Aug. 25, 1964 R. G. ZELLER 3,146,022

CONVERTIBLE TOP

Filed Jan. 22, 1962 3 Sheets-Sheet 1

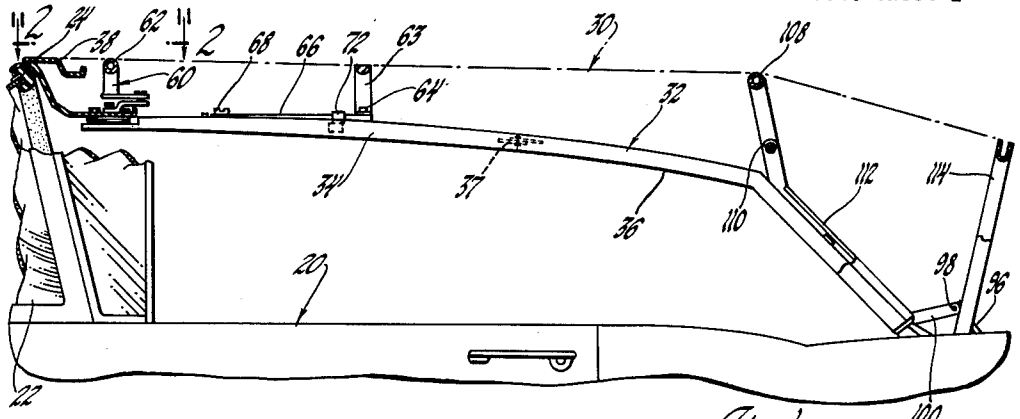

Fig. 1

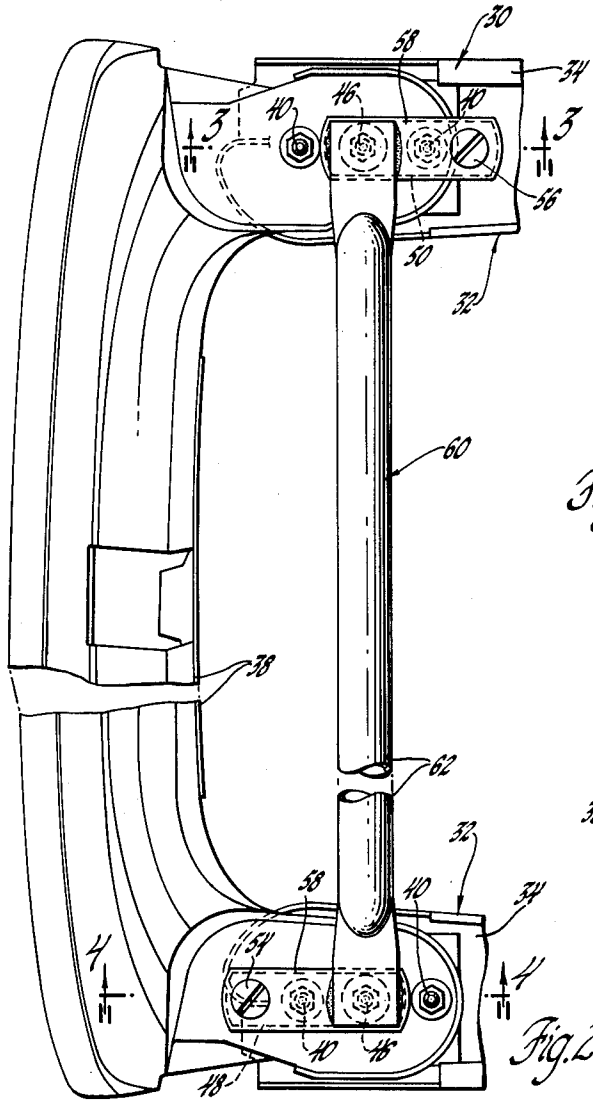

Fig. 2

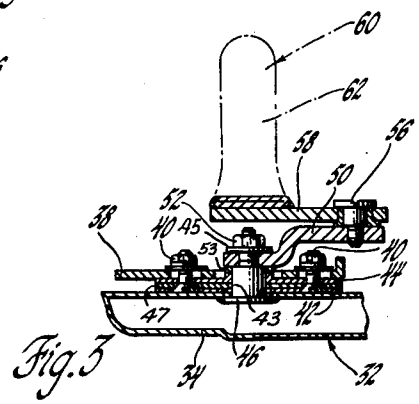

Fig. 3

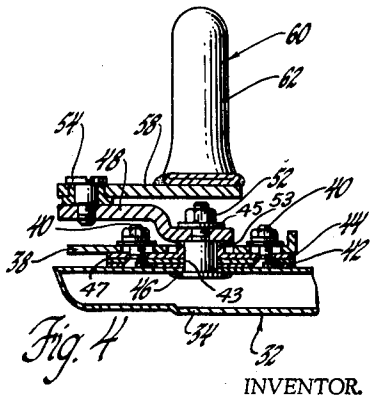

Fig. 4

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CONVERTIBLE TOP

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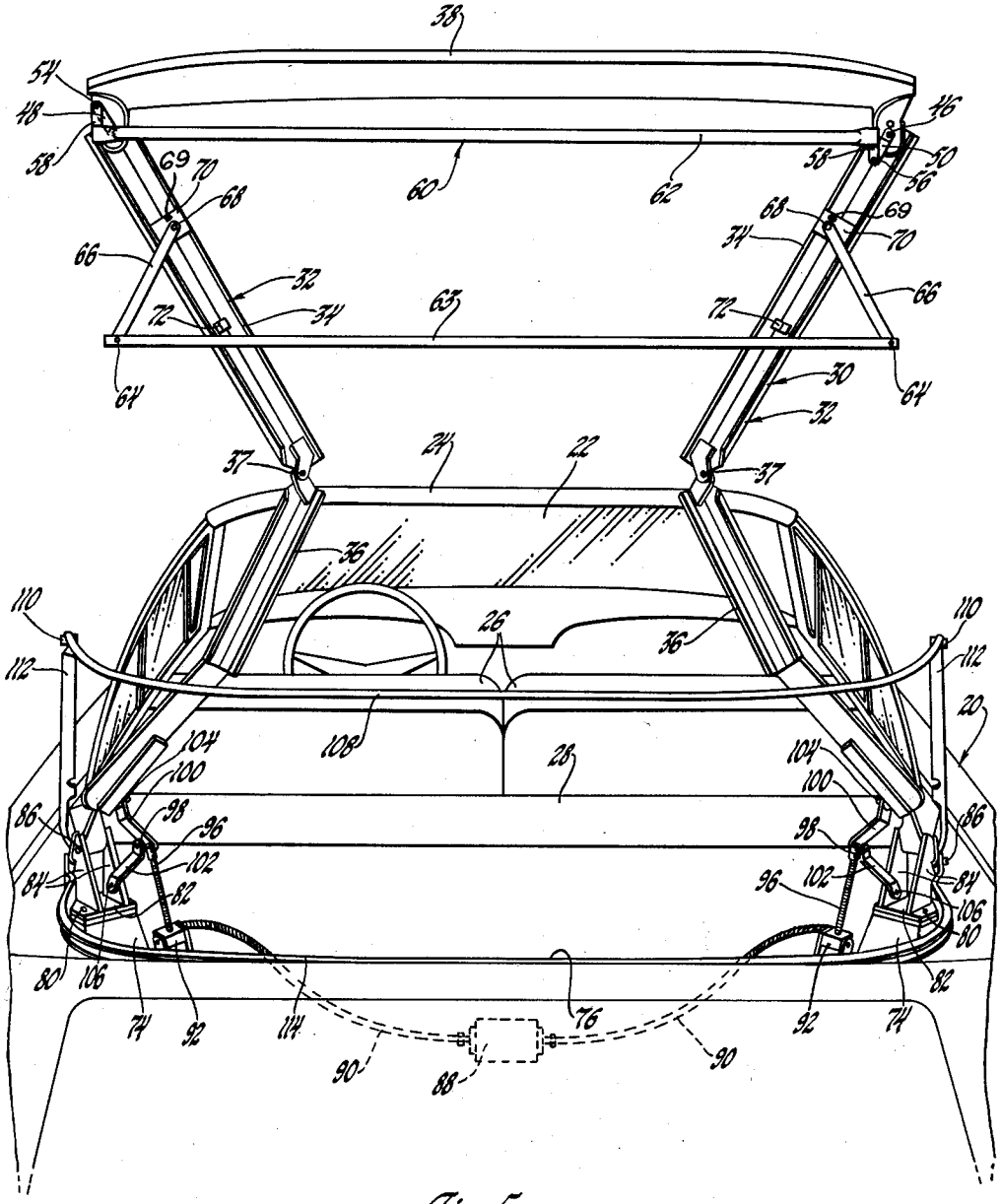

Fig. 5

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CONVERTIBLE TOP

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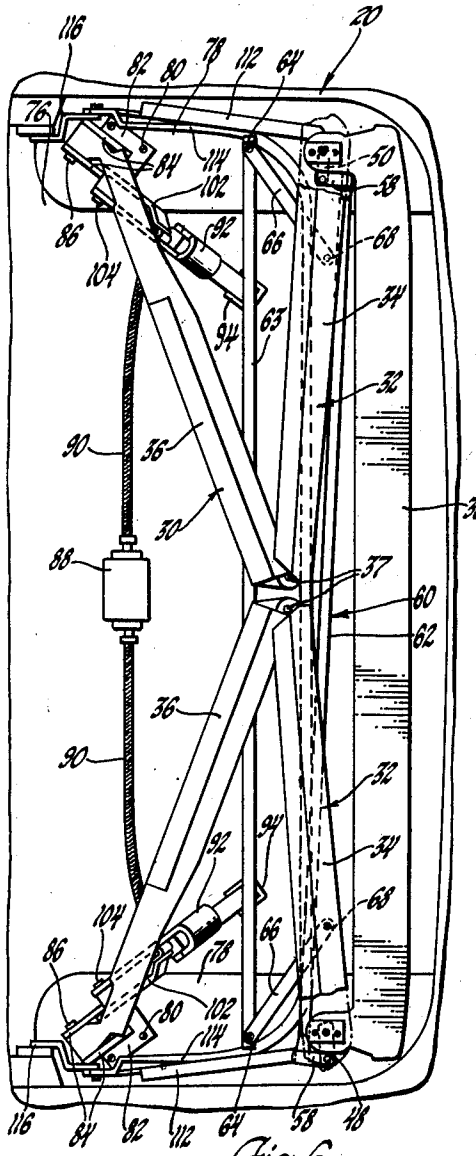

Fig. 6

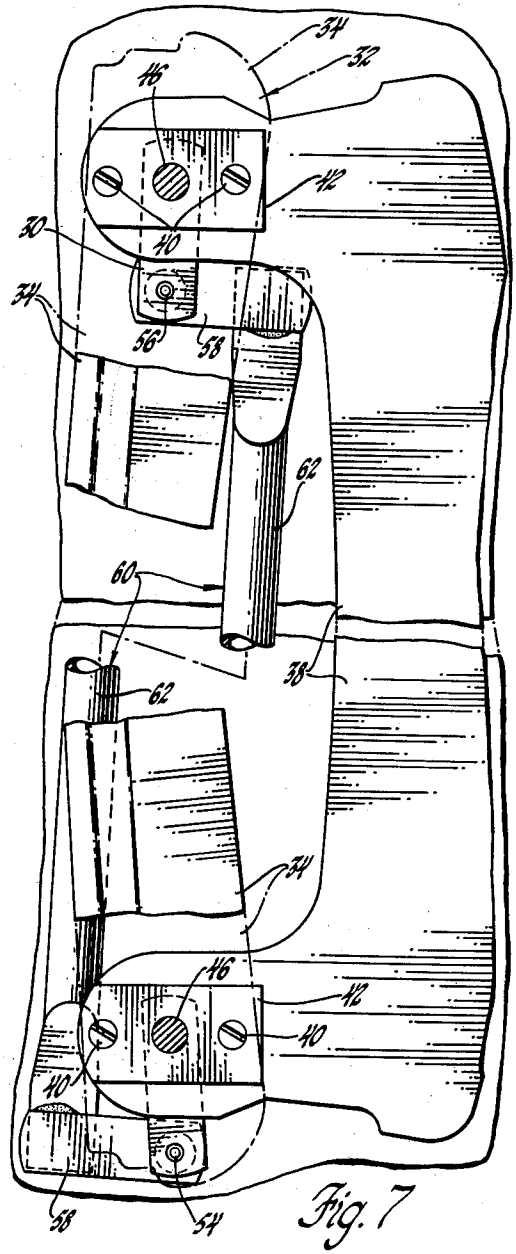

Fig. 7

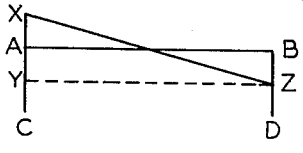

Fig. 8

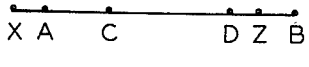

Fig. 9

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3,146,022

CONVERTIBLE TOP

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Filed Jan. 22, 1962, Ser. No. 167,511
5 Claims. (Cl. 296—116)

This invention relates to convertible tops and more particularly to stabilizing means for convertible tops of the general type having inward folding side rails.

The stabilizing means of this invention is particularly useful for controlling the folding and unfolding movement of the side rails with respect to each other as the top is lowered and raised to ensure synchronous movement thereof. In the absence of any stabilizing means, the rails are free within limits set by the top header to fold and unfold at will so that the top header will sway or shift laterally of the body rather than move evenly at all times in generally parallel alignment with the windshield header.

In the past, it has been proposed to control the folding and unfolding movement of the side rails by controlling the folding movement of the side rail sections of each rail with respect to each other. However, the stabilizing means of this invention functions between the pivots of the side rails to the top header and is of very simple construction but yet controls and synchronizes the movement of the rails at all times so that the top header moves generally parallel to the windshield header as the top is both raised and lowered and movement of the top header relative to the body is effectively prevented.

The primary object of this invention is to provide a new and improved stabilizing means for a convertible top of the general type including inward folding side rails. Another object of this invention is to provide a stabilizing means for controlling and synchronizing movement of a pair of inward folding convertible top side rail assemblies. A further object of this invention is to provide a stabilizing arrangement for accurately positioning a convertible top header with respect to a windshield header and a pair of inward folding convertible top side rails during both raising and lowering movement of the top assembly.

These and other objects of the invention will be readily apparent from the following specification and drawings, wherein:

FIGURE 1 is a partially broken away partial side elevational view of a vehicle body having convertible top assembly mounted thereon of the general type including inward folding side rails and embodying a stabilizing means according to this invention;

FIGURE 2 is an enlarged view taken generally along the plane indicated by line 2—2 of FIGURE 1;

FIGURE 3 is a sectional view taken generally along the plane indicated by line 3—3 of FIGURE 2;

FIGURE 4 is a sectional view taken generally along the plane indicated by line 4—4 of FIGURE 2;

FIGURE 5 is a rear perspective view of the top assembly in a partially lowered position;

FIGURE 6 is a plan view of the top assembly in a fully lowered position within the top well;

FIGURE 7 is an enlarged view of a portion of FIGURE 6;

FIGURE 8 is a schematic illustrating the principles of the stabilizing means of this invention, and;

FIGURE 9 is a schematic illustrating the principles of this invention.

Referring now particularly to FIGURES 1, 5 and 6 of the drawings, a convertible vehicle body **20** includes a windshield **22** and a windshield header **24**. The passenger compartment of the body includes a vehicle front seat assembly **26** and a vehicle rear seat **28**. A convertible top assembly of the inward folding rail type is mounted on the body **20** for movement between a raised position, as shown in FIGURE 1, and a lowered position, as shown in FIGURE 6, in order to open and close the passenger compartment of the body.

The top assembly **30** generally includes a spaced pair of inwardly folding side rails **32**, each of which includes a front rail section **34** and a rear rail section **36** pivoted thereto at **37**, with the rear rail section being supported on the body. Since the rails **32** are of like construction, although of different hand, only one such rail will be described, and it will be understood that the other is of the same construction.

The front rail sections **34** are each pivotally connected to one end of a convertible top header **38** which spans the body and is adapted to bear against the windshield header **24** in the raised position of the top, as shown in FIGURE 1. As best shown in FIGURES 2, 3 and 4 of the drawings, the rearward ends of the header **38** are bolted at **40** to a bearing plate assembly which includes a lower flat bearing plate **42** apertured at **43** and an upper bearing plate **44** having a flanged central aperture **45**, with plates **42** and **44** being separated by shims **47** as shown, if necessary. The rearward ends of the header **38** are apertured to receive the central flanges of plates **44** therethrough, with these apertures and the apertures therein receiving the bolts **40** being enlarged to provide for both lateral and longitudinal adjustment of the top header relative to the bearing plate assemblies. A headed stud **46** is welded to each front rail section adjacent the forward end thereof and projects upwardly therefrom, with studs **46** rotatably receiving the bearing plate assemblies to pivotally interconnect the top header **38** with each of the front rail sections **34**. An offset link or member **48** extends forwardly of the top assembly from the left-hand stud **46** and a similar offset link or member **50** extends rearwardly from the right-hand stud **46**, with links **48** and **50** seating on shoulders of the studs **46** and overlying the central flanges of plates **44**. The links **48** and **50** are arranged to lie along the center lines of each of the front rail sections **34** with each link being fixedly secured to the studs **46** by nuts **52**, so that the links will move with the front rail sections **34** as these rail sections pivot relative to the top header **38** during both folding and unfolding movement of the top assembly. Washers **53** interposed between links **48** and **50** and the central flanges of plates **44** retain the bearing plate assemblies in place on studs **46**.

The links **48** and **50** form part of the stabilizing means of this invention and each link is pivotally secured at **54** and **56**, respectively, adjacent the free end thereof to a pair of like members or end sections **58**, which are part of a stabilizing member or assembly **60**. Member **60** further includes a center tubular section **62** located generally normal to each of the sections **58** and including flattened end portions which are welded or otherwise fixedly secured thereto. The end sections **58** are of the same length, while the link **48** is slightly longer than the link **50** in order to accomplish the purposes of the stabilizing means of this invention, as will be further described. It will be noted that the stabilizing assembly **60** is of generally Z-shape and that the center section **62** of the assembly is generally parallel to the top header **38** and remains generally parallel to the top header **38** at all times during movement of the convertible top assembly between its raised and lowered positions.

A front or No. 1 bow **63** of rigid construction has its ends pivoted at **64** to the rearward ends of links **66**. The forward ends of links **66** are pivoted at **68** to brackets **70** welded to the front rail sections **34**. In order to locate links **66** and bow **63** laterally of rails **32** in the raised

position of the top, a pair of brackets **72** are welded to the rail sections **34**, with each bracket being provided with an offset pocket receiving a respective link **66** in the raised position of the top. When the front rail sections **34** swing inwardly as the top is being lowered, the links **66** swing outwardly of the rail sections **34** about their pivots **68** to allow the bow **63** to move with the top and to be folded relative to the rail sections **34**. Suitable stop pins **69** secured to brackets **70** are engaged by links **66** in the fully lowered position of the top to locate the links and bow **63**.

Referring now particularly to FIGURES 1, 5 and 6 of the drawings, the manner in which the rear rail sections **36** are mounted on the body will be described. A mounting support **74** is mounted within the top well **76** of the body located rearwardly of the rear seat **28**. Preferably, the support **74** is welded or otherwise rigidly secured to the inner rear wheel housing **78** of the body. Support **74** is bolted at **80** to the lower plate of a trunnion bracket **82** which includes a spaced pair of upstanding ears **84** pivotally secured at **86** to the rear rail sections **36**. The axes defined by the pivots **86** lie in a horizontal plane, with each axis extending generally forwardly and inwardly of the body in this horizontal plane whereby the axes converge with respect to each other. Each axis lies in a vertical plane located approximately 45° with respect to the vertical plane of the center line of the body.

The rear rail sections **36** are power operated in order to move the top between raised and lowered positions. As shown in FIGURES 5 and 6, an electric motor **88** mounted on the body rearwardly of seat **28** drives a pair of flexible cables **90**. Each cable drives a gear drive unit **92** which is supported by an upwardly extending bracket **94** fixedly mounted on the body. The gear drive units **92** are of known type and reference may be had to Patent Number 2,905,012 Lohr et al. for the details of a suitable unit. A screw shaft **96** is threadedly received through each of the drive units, with the upper end of the screw shaft being pivoted at **98** to one end of links **100** and **102**. Link **100** is pivoted at its other end at **104** to the rail sections **36** and link **102** is pivoted at its other end at **106** to the inboard ear **84** of bracket **82**. Upon operation of the motor **88**, the drive units **92** will rotate so as to thread the shaft **96** inwardly and outwardly thereof to thereby fold and unfold links **100** and **102** and swing the rail sections **36** about the pivots **86**.

The intermediate or No. 2 bow **108** is of rigid one-piece construction and has its ends pivoted at **110** to bow supports **112** which rest on rail sections **36** in the raised position of the top. The bow supports **112** and the rear or No. 3 bow **114** are pivoted to brackets **116** secured to the body for swinging movement of the bow supports and bow **114** in parallel longitudinal vertical planes with respect to the body.

The movement of the convertible top from a raised position, as shown in FIGURE 1, to a lowered position, as shown in FIGURE 6, will now be described. Upon operation of the motor **88** in a suitable direction to operate each of the drive units **92** and in turn shift the screw shafts **96** downwardly of the body, the links **100** and **102** will be folded with respect to each other to swing the rear rail sections **36** rearwardly and downwardly of the body about the pivots **86**. As the rail sections **36** swing rearwardly and downwardly of the body, the rail sections **34** will swing generally outwardly with respect to the rail sections **36** about pivots **37** so as to fold each of the rails **32**. The links **66** will generally swing outwardly of the rail sections **34** about their pivots **68** as can be seen in FIGURE 5 to allow the rail sections **34** to swing inwardly with respect to the front or No. 1 bow **63**. The top fabric will cause the bow supports **112** and bow **114** to swing generally rearwardly and downwardly of the body, as the rail sections **36** swing rearwardly, downwardly and inwardly of the body from underneath the bow supports **112** as can be seen in FIGURE 5.

Thereafter, upon continued folding movement of the top, the top will move to a folded position, as shown in FIGURE 6, within the top well **76**. Generally, the rail sections **34** and **36** will be stored above the bows **108** and **114**, and the bow **63** will be stored below rail sections **34** and forwardly of the bows **108** and **114**. Without any stabilizing means, it can be seen that, during movement of the top **30** between raised and lowered positions, the front rail sections **34** can swing laterally of the body about their pivots **37** to the rear rail sections **36** whereby the rails **32** will not fold and unfold synchronously and in unison with each other. The top header **38**, will, of course, shift laterally of the body as the rail sections **34** swing laterally of the body about their pivots **37** so that the header could assume many positions with respect to the windshield header **24** despite the fact that it is desirable that this header move generally parallel to the windshield header at al times. Any such movement of the front rail sections **34** and the top header **38** is effectively prevented by the stabilizing assembly **60**. When the top is in raised position, the side rails **32**, the links **48** and **50**, and the end sections **58** of assembly **60** are all located generally parallel to the center line of the body. As the front rail sections **34** fold inwardly of the body when the top is lowered, the left-hand link **48** swings or moves counterclockwise or outwardly of the body, as viewed in FIGURE 5, while the right-hand link **50** swings or moves clockwise or inwardly of the body, as the links move with their respective rail sections **34** and these rail sections swing in opposite directions about pivots **37**. The stabilizing assembly **60** including the end sections **58** induces rotation of the front rail sections **34** in a direction opposite their direction of movement with respect to the body so as to eliminate any swinging movement of the front rail sections **34** with respect to the rear rail sections **36**, other than synchronous swinging movement. Thus, the top header **38** will not shift laterally of the body but will move longitudinally thereof and remain parallel to the winshield header at all times. The stabilizing assembly will also act to brake any greater rotation of one rail section **34** with respect to the other rail section **34** so as to cause these rail sections to rotate at the same rate about their pivotal connections **37** with respect to the rear rail sections **36**.

It will be remembered that the left-hand link **48** is longer than the right-hand link **50**. This is necessary in order to have an operable stabilizing assembly and will now be explained with reference to the schematics of FIGURES 8 and 9, the schematic of FIGURE 8 representing the raised position of the top and the schematic of FIGURE 9 representing the lowered position of the top.

In the schematics:

AC, BD: front side rail sections **34**.
AB: length of header **38** between centers of pivots **46**.
XZ: straight line distance between centers of pivots **54** and **56**.
XA: link **48**.
BZ: link **50**.
XY: sum of the link lengths between centers **46**, **56**, and **46**, **54**.
YZ: line drawn parallel to header **38** through the pivotal connection **56**, so as to complete a right triangle (in FIGURE 8).

In FIGURE 8, the distance XZ is greater than the length AB inasmuch as XZ forms the hypotenuse of triangle XYZ and AB equals the base YZ of the triangle. Referring to FIGURE 9, if link XA were equal in length to link ZB, then AB would equal XZ and XAC and DZB could not attain a straight line position without distortion or bending of assembly **60**. In order for XZ, then, to reach the position shown in FIGURE 9, the difference in the lengths of pivot links XA and BZ must equal the difference in lengths of AB and XZ. That is,

when the hypotenuse XZ is superimposed on the base AB and moved a distance ZB to the left of base end B, the hypotenuse end X is farther from base end A than hypotenuse end Z is from base end B.

Thus, in order to have an operable stabilizing means, length of the counterclockwise swinging pivot link **48** must exceed the length of the clockwise swinging link **50** by the difference between the distance between the pivots **46** and the distance between the pivots **54** and **56**. Referring to FIGURE 8, and letting K represent the height XY of triangle XYZ, L the base YZ, M the hypotenuse XZ, h_1 the longer link and h_2 the shorter link, the following equations are true.

$$K=h_1+h_2$$
$$L=M-h_1+h_2$$
$$M=L+h_1-h_2$$
$$K^2+L^2=M^2$$
$$h_1=M-L+h_2$$
$$h_2=h_1+L-M$$
$$h_1-h_2=M-L$$

As the top moves from a raised to a lowered position, link XA rotates outwardly or counterclockwise and link BZ inwardly or clockwise with respect to the body. Since link XA is longer than link BZ and both links rotate at the same rate, point X moves about point A faster than point Z moves about point B. This causes a continual lengthening of the triangle base YZ as its height XY decreases. The constant length XZ is the appropriate hypotenuse for the triangle throughout the infinite number of combinations of base and height lengths. When the rail sections **34** have rotated 45 degrees from their position of FIGURE 1 toward their position of FIGURE 6, the stabilizing means encounters its greatest resistance. Beyond that point, it gradually diminishes and becomes zero at a 90 degree position of rail sections **34**, not reached, and a straight line position of rail sections **34** with respect to rail sections **36**.

Although the schematic of FIGURE 9 assumes that the rail sections **34** rotate through an arc of 90° during movement of the top **30** from its raised to its lowered position, the rail sections **34** actually rotate only through an arc of approximately 80° since rotation through a greater arc is undesirable. However, the schematic of FIGURE 9 serves to illustrate the principles underlying this invention.

When the top is in a lowered position and initially starts to move toward a raised position, the initial force on the links **48** and **50** is applied by the front rail sections **34** along lines generally transverse of the body. If the links **48** and **50** where in a transversely aligned position, rather than the position as shown in FIGURES 6 and 7, when the front rail sections applied force to these links transversely of the body, one of the links might rotate overcenter so that both links would begin to rotate in the same direction and thereby lock the top assembly against any further movement. Accordingly, it is desirable to prevent the links **48** and **50** from assuming any aligned position transversely of the body when the top assembly is in a lowered position, and accordingly it is desirable to have the front rail sections **34** rotate through an arc of less than 90° during movement of the assembly from a raised position to a lowered position.

It is believed that a comparison of FIGURE 2 with FIGURES 6 and 7 in conjunction with the foregoing explanation of the principles underlying this invention will clearly illustrate the manner in which the stabilizing assembly functions during movement of the top assembly between its raised and lowered positions.

Although a particular type of inward folding side rail top assembly has been shown and described herein, the stabilizing means of this invention is not limited to this one top assembly but may be used with equal success with other types of inward folding rail top assemblies by application of the principles underlying the invention as hereinbefore set forth.

Thus, this invention provides a new and improved stabilizing means for convertible tops of the general type having inward folding side rails.

What is claimed is:

1. In a convertible top of the type including a spaced pair of inward folding rails pivotally interconnected by a transverse top header, stabilizing means comprising, in combination, means secured to each of said rails for movement therewith, one of said means being located to one side of one of said rail pivots and the other of said means being located to the other side of the other of said rail pivots, and a stabilizer member pivotally connected adjacent one end thereof to said one means to said one side of said one rail pivot and pivotally connected adjacent the other end thereof to said other means to said other side of said other rail pivot, said stabilizer member pivots being located on opposite sides of said stabilizer member, the distance between the centers of one pair of pivots, comprising said one stabilizer member pivot and said one rail pivot, being greater than the distance between the centers of the other pair of pivots, comprising said other stabilizer member pivot and said other rail pivot.

2. In a convertible top of the type including a spaced pair of inward folding rails pivotally interconnected by a transverse top header, stabilizing means comprising, in combination, means secured to each of said rails for movement therewith, one of said means being located to one side of one of said rail pivots and the other of said means being located to the other side of the other of said rail pivots, and a stabilizer member pivotally connected adjacent one end thereof to said one means to said one side of said one rail pivot and pivotally connected adjacent the other end thereof to said other means to said other side of said other rail pivot, said stabilizer member pivots being located on opposite sides of said stabilizer member, the distance between the centers of one pair of pivots, comprising said one stabilizer member pivot and said one rail pivot, being greater than the distance between the centers of the other pair of pivots, comprising said other stabilizer member pivot and said other rail pivot, lines through said centers of each of said pairs of pivots being generally parallel to each other in the unfolded position of said rails and being generally in alignment with each other in the folded position of said rails.

3. In a convertible top of the type including a spaced pair of inward folding rails pivotally interconnected by a transverse top header, stabilizing means comprising, in combination, means secured to each of said rails for movement therewith, one of said means being located to one side of one of said rail pivots and the other of said means being located to the other side of the other of said rail pivots, and a generally Z-shaped stabilizer member including a center section and a pair of opposite laterally extending end sections, one end section being pivotally connected to said one means to said one side of said one rail pivot and the other end section being pivotally connected to said other means to said other side of said other rail pivot, the distance between the centers of one pair of pivots, comprising said one end section pivot and said one rail pivot, being greater than the distance between the centers of the other pair of pivots, comprising said other end section pivot and said other rail pivot.

4. In a convertible top of the type including a spaced pair of inward folding rails pivotally interconnected by a transverse top header, stabilizing means comprising, in combination, a member secured to each of said rails for movement therewith relative to said header about a respective rail pivot, one of said members extending to one side of one of said rail pivots and the other of said members extending to the other side of the other of said rail pivots, and a stabilizer member pivotally connected adjacent one end thereof to said one member to said one side of said one rail pivot and pivotally connected adjacent the other end thereof to said other member to said other side of said other rail pivot, said stabilizer member pivots being

located on opposite sides of said stabilizer member, the distance between the centers of one pair of pivots, comprising said one stabilizer member pivot and said one rail pivot, being greater than the distance between the centers of the other pair of pivots, comprising said other stabilizer member pivot and said other rail pivot.

5. In a convertible top of the type including a spaced pair of inward folding rails pivotally interconnected by a transverse top header, stabilizing means comprising, in combination, a link secured to each of said rails for movement therewith relative to said header about a respective rail pivot, one of said links extending forwardly of said top from one of said rail pivots and the other of said links extending rearwardly of said top from the other of said rail pivots, and a stabilizer member pivotally connected adjacent one end thereof to said one link forwardly of said one rail pivot and pivotally connected adjacent the other end thereof to said other link rearwardly of said other rail pivot, said stabilizer member pivots being

located on opposite sides of said stabilizer member, the distance between the centers of one pair of pivots, comprising said one stabilizer member pivot and said one rail pivot, being greater than the distance between the centers of the other pair of pivots, comprising said other stabilizer member pivot and said other rail pivot, lines through said centers of each of said pairs of pivots being generally parallel to each other in the unfolded position of said rails and being generally in alignment with each other in the folded position of said rails.

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