June 11, 1963 C. EAMES ETAL 3,093,414

FOLDING CHAIR

Filed Jan. 14, 1960 2 Sheets-Sheet 1

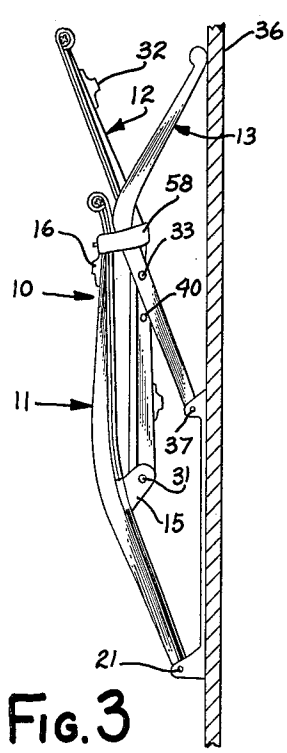


FIG. 3

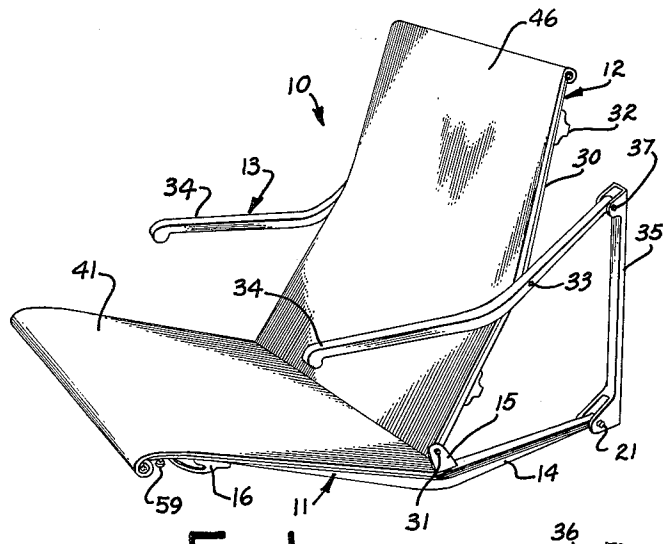


FIG. 1

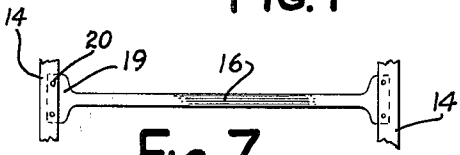


FIG. 7

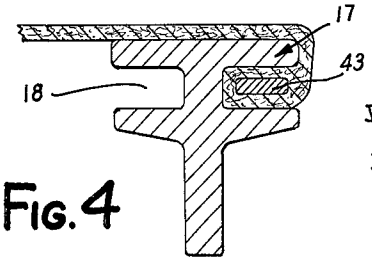


FIG. 4

FIG. 2

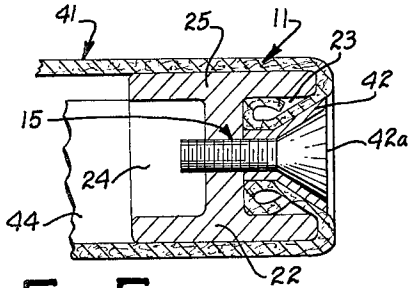


FIG. 5

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Filed Jan. 14, 1960 2 Sheets-Sheet 2

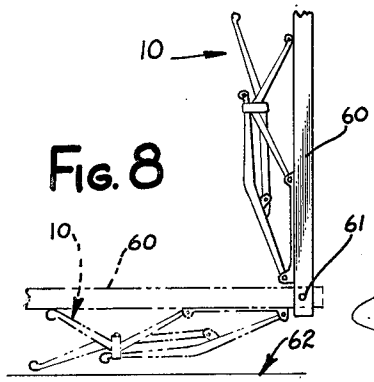


FIG. 8

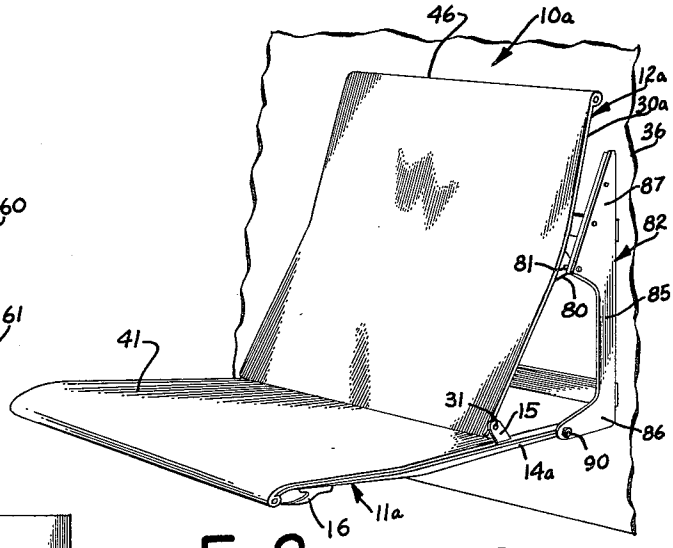


FIG. 9

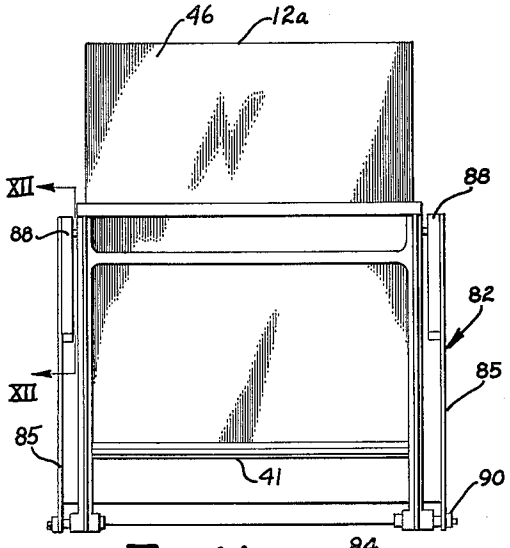


FIG. 11

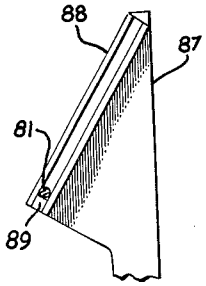


FIG. 12

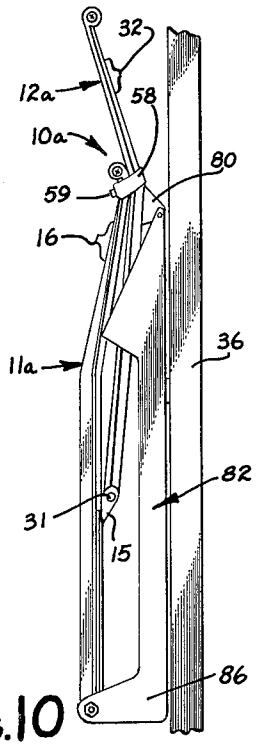


FIG. 10

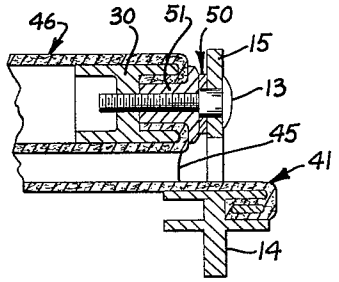


FIG. 6

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3,093,414

FOLDING CHAIR

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Filed Jan. 14, 1960, Ser. No. 2,519
5 Claims. (Cl. 297—323)

This application relates to seating and more particularly to a folding chair designed to be mounted on a fixed vertical support such as a wall.

This invention is intended to provide a compact chair structure which will afford maximum utility to the room in which it is used. Because of the high cost of building construction, it is most important in many structures such as dormitories, apartments and commercial establishments that space be so divided that it be able to serve double purposes. Conventional furniture which does not fold is, at the most, only used a portion of the time. The rest of the time it merely creates a storage problem occupying costly floor space, rendering the area unsuitable for other uses. This invention is designed to reduce this problem by providing a chair which, in one instance, is unfolded for use and in the other is compactly stored away.

This construction leaves the floor clear. No portion of the chair contacts the floor. This has certain advantages. It eliminates the problem of marking of tile type floor covering or of indentation or cutting of carpet or other fabric type floor covering. It also facilitates cleaning the floor since there are no structures directly bearing on the floor which have to be removed for cleaning purposes or require careful manipulation of the cleaning equipment about them.

At the same time, this invention provides a comfortable chair which, in a preferred embodiment, is relatively inexpensive to upholster. The chair is easy to manipulate from a folded to an open position and vice versa. It has a pleasing and attractive appearance.

These and other objects and purposes of this invention will be understood by those acquainted with the design and manufacture of furniture upon reading the following specification and the accompanying drawings.

In the drawings:

FIG. 1 is an oblique view of a chair incorporating this invention shown in open position;

FIG. 2 is a side elevation view of the chair shown in open position;

FIG. 3 is a side elevation view of the chair shown in folded position;

FIG. 4 is a fragmentary enlarged sectional view taken along the plane IV—IV of FIG. 2;

FIG. 5 is an enlarged fragmentary sectional view taken along the plane V—V of FIG. 2;

FIG. 6 is an enlarged fragmentary sectional view taken along the plane VI—VI of FIG. 2;

FIG. 7 is a fragmentary view of the spreader for the seat frame of the chair taken along the plane VII—VII of FIG. 2;

FIG. 8 is a somewhat schematic view showing the chair attached to a panel support which in itself is so mounted that it may swing from a vertical to a horizontal position;

FIG. 9 is an oblique view of a modified construction for the folding chair of this invention;

FIG. 10 is a side elevation view of the chair illustrated in FIG. 9 showing the chair folded;

FIG. 11 is a rear elevation view taken along the plane XI—XI of FIG. 10;

FIG. 12 is a sectional view taken along the plane XII—XII of FIG. 11.

In executing the objects and purposes of this invention, there is provided, in its preferred embodiment, a chair having basically a seat frame, a back frame and arm link means. The ends of the arm link means and of the seat frame are pivotally attached to a vertical support. In addition, the link means and the seat and back frames are all pivotally connected so that the chair may be folded or opened. Further, the chair is designed to be mounted upon a vertical wall or panel so that no part of it touches the floor and when it is folded it leaves the floor entirely free of any obstructions and occupies a very small amount of area in the room.

Referring specifically to FIG. 1, the numeral 10 indicates a chair having a seat frame 11, a back frame 12 and a pair of tie links 13. The seat frame has a pair of side links 14 of a somewhat shallow V-shape. Each of the links 14 near the apex of the V has an upstanding boss or ear 15. Near the forward or free end of the seat frame 11, the side links 14 are positively held apart by a spreader or cross bar 16 (FIG. 7). As illustrated in FIG. 4, the side links 14 are generally H-shaped, having an outer channel 17 and an inner channel 18. The cross bar 16 has flared ends 19 designed to seat in the inner channels 18 of the side links 14. Further attachment between the side links 14 and the cross bar 16 may be effected by suitably positioned fasteners such as the set screws 20. The cross bar 16, when attached to the side links 14, is a stabilizer and gives the seat frame substantial rigidity.

At the outer ends, each of the side links 14 terminates in a circular terminal embossment 22 having an outer socket 23 and an inner socket 24. These are separated by a web 25. The purpose of this socket will be explained in connection with the upholstering of the chair. At the inner or rearward ends, each of the side links 14 has a hole to receive one of the pivot pins 21.

The back frame 12 is quite similar in construction to the seat frame 11 and has a pair of side frame members 30, also of somewhat shallow V-shaped configuration. The upper ends of the side frame members 30 of the back frame terminate in circular terminal embossments identical to the terminal embossments 22 on the front ends of the side link members 14 of the seat frame 11. The lower ends of the side frame members 30 are pivotally secured to the ears 15 by pins 31. The pins 31 each pass through a spacer washer 50 and a tapered collar 51 (FIG. 6). The tapered collar 51 is seated in the outer socket 23 of embossment at the lower end of the back frame. The collar 51 serves a second purpose which will be explained in connection with the mounting of the web 46 on the back frame. One end of the tapered collar bears against the washer 50. The shank of the pivot pin 31 is enlarged through the ear 15 and the washer 50, creating a shoulder which bears against the collar. This permits the pivot pin 31 to be tightened without interference with the relative pivotal movement between the ears 15 and the side links 30 as the chair is folded and unfolded. Also, adjacent the upper or free ends of the side links 30 of the back frame 12, the side links are held apart and secured by a spreader bar 32, identical in construction and means of attachment to the cross bar 16 illustrated in FIG. 7.

Adjacent the apex of the general shallow V-shape of the back frame 12, a pair of tie or arm links 13 are pivotally secured to the back frame by suitable means such as the pins 33. In those situations in which the chair is designed to be merely a side chair without arms, the tie links 13 extend forwardly or outwardly only a sufficient distance to seat the pins 33. Where, however, the chair is designed to be an arm chair and to have arm rests on each side of the seat portion, such as illustrated

in FIG. 1, the tie links **13** are extended substantially beyond the pins **33** to form arm rest portions **34**.

The inner or rearward ends of both the tie links **13** and the side links **14** of the seat frame are pivotally secured to anchor brackets **35**, one on each side of the chair. The anchor brackets are designed to be arranged vertically and to be secured by any suitable means, such as screws or bolts, to a vertical support **36** (FIG. 2), such as a wall panel. Each of the anchor brackets, adjacent both its upper and lower ends, has a forwardly projecting boss, the lower one being designed to receive the pivot pin **21** and thus anchor the rearward ends of the side links **14** of the seat frame **11**. The upper bosses are designed to receive the pivot pins **37** which pivotally attach the rearward ends of the tie or arm links **13**. The bosses on each of the anchor brackets **35** are substantially spaced vertically which contributes materially to the stability and strength of the chair as will be understood from the subsequent description.

It will be recognized that it is not essential to this invention that the anchor brackets **35** be two independent vertical bars or strips but rather they could be parts of a larger framework, all of which is secured to the supporting panel or wall **36**.

It will be seen that both the arm links **13** and the seat frame **11** are freely pivotable about the pins **37** and **21**. To limit the downward swinging movement of these structures about these pins, a stop **40** is provided on the back frame **12** in such a position that it will make contact with the lower edge of the tie or arm links **13** when the chair is unfolded or opened to the proper preselected sitting position (FIG. 2). This stop must be rigidly secured to the back frame **12**.

The several links and brackets making up the frame structure of this chair can be fabricated from any suitable material having adequate strength for the purpose. As an example, it can be fabricated from aluminum or steel. The side links **14** of the seat are connected by a web **41** of suitable material which will provide comfort for the user, sufficient strength to withstand the expected usage and wear resistance for durability. As an example, this web may be a pad composed of several layers of various materials such as a foam enclosed on both sides with a reinforced, vinyl chloride sheet material such as that sold under the name of "Naugahyde." It may be a woven fabric of natural or synthetic fibers.

On the seat frame **11**, the forward end of the web **41** is wrapped around into a roll and its side margins are tucked into the outer socket **23** of the terminal embossment **22** and secured by suitable means such as the cone sleeve **42** and cone headed screw *42a* (FIG. 5). The edges of the web have a cross sectionally rigid stay bar **43** incorporated into them (FIG. 4). The stay bar **43**, longitudinally, has limited flexibility. The stay bars **43** are suitably secured to the edges to prevent disengagement from the web. The stay bar **43**, together with the encompassing edge margin of the pad **41**, is passed over the edge of each of the side links **14** and seated in the outer channel **17** on these links. The links are held apart by the cross bar **16**, keeping the pad **41** under lateral tension. By reason of the means of anchorage at the edge of the pad, disengagement of the margin or edge of the pad from the channel **17** is prevented and the pad provides a taut web, forming a resilient and comfortable seat.

The rear end of the web **41** terminates approximately at the ears **15** and is suitably reinforced to sustain its operating loads without sagging or tearing. Between the ears **15** the web **41** has a flap **45** (FIG. 6) which is carried up and secured in the roll at the lower end of the web **46** of the back frame **12**. This flap **45** eliminates any gap between the back and seat webs at this juncture.

The lower end of the web **46** of the back frame **12** is secured in the socket of the embossment at the lower

end of each of the links **30** in the same manner as the front end of the web **41** of the same. The edges of the web **46** folded into the embossment's socket are anchored by the tapered collar which serves the same purpose as the cone sleeve **42** (FIG. 5).

Considering the chair to be open, as illustrated in FIGS. 1 and 2, it will be noted that the rearward portions of the seat frame **11** are substantially horizontal. Forward of the ears **15**, the seat frame slopes gently upwardly to provide a comfortable seat. The amount of slope given this portion of the frame depends upon what is considered necessary to create a comfortable support for the user. It will also be noted that the back frame **12** slopes upwardly and rearwardly from the ears **15** to a point slightly above the pivotal attachment to the tie or arm links **13**. Above this, the back frame **12** rises more vertically. This, again, is intended to provide comfort since this particular contouring will give both the upper and lower portions of the user's back firm and comfortable support. Once again, the particular shape of this frame will depend upon the degree of slope necessary to provide comfort to the user. So far as the mechanical operation of the chair is concerned, both the seat frame **11** and the back frame **12** can be straight.

It will also be noted that the tie links **13** extend sharply downwardly from their point of attachment at the pins **37** to the anchor brackets **35**. Where these links are extended to produce the arm rest **34**, they change direction outwardly of the pivot pin **33** to generally parallel the adjacent portion of the seat frame **11**.

The chair is held in open position by the stop **40**. No further downward displacement of the seat may occur since downward forces applied to the seat cause the tie links **13** and the back frame **12** below the pivot pin **33** to attempt to become parallel. Since the stop **40** prevents this movement, the chair is stabilized. The structure provides a particularly strong chair since the downward forces applied to the seat produce a force couple about the pivot pins **31**. The attachment of the rearward end of the seat frame **11** to the anchor brackets **35** prevents upward rotation of the rearward end of the seat frame. At the same time, the downward tension force created at the pivot pin **31** is transmitted as tension load to the pivot pin **37** at the upper end of the anchor bracket **35** through the lower portion of the back frame **12**, the pivot pins **33** and the tie links **13**. In this connection it should be noted that the stop **40** holds these links in substantially aligned position, greatly reducing the tendency to set up any twisting forces within the back frame **12** and the tie links **13**. At the same time, since the seat is anchored on each side at two points, widely separated vertically, one being generally in alignment with the seat and the other half way or more up the back, the seat is stabilized effectively against side sway or racking motion. Further, this two point attachment is provided on each side of the chair.

In the closing or folding of the chair, the rearward portions of the tie links **13**, the lower portion of the back frame **12** and the rearward portion of the seat frame **11**, together with the anchor brackets **35**, operate somewhat in the nature of a pantograph. Therefore, as the chair is folded, the vertical displacement of the pivot pins **31** at the ears **15** is equal to the vertical displacement of the pivot pins **33**. In the folding operation the arm rest portions **34** of the tie links **13** move upwardly and outwardly until the pivot pins **33** are in the same horizontal plane as the pins **37**. Thereafter, the arm rest portions **34** move upwardly and rearwardly with their free ends coming into contact with the supporting wall **36**. At the same time, the forward portion of the seat frame **11** moves to a position substantially parallel with the wall **36** with the lower portion of the back frame **12** parallel to this portion of the seat frame and slightly rearwardly of it.

Thus, the chair, when folded, produces a compact package occupying very little floor space, thereby freeing the area it normally occupies for other uses. This permits the general room area to have dual purpose usage. Thereby, a smaller room, which with conventional furniture would have been wholly inadequate, will serve adequately for various types of activities. This greatly reduces the amount of capital investment which must be made to build such structures as dormitories, motels, hotels and similar facilities.

When the chair is in folded or raised position, it is retained by straps **58**, one on each side of the chair (FIG. 3). The straps **58** may be secured to the rearward face of each of the side links **30** so that they will be behind the chair back when the chair is open and thus be substantially concealed. The straps may engage a knob **59** on the lower face of the links **14** as a means of attachment. These knobs are on the underside of the seat when the chair is open and therefore inconspicuous. It will be recognized that other means of attachment may be employed.

Since the chair frame acts in a manner very similar to a pantograph and the straps **58** prevent relative displacement between the several links of the chair, the straps alone are quite adequate to lock the chair in folded position without attachment to the panel **36** other than that provided by the pins **21** and **37**. In fact the chair will be effectively retained even though the panel is pivoted to a horizontal position as suggested in FIG. 8 and described in our co-pending application entitled Storage. The concept of mounting the chair on a panel which itself may be pivoted into a horizontal position is diagrammatically suggested in FIG. 8 wherein the support panel is, in fact, part of the frame of a bed **60** which itself is mounted on a pivot **61** adjacent its lower end. The bed **60** is adapted to swing from a vertical to a horizontal position, as indicated in phantom lines, with the folded chair being stored, when the bed is down, beneath the bed but still spaced above the floor **62**. Therefore, the character of the panel wall **36** on which the chair is mounted is immaterial to this invention so long as it is so constructed that it will adequately support the load applied to it by the fact that the chair is mounted on it. It is to be noted that this wall or panel mounting of the chair also eliminates all necessity for any portion of the chair resting on the floor. This prevents the floor from being damaged by the legs of the chair being dragged over it or, as sometimes occurs, the legs of the chair forming indentations or impressions in the floor. Further, when the chair is folded, the floor is entirely clear for cleaning or any other function which must be performed on the floor.

FIGS. 9 through 12 illustrate a modified construction for this invention. The modified chair **10***a* has a seat frame **11***a* with side links **14***a* substantially identical to the seat frame **11** and side links **14**, respectively, except that they are somewhat shorter. Each of the side links **14***a* has an ear **15** projecting upwardly at substantially the same location and for the same purpose as the ears **15** on the chair **10**. The back frame **12***a* and its side links **30***a* are substantially identical to the corresponding frame and links of the chair **10**. However, the links **30***a* each, substantially midway between their ends, have a rearwardly projecting arm **80**. Each of the arms **80** mounts a pin **81**. The pins **81** project laterally outwardly from the arms.

The chair is secured to an upright panel or other supporting structure **36** by means of an anchor frame **82**. The anchor frame consists of a pair of vertically spaced cross bars **83** and **84** which tie together the side standards **85**. The cross bars **83** and **84** are firmly secured to the panel **36** by any suitable means such as screws, bolts or lags.

The side standards **85** each have a forwardly projecting foot piece **86** on their lower end and an enlarged portion **87** on their upper end. The forward face of the enlarged portion **87** is downwardly and outwardly sloped away from the panel **36** and each mounts an inwardly opening channel shaped track **88**. The tracks **88** are of such width that they will slidably receive the pins **81** on the arms **80**. At the lower ends of the tracks **88**, a stop **89** is provided in the track to limit the downward travel of the pins **81**.

The rearward ends of the links **14***a* of the seat frame **11***a* are pivotally secured to the outer ends of the foot pieces **46** of the standards **85** by suitable means such as the pins **90**. When the chair is open and ready for use, the pins **81** are seated against the stops **89** in the tracks **88**. This stabilizes the chair, since the pins prevent further downward movement of the back frame **12***a*, which thereafter acts as a tension member supporting the seat frame **11***a* against further rotation about the pins **90**. To fold the chair, the seat frame **11***a* is raised, pivoting it about the pins **90**. This causes the back to move upwardly, sliding the pins **81** upwardly along the tracks **88**. In this movement, the central portion of the back is moved toward the panel **36** and the seat ultimately folds flat against the back (FIG. 10).

The chair is locked in folded position by a strap **58** attached to the rear face of the back frame **12** and anchored over the button **59** on the lower face of the seat frame. The strap and button arrangement are identical to that illustrated in connection with the chair **10** and, as in the case of the chair **10**, the strap will hold the chair in folded position even though the panel **36** on which the chair is mounted is, itself, pivotally supported so it can be moved to a horizontal position.

As in the case of the chair **10**, the links of the back and seat frames are connected by webs **41** and **46**, respectively. These webs are, for all practical purposes, identical to that illustrated in connection with the chair **10** and the links are so constructed that they are secured to the side links in exactly the same manner, therefore, a detailed description of their mounting may be understood from reading the description presented above in connection with the chair **10**.

This invention provides a simple, compact and comfortable chair. It has particular utility under circumstances where space must of necessity be carefully restricted to only that which is essential for the proper execution of the functions of the space.

While there has been described a preferred embodiment of this invention, it will be recognized that various modifications of this concept may be made, each incorporating the principles of this invention. These modifications are to be considered as included in the hereinafter appended claims unless these claims by their language express otherwise.

We claim:

1. A folding chair having a seat frame and a back frame; an anchor frame adapted to be mounted on a vertical support; the rearward end of said seat frame being pivotally attached to said anchor frame; one end of said back frame being pivotally attached to said seat frame at a point spaced outwardly from said anchor frame; link means pivotally attaching said back frame to said anchor frame at a point susbtantially spaced from said seat frame; said link means holding said back frame substantially outwardly from said anchor frame when said chair is open; said link means permitting said chair to be folded from an open position to a closed position with both said seat and back frames adjacent and generally parallel to said anchor frame; stop means limiting opening swinging movement of said back and seat frames when said seat is generally horizontal.

2. A folding chair having a seat frame and a back frame; an anchor frame adapted to be mounted on a vertical support; the rearward end of said seat frame being pivotally attached to said anchor frame; one end of said

back frame being pivotally attached to said seat frame at a point spaced outwardly from said anchor frame; link means pivotally attaching said back frame to said anchor frame at a point substantially spaced from said seat frame; said link means holding said back frame substantially outwardly from said anchor frame when said chair is open; said link means permitting said chair to be folded from an open position to a closed position with both said seat and back frames adjacent and generally parallel to said anchor frame; stop means limiting opening swinging movement of said back and seat frames when said seat is generally horizontal; said link means projecting substantially forwardly of said back frame for forming arm members for said chair.

3. A folding chair comprising: vertical support means; a seat link pivotally secured to said means; an arm link pivotally secured to said means at a point vertically spaced above said seat link; a back link pivotally secured to said seat link and to said arm link at points spaced from said means whereby on raising the free end of said seat link said arm and back links together with said seat link will fold upwardly into a generally vertical position; stop means limiting downward swinging movement of said links when said seat link is generally horizontal.

4. A folding chair as recited in claim 3 wherein the

relationship of the spacing between said points of pivotal connection is such that the vertical travel of the pivotal connection between said back and arm links is generally the same as the vertical travel of the pivotal connection between said back and seat links.

5. A folding chair as recited in claim 3 wherein means are provided to hold said chair in raised and folded position.

References Cited in the file of this patent

UNITED STATES PATENTS

45,887	Weaver	Jan. 10, 1865
145,229	Nolan	Dec. 2, 1873
159,205	Nolan	Jan. 26, 1875
243,849	Chambers et al.	July 5, 1881
1,104,615	Braden	July 21, 1914
2,257,211	Willoughby	Sept. 30, 1941
2,583,372	Hall	Jan. 22, 1952
2,707,987	Gibson	May 10, 1955
2,855,981	Dierikx	Oct. 14, 1958

FOREIGN PATENTS

16,561	Great Britain	1912
382,629	Great Britain	Oct. 24, 1932
936,127	France	Feb. 16, 1948