enlarged cross-sectional view taken along line XVI—XVI in FIG. 13 showing the position limiting stops for limiting the rotation of the bracket; and showing the pivot means in the circular aperture;

FIG. 17 is an enlarged cross-sectional view taken along line XVII—XVII of FIG. 13 showing the alignment of the bearing and guiding slot;

FIG. 18 is a partial vertical cross-sectional view of another embodiment similar to FIG. 15, but showing the slot and resilient means at the lower end of the hinge assembly;

FIG. 19 is a cross-sectional view taken along line XIX—XIX in FIG. 18 showing the alignment of the slot aperture and the installation of the resilient means.

FIG. 20 is a cross-sectional view similar to FIG. 19 showing another embodiment of the resilient means for maintaining a limiting position of transverse movement of a hinge pivot;

FIG. 21 is a partial plan view similar to FIG. 14 showing still another embodiment of a resilient means;

FIG. 22 is a partial plan view similar to FIG. 21 showing a further embodiment of a resilient means; and

FIG. 23 is an enlarged perspective view of the lower end of a further embodiment of this invention showing a further alternate form of the resilient means, and showing in dotted lines a different position of the pivoted axis with its associated members.

For the purposes of illustration of the transversely movable hinge of this invention, it will be described in connection with a support for a swingable stool attached to the side of a table or desk, so that the advantages of the different degrees of freedom of movements of the hinge may be better understood.

I. A SWINGABLE STOOL

Referring now to FIGS. 1, 2, 12 and 13, there is disclosed a section of a desk **10** having a kneehole **11** therein resting on a floor **12**, to the outer corner of which kneehole of the desk is attached a transversely movable hinge device **20**, or **120** in FIGS. 12 and 13, of this invention, such as by means of a pair of screws or bolts **21**. The hinge device **20**, or **120** in FIGS. 12 and 13, provides a substantially vertical pivoted axis **22** upon which is horizontally swingably mounted a stool supporting bracket **30** or **130** composed of one or more portions **31**, **32**, and **33**, or **131**, **32** and **133**, all of which portions may be joined together such as by welding **39** into the rigid bracket frame **30** or **130**. The vertical tubular members or portions **31** or **131** may be axially aligned with the pivoted axis **22** of the hinge **20** or **120** and may have journalled in their spaced ends spaced pivot means **37** and **38** for this axis as shown in FIGS. 9, 15 and 18. Each pivot means may comprise an internally threaded shouldered sleeve **34**, welded at **35** at its shoulder into an end of the tubular members or portions **31** or **131**. Bolts **36** may be tightly threaded into the shoulder sleeves **34** to clamp the ends of the pivot bearing sleeves **37** and hold them in place, which spaced pivot sleeves **37** are journalled in the spaced bearing and guiding means to be described later. Between these spaced bearing and guiding means and the shoulder ends of the sleeves **34** may be inserted washers **38**, which may be made of nylon.

The normally substantially vertical tube **32** may have depending therefrom a rigid post or leg **40**, and also may have at its lower end a vertically adjustable screw threaded foot **41** which may have a plastic or rubber bottom surface **42** or a swivelable caster **43** (see FIG. 13)

for resting against the surface of the floor **12**. Telescoping into the upper end of the tube **32** there may be provided a vertically adjustable post **44** upon the upper end of which may be located a swivelable seat **45**. The telescoping post **44** may be clutched at different heights from the floor **12** by balls **46** in a frusto-conical wedging device **47**, such as that shown in section in FIG. 3 and described in above mentioned Campbell U.S. Patent No. 2,364,191. In this embodiment, the stool seat **45** may be re-set by pulling it up as far as it will go so that the friction sleeve **48** in the wedging device **47** will contact a stop or outwardly flaring bottom flange on the post (not shown) to release the clutch action of the balls **46**, and then completely lowering the seat as far as it will go to re-set the sleeves **48** by action of the sleeve **49** before raising it again to the height desired.

II. THE TRANSVERSELY MOVABLE HINGE

A. *Rockable Plate Type*

This vertically adjustable swingable stool and bracket **30** which is attached to the edge of the kneehole **11** of a desk **10**, is further supported by a transversely movable hinge device **20** shown in more detail in FIGS. 4 through 9.

Referring first to FIGS. 4, 5 and 6, there are disclosed the two cooperating rocking plate members **50** and **60** of the transversely movable hinge device **20**, the former plate **50** of which as shown in FIG. 4 comprises an obtuse-angle channel member, one side or portion **51** of which may be provided with one or more apertures **52** through which the screws or bolts **21** may rigidly anchor the hinge **20** to a fixed or stationary support, such as the side or edge of a table, bench or desk **10**. However, other means of relatively stationarily anchoring this plate **50** may be employed without departing from the scope of this invention. The other side or portion **55** of the plate **50** is herein shown extending at such an angle to the side **51**, that when the stool seat **45** is in its normal seating position (see full lines in FIG. 2), with the knees of the person seated thereon in the kneehole **11** of the desk **10**, any transverse torque applied to the hinge device **20** is transferred through the bracket **30** substantially at right angles to the face of the plate portion **55**. This portion **55** may also be provided with a pair of apertures or holes **53** and **54** to which the other or rocking plate **60** shown in FIGS. 5 and 6, may be attached by means of the connecting and guiding means or bolts **71** and **72** described later.

The rocking plate **60** shown in FIGS. 5 and 6 is provided also with a pair of holes **63** and **64** which align with the holes **53** nad **54** and through which the bolts **71** and **72**, respectively, pass as shown in FIGS. 7 and 8. The rocking or contacting surface **65** of the rocking plate **60** is shown herein to be arced or bevelled at its lower end **66**, which bevel merges at about the edge **67** with the surface **65** slightly upwardly from the lower aperture **64** therein, so that when the plates **50** and **60** are assembled in the limiting rocking position shown in FIG. 7, the bolt **72** through the aligned holes **54** and **64** may be tightened with space between the surface of the plate **55** and the bevelled surface **66** permitting rocking about the edge or rocking axis **67** (perpendicular to the axis **22** of rotation through the pivot means **37**) and loosening of the bolt **72**, when the plate **60** is rocked into the position as shown in FIG. 8. Attached to the opposite side of the plate **60** from that of its rocking surfaces **65** and **66** there may be welded or otherwise attached a pair of similar angle brackets **68** through which aligned apertures **69** may be provided for the bolts **36** and pivot bearing sleeves **37** along the pivotal axis **22** of tube **31** as mentioned above, for the pivotal connection of the swingable bracket **30**. Since more strain usually occurs at the lower end of the rocking plate **60** than at its upper end as herein employed, the aperture **64** may be extended through and reinforced by the lower portion of the lower angle bracket **68**.

It is desirable that the apertures **63** and **64** in the plate **60**, and preferably also the apertures **52** in the plate **50**, be of slightly greater inside diameter than the outside diameter of the bolts **71** and **72** extending through them, in order to permit slight movement of the bolts therein and prevent binding due to any misalignment of the parts or applied forces, as well as to permit easy guided rocking movement between the plates **50** and **60**, away from its limiting rocking position of FIG. 7 through that shown in FIG. 8.

The bolt **71**, in view of the rocking movement described, necessarily must be longer or have a longer shank portion than the bolt **72** to permit the spreading apart of the upper ends of the plates **50** and **60** as shown in FIG. 8. For this a shoulder type bolt **71** may be employed, in which its nut **73** is tightened thereon against its shoulder and prevents the bolt **71** from being drawn through the hole **53** in the plate **50** but yet permits limited free longitudinal movement of the shank of the bolt through the substantially aligned apertures **53** and **63** for both connecting and guiding within limits the rocking motion between the plates **50** and **60**.

So that the device normally remains in the position shown in FIG. 7, with the stool foot **42** raised off the floor **12** a short distance *d* (see FIGS. 1 and 8) and the bracket **30** in a substantially horizontal position, a compression spring **75** may be inserted around and between the head of the bolt **71** and the back of the plate **60**, so that any rocking movement between the plates **50** and **60** away from the limiting position of FIG. 7, tends to further compress the spring **75** as shown in FIG. 8. This spring **75** may be sufficiently stiff to normally raise and support the weight of the bracket **30** and stool seat **45** and its post leg **40**, so that the foot **42** will be normally raised from the floor and the stool **45** will be readily swingable into any one of the dotted line positions shown in FIG. 2. But the spring **75** is not sufficiently strong to overcome the weight of a person who would sit on the stool seat **45** to rock the plate **60** and move the stool into the full line position shown in FIG. 8 (from its dotted line position shown in FIG. 8) and thereby press the foot **42** onto the floor **12** to support directly and vertically through the posts **40**, **32**, and **44** substantially the whole weight of that person. This rocking or transverse movement to the pivotal axis **22** into position **22'**, prevents any great transverse torque from being applied to the hinge device **20** and transferred therethrough to its anchoring means on bolts **21** and hence to the desk **10**, which as a result may be constructed of conventional unreinforced materials, walls or legs, provided they can support the stool assembly per se plus the pull of the compressed spring **75**. Simultaneously and correspondingly, as soon as the weight of that person is removed from the seat **45** of the stool, the spring **75** on the bolt **71** brings the whole assembly into the position shown in FIG. 7, so it may be readily swung back out of position within the kneehole **11** of the desk **10** as shown in FIG. 2.

FIGS. 10 and 11 illustrate other means of resiliently biasing this rockable plate type of embodiment of the transversely movable hinge of this invention. In FIG. 10 plate or fixed support member **92** may be similar to plate portion **55** of member **50** with the portion **51** being shown broken away, plus a lower bent offset extension **93** having an aperture **94**, while the opposite upper end of portion **92** has an aperture **95**. The apertures **94** and **95** carry bolts **96** and **97** respectively to attach the rocking plate **101** to the said modified rock engaging member **92** by means of the apertures **102** and **103** in said rocking plate. (The rocking plate **101** of FIG. 20 is similar to the rocking plate **60** of FIG. 7 but turned end for end.) A coil compression spring **104** may be installed coaxially to bolt **96** between members **101** and the offset portion **93** of member **92**. This spring normally keeps these members **92** and **101** apart.

When member **101** moves relative to member **92**, it pivots about the knuckle edge **105** as an axis of rotation perpendicular to the axis **22** of the hinge. As weight is applied at the end of arms **33**, such as at a stool, member **101** pivots about knuckle **105** until surface **106** of member **101** is in contact with member **92** and movement ceases. The principles of action are the same here as disclosed above.

FIG. 11 illustrates an alternative method of resiliently biasing the lower connection of a pair of rocking plates **55** and **110**. In this case the rock engaging member **55** may be identical to the like numbered portion 55 in FIG. 4 with the portion **51** being shown broken away. The rocking plate **110** is a modification of rocking plate **101** shown in FIG. 10 in that plate **110** may be considered as being the flat engaging surface **106** and also a lower offset portion **111** added thereto. This offset portion **111** carries an aperture **112** wherein bolt **113** cooperates and connects the rocking plate **110** to the rock engaging plate portion of member **55**. Located coaxially of said bolt **113** may be a coiled compression spring **114** which acts as a bias to normally maintain the plates **55** and **110** in the position illustrated in FIG. 11. This spring **114** is compressed when a force is applied to the end of the arms **33**. The action of this embodiment of the rocking plate assembly is substantially as described above for the embodiment of FIG. 10, and the rocking and rock engaging plates may be interchanged and/or reversed without departing from the scope of this invention.

Either one or both of the rocking plates **50** and **60** may have different shaped contacting rocking curved or bevelled surfaces without departing from the scope of this invention, and the degree or angle of rock may be varied within limits as desired.

B. *Slotted Aperture Type*

This type of embodiment of the principle underlying this invention is illustrated in FIGS. 12 through 23 and by way of example also is applied to the support of a vertically adjustable swingable stool and bracket **130** which is affixed to the edge of a kneehole **11** of a desk **10**.

Referring first to FIGS. 12, 13 and 14, there are disclosed two basic elements which are connected and movable relative to each other with two degrees of freedom; these are the stool bracket **130** and the bolting plate **140** which is attached to the corner of the kneehole **11** by the bolts **21**. The bracket **130** may be comprised of a pair of curved tubular members **133** which end in vertical portions **131**. The bolting plate **140** may be formed from steel flat bar and may carry apertures **141** and **142** (see FIGS. 15 and 18) at each end thereof through which the bolts **21** may be passed for anchoring the hinge **120** to the desk **10**. A pair of spaced angle sections **143** and **144** or **145** may be attached to or made integral with the bolting plate **140** for supporting the bracket **130** through a cooperating pair of spaced pivot means. These angle sections **143** and **144** or **145** may have upon their horizontal surfaces **146** apertures **147** and **148**, or **149**, respectively, of circular and elongated configurations as will be described later.

Referring to the construction of the bracket **130**, the vertical portions **131** of the tubular members **133** may be aligned along the axis **22** or **22'** upon which the bracket **130** rotates. The axis **22'** and **22''** are other positions of the axis **22** of the pivot means than the normal unloaded position thereof, such as when this axis is transversely moved about the perpendicular thereto, as about the rocking edges **67** and **105** in FIGS. 8 and 10 respectively in the previous type embodiment. Within these vertical portions **131** may be installed the pair of spaced pivot means which may comprise as previously described an internally threaded shouldered sleeve **34** welded at **35**, a bolt **36**, a pivot sleeve **37** between the bolt head and the sleeve **34**, and a washer **38** (see FIG. 9). The pivot sleeves **37** cooperate with the aperture **147** and **148**, or **149** named above and may serve as the connecting means between the two relatively movable members of the hinge **130**, namely, the bolting plate **140** and the bracket **130**.

The apertures **147** and **148** or **149**, as disclosed in the drawings, may each be of a different nature. Aperture **147** located in the horizontal surface **146** of and associated with the angle section **143**, may be substantially circular in configuration with a diameter larger than the extreme or outer diameter of the pivot sleeve **37** which cooperates with this aperture and may be located concentric to the normal axis **22**. This larger diameter circular aperture permits wobbling movement of the pivot means therein and acts as a seat for the transverse axis about which the transverse movement of the hinge and axis **22** occurs. This angle section **143** may be located either at the upper end of the hinge **130** as shown in FIGS. 18, 19 (20 and 23) or at the lower end of the hinge as shown in FIGS. 12 through 17 (21 and 22).

Aperture **148** is associated with angle section **144** at the upper end of the hinge **130** as shown in FIGS. 12 through 17 and 21, and may be a slot with semi-circular ends, the diameter of which semi-circle and the width of which slot are greater than the outer diameter of the sleeve **37** to permit free reciprocating or transverse movement therein of the other spaced pivot means at the hinge **130**. The aperture **148** may be located such that one end of the slot is aligned with the normal axis **22** and the other end of the slot may extend away from the bolting plate **140** at an angle to the bolting plate **140** for positions **22'** of said axis **22**. Aperture **149** is associated with angle section **145** at the lower end of the hinge **130** as shown in FIGS. 18, 19, 20 and 23, and also may be a slot with semi-circular ends similar to aperture **148**, and may be located such that one end of this slot is aligned with axis **22** and the other end of this slot may extend toward the bolting plate **140** at an angle to the bolting plate **140** for other positions **22''** of said axis **22**. FIGS. 17 and 20 through 23 show that the slot apertures **148** and **149** may be aligned at an angle to the plane of the bolting plate **140** aligned or corresponding to the most common in-use position of the bracket **130**, for the same reason that the plate portion **55** in FIG. 4 is at an angle to the plate portion **51**. Thus, the slotted apertures **148** or **149** provide the transverse movement of the rotational axis **22'** or **22''** by allowing one of the sleeves **37** associated with the bracket **130** to move farther in a transverse direction than the other of these sleeves **37** is allowed to move in the other spaced aperture **147** or bearing and guiding means. Accordingly, the stool **45** in the vertical tubular member **32** is capable of moving in two planes, with one of these planes of motion at all times being perpendicular to the instantaneous plane of the other component of motion.

So that the device or stool normally or unloaded remains in the position shown in FIG. 13, with the bottom of the depending leg **41** raised off the floor **12** the distance *d*, it is desirable that a resilient means be employed to maintain the pivot and bearing means aligned with normal axis **22**, rather than have these means remain in the position corresponding to the stool with a person sitting thereon with the pivot means along axis **22'** or **22''**. Accordingly, resilient means may be applied to the pivot cooperating with the slot apertures **148** and **149** to maintain the pivots in a position along axis **22**. FIGS. 14, 15 and 18 through 23 illustrate various means for resiliently biasing the hinge device of this invention.

Referring to FIGS. 14 and 15, a tension coil spring **150** may be used to resiliently bias the upper one of the pair of spaced pivot means. An extension arm **151** may be attached to the angle section **144** and may carry an anchoring pedestal or pin **152** to which one end of the spring **150** may be affixed. The other end of the spring

150 may be attached to the screw 153 which may be tapped into the bolt 36. When a force is applied at the end of arm 133, the corresponding pivot means 37 may move in aperture 148 extending the spring 150. When the force is removed from the end of the arm 133, the force in the spring 130 may overcome the weight of the bracket 130 and stool 45 returning this corresponding pivot means 34–38 to the position shown in FIG. 12. The stiffness of the spring 150 should not be so great as to overcome also the weight of the person to sit on the stool 45, for then the depending leg 41 of the stool would not make contact with the floor 12 resulting in a large torque being transmitted through the hinge 20 to the desk 11 defeating an important purpose of this invention.

FIGS. 18 and 19 show a resilient bias applied to the lower end of the hinge assembly. The slot aperture 149 in this embodiment thus extends away from the neutral axis position 22 of the lower spaced pivot bearing means 34–38 toward the bolting piece 140. Herein an extension arm 155 may be fixedly attached to the angle section 145 and may have an apertured flanged end 156. Beneath the extension 155 may be located an L-shaped sliding member 157 attached by an aperture 158 around the end of the lower movable pivot means 37 and having an apertured flanged end 159 alignable with the aperture in the end 156, through which aperture a guiding rod or pin 160 may be positioned and anchored to one of said flanges, such as flanged end 156 by means of a nut 161 or the like. Located concentric to the guide rod 160, between the flanged ends 157 and 159 may be a compression spring 162. Spring 162 may act as the lower pivot means 34–38 moves from alignment with axis 22 to alignment with axis 22″ producing the same result as was described in connection with the embodiment of FIGS. 14 through 17.

FIGS. 20, 21, 22 and 23 illustrate alternate means for resiliently biasing the normal unloaded portion of this type of embodiment of the invention. In FIG. 20 a torsion spring 165 having two tangentially projecting ends 166 and 167 may be used in conjunction with aperture 149 and a lower angle section 145. One and a straight end 166 of spring 165 may act against bolting plate 140 while the other and curved end 167 may act against sleeve 37 of the pivot bearing means 34–38, with the spring 165 being maintained in position by a retaining post 168 projecting from the surface of the angle section 145. A torsion spring 165 also may be used in conjunction with the pivot bearing means 34–38, the aperture 148, and an upper angle section 144 as disclosed in FIG. 21. When this manner of resilient bias is used, the spring may be reversed and its straight end 166 may bear against a bearing post 169 fixed at the outer edge of the surface of the angle section 144.

Instead of a spring, a rubber block 170 as disclosed in FIG. 22 may be used in conjunction with either upper or lower bearing and guide means, namely, aperture 148 as disclosed or aperture 149. The sleeve 37 of the pivot bearing means 34–38 may cooperate directly against a plate 171 adhered to the rubber block 170, which block may be attached to and abut against a stop or pin 169 at the edge of the angle section 144, or 145, against the plate member 140 as shown in FIG. 20.

Referring now to FIG. 23, a leaf spring 175 may be attached to bolting plate 140 such as by a rivet 176 (and a screw 21 through aperture 142) for cooperation with bearing means 34–38 functioning in conjunction with aperture 149 of a lower angle section 144. A nylon sleeve 177 may be fitted concentric with sleeve 37 for slidable bearing contact with the free end 178 of spring 175 as the spring acts to maintain the tubular member 31 in alignment with axis 22. Also, if desired, the leaf spring 175 may be inverted and placed above the angle section 145, or above or below an upper bearing and guiding means as in the embodiments of FIGS. 12 through 17, 21 and 22 without departing from the scope of this invention.

The means of permitting the motion of the slotted aperture type hinge means 120 with two degrees of freedom has thus been disclosed. It may be desirable to limit the motion of the bracket member 130 with respect to these two degrees of freedom. The transverse motion in the substantially vertical plane may be limited by judicious selection of the length of the slot apertures 148 and 149. As the bearing means 34–38 moves relative to the bolting plate 140 within apertures 148 and 149, this motion will be reflected elsewhere on the axis 22′ or 22″ along which the bearing means 34–38 are located and aligned.

The amount of rotation permitted the bracket 30 or 130 may be limited by stop pieces 180 as disclosed in FIGS. 11–19, and 23. These stop pieces may be in the form of a pair of parallel metal rods or bars extending between and attached to the angle sections 143 and 144 or 145, and so positioned as to abut against the projecting sides 33 or 133 of the bracket 30 or 130 to limit the swing of said brackets 30 or 130. They may be continuous over this distance between the angle sections as shown, or they may cover only a part of this distance, or cooperate with other stops or projections (not shown) on the tubular members 31 or 131 adjacent the spaced pivot means 34–38.

Although the above description is directed to a specific type of a hinge support for a disappearing stool to be attached to the edge of a table, bench or desk, the principle of the hinge of this invention may be applied to any other means wherein the transverse torque which is transmitted by a weight at the end of a swingable lever arm, such as frame or bracket 30 or 130, to the pivotal axis 22 of a hinge, may be limited by the transverse movement of this axis by the guided and limited rocking of two plates 50 and 60 loosely connected together or of the spaced pivots of the hinge axis itself, so that the additional weight will be supported by another rigid member, apart from that of the hinge assembly and remove such transverse torsional forces from the pivoted axis 22 of the hinge.

The amount of rocking of the hinge device 20 can readily be varied and compensated by the screwing in and out of the foot 41 or caster 43 in the end of the post 40 of the stool, so as to conform with slight variations in the mounting of the hinge plate portion 51 on the side of a desk or table 10, and any irregularities in the floor 12.

It is also to be understood that a non-vertically adjustable stool may be attached to the tube 32 of the bracket 30 or 130 or any other type of extensible means than that shown in FIG. 3 may be employed, without departing from the scope of this invention.

While there is described above the principles of this invention in connection with specific apparatus, it is to be clearly understood that this description is made only by way of example and not as a limitation to the scope of this invention.

What is claimed is:

1. A hinge means permitting movement in planes perpendicular to each other comprising:
   (*a*) a stationary supporting plate having a rock engaging surface,
   (*b*) a rocking plate having a cooperating rock engaging surface,
   (*c*) a pair of pins substantially perpendicular to and extending through said cooperating surfaces to connect said plates and guide them during their relative rocking movements, said rocking movements being in a plane of the axes of said pins and perpendicular to said surfaces, and
   (*d*) a pivot means mounted on said rocking plate having an axis perpendicular to the instantaneous axis of rock between said plates.

2. A hinge means according to claim 1 including

means for limiting the amount of rock between said surfaces.

3. A hinge means according to claim 2 wherein one of said pins for connecting and guiding said surfaces includes a resilient means for normally holding said surfaces in one of the limiting positions of their rocking movement.

4. A hinge means according to claim 3 wherein one end of one of said cooperating rocking surfaces is offset to accommodate said resilient means, and wherein said resilient means is a coil spring.

5. A hinge means according to claim 1 wherein one of said rocking surfaces comprises a flat plate with a bevelled end portion.

6. A hinge having a rockably movable pivotal axis comprising:

(1) a pair of relatively movable connected members,
(2) a pair of spaced coaxially oriented pivots mounted on one of said members,
(3) a rocking plate movable with respect to both said members, and having:
  (*a*) a pair of spaced cooperating bearing means for journalling said spaced pivots, and
  (*b*) a first rocking surface,
(4) a second rocking surface cooperating with said first rocking surface and located on the other of said members, and
(5) pin means extending perpendicular to said rocking surfaces for connecting said plate to said other member and permitting more transverse movement of one of said pivots than the other relative to said second rocking surface,

whereby said one member is rotatable relative to said other member both about the axis through said pivots and transversely thereof.

7. A hinge according to claim 6 wherein said pin means for permitting transverse movement includes means for guiding and limiting said transverse movement.

8. A hinge according to claim 7 wherein said limiting means includes a resilient means for normally urging said one of said pivots toward one of its limiting positions.

9. A hinge according to claim 8 wherein said plate is offset and said resilient means is located in said offset.

10. A hinge according to claim 6 wherein one of said members is mounted on a vertical support and the other of said members is connected to a stool bracket and seat swingable about the axis of said pivots.

11. A hinge according to claim 10 wherein said stool bracket includes a vertically adjustable foot for contact with a horizontal support when a weight is placed on said feet to transversely move said one pivot.

12. A swingable stool mounted on the side of a bench, including:

I. a hinge means attached to said bench,
II. an arm substantially vertically pivoted by said hinge means for substantially horizontally swinging movement, said arm having mounted thereon
  A. a stool seat and
  B. a depending leg normally just clearing the floor upon which the bench rests,

said hinge comprising:

(1) pivot means for said arm,
(2) a rocking plate movable with respect to both said arm and said bench and having
  (*a*) bearing means for said pivot means, and
  (*b*) a first rocking surface
(3) a second rocking surface mounted on said bench for cooperating with said first rocking surface,
(4) pin means extending through and substantially perpendicular to one of said rocking surfaces for connecting said rocking plate to said bench and for permitting transverse movement of said pivot means, and
(5) resilient means associated with said pin means for normally maintaining said arm with its seat and leg in a freely swinging position about said pivot means above the floor and when weight is applied to said seat said plate rocks against the action of said resilient means so that said leg contacts the floor so that substantially all of said weight is supported by said leg and floor and not by said hinge means and bench.

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