April 4, 1967 S. PODWYS 3,312,499

CONVERTIBLE TOP

Filed June 22, 1965 3 Sheets-Sheet 1

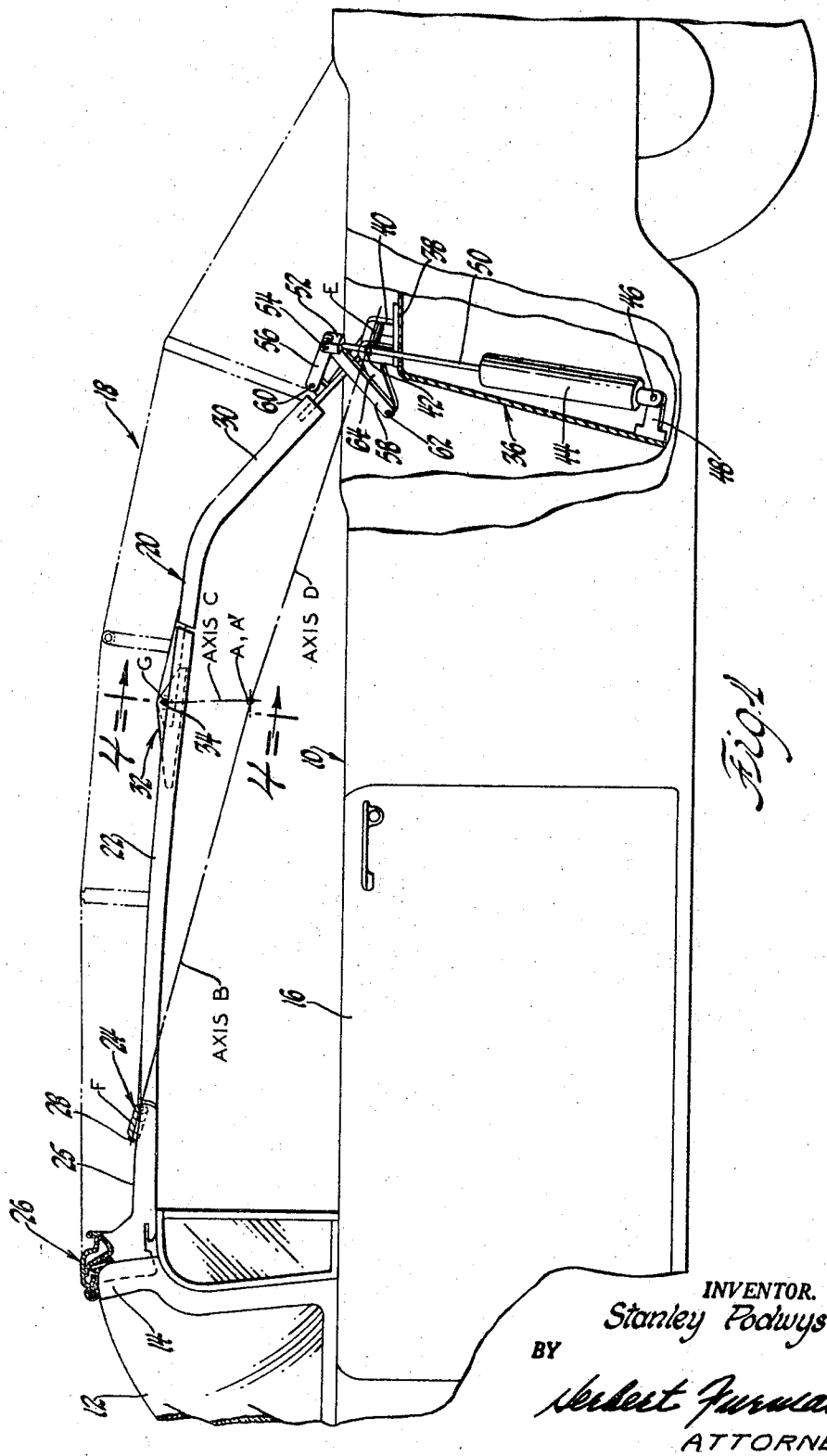


Fig. 1

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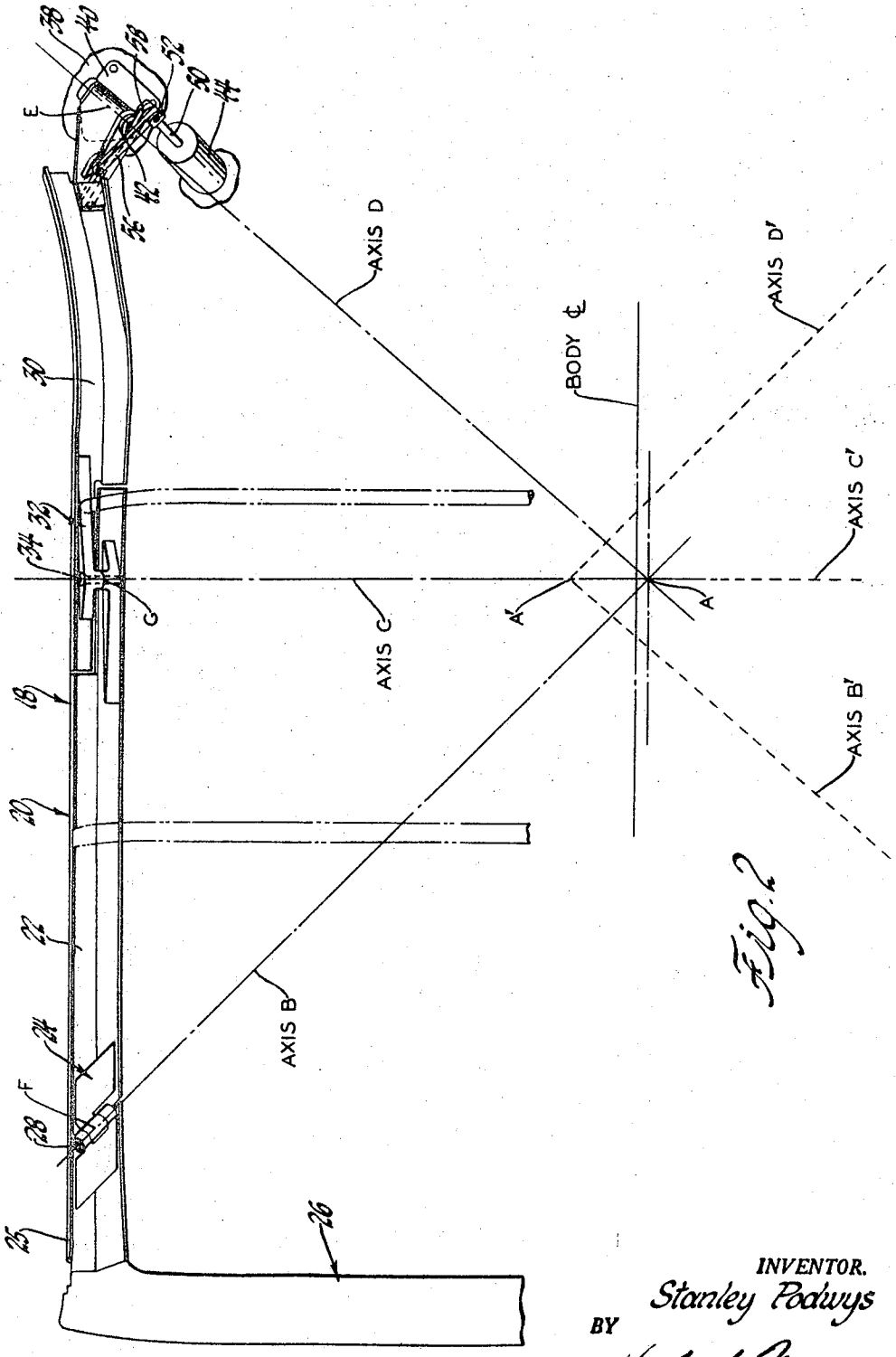


Fig. 2

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CONVERTIBLE TOP

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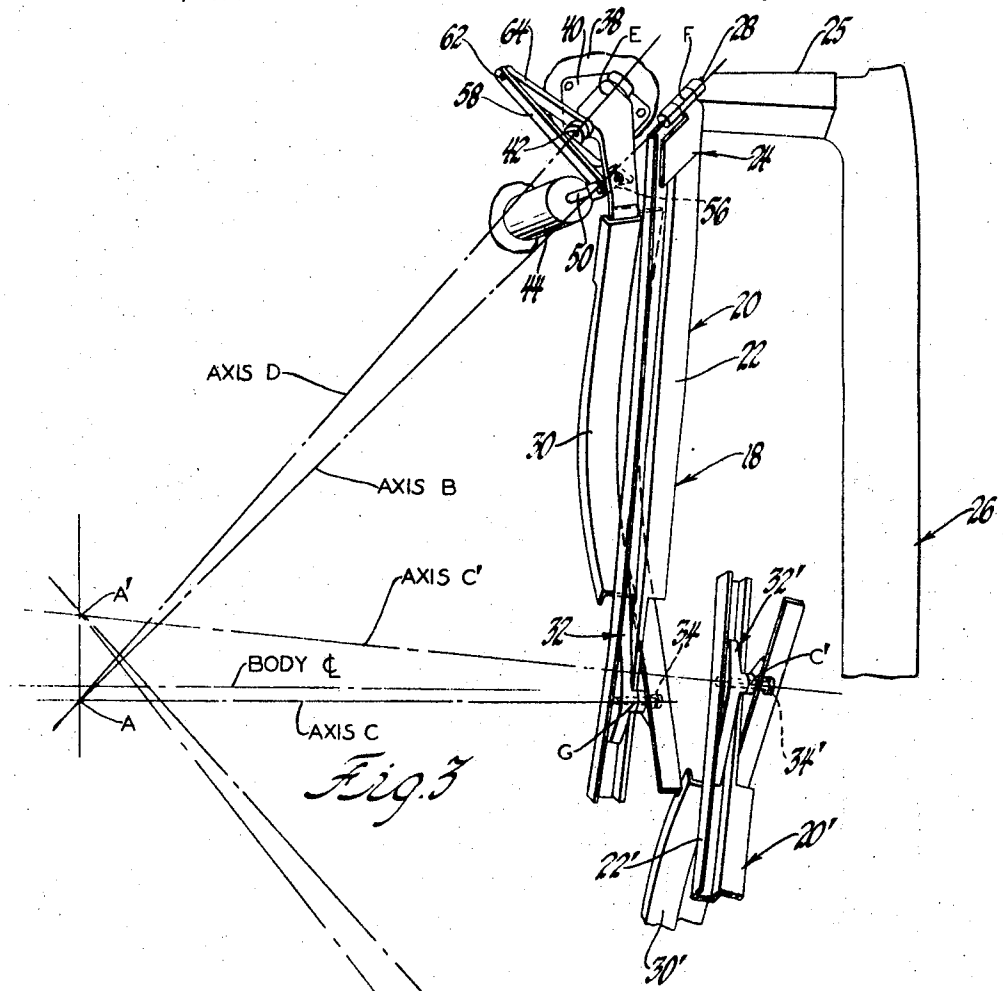


Fig. 3

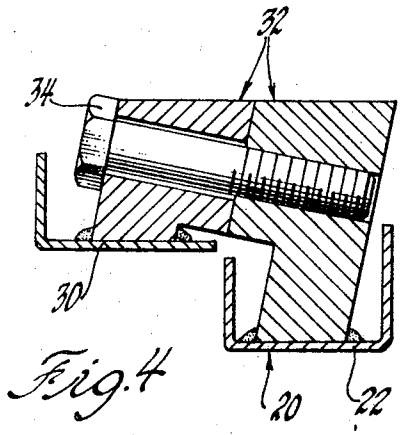
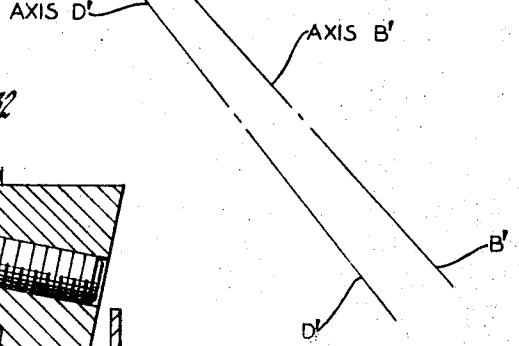


Fig. 4



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3,312,499

CONVERTIBLE TOP

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8 Claims. (Cl. 296—117)

This invention relates to convertible tops and more particularly to convertible tops of the inwardly folding side rail type.

Conventional convertible tops generally include a plurality of pivotally interconnected rail sections which are foldable longitudinally of the body in a generally straight line path when the top is moved between raised and lowered positions. The folding movement of the rails is usually controlled by linkages and the rear side rails and portions of the linkages are mounted on the body within top well portions located at the sides of the rear seat. These top well portions reduce the usable rear seat width to less than that of closed body styles and do not permit the manufacture of a four door convertible body since they extend into the area which would normally be used for the rear door openings.

Further, the side rails and the outer portions of the top bows are generally stacked one upon another above the rear wheel housings and behind and outward of the rear seat back. The considerable stack height of the rails and bows may be accommodated by either depressing the wheel housing height or by permitting the stacked rails and bows to protrude above the upper body surfaces.

Certain of these undesirable features of conventional folding tops have been eliminated in certain bodies by folding the top completely rearward of the rear wheel housings and into the area generally reserved for luggage. However, the elimination of severe reduction of luggage space and the complex mechanisms required are usually considered to be greater penalties than the undesirable features of conventional folding tops.

Various folding tops have been proposed which purport to eliminate the undesirable features of both the conventional tops and the completely rearwardly folding tops. These are generally described as inward folding rail types since the side rails are hinged and controlled so as to fold and to be located rearwardly of the rear seat when stored. The inboard portions of the symmetrically folded side rails remained on their original side of the longitudinal center line or plane of the body.

Such inwardly folding tops also required multiple hinge axis joints which create instability in the rails, both in their movement between raised and lowered positions and in such positions.

The inward folding side rail convertible top of this invention overcomes the disadvantages of such various types of convertible tops.

One feature of this invention is that it provides a convertible top of the inwardly folding side rail type. Another feature of this invention is that it permits the inwardly folded side rails of the top to be located in various positions with respect to each other, such as to be located in abutting relationship, in overlapping relationship, or in generally horizontally disposed tandem relationship. A further feature of this invention is that the axes of the pivotal joints of one side rail need not be arranged with respect to each other in the same manner as the axes of the other side rail are arranged with respect to each other. Yet another feature of this invention is that it permits regular production two and four door bodies to be used as convertible bodies without major structural changes and without diminishing to any great extent the luggage area of such bodies. Still

another feature of this invention is that it provides a convertible top hinge arrangement wherein the axes of the pivotal joints of each side rail converge and meet at single points located inwardly of the respective side rails and short of infinity. Still a further feature of this invention is that the convergent points are located in various relationships with respect to each other and to the center line or plane of the body. Yet still another feature of this invention is that it provides a convertible top of the inwardly folding side rail type having the rails thereof folding in a multidirectional manner but yet having the rails pivotally interconnected by single or unitary axis hinge means.

These and other features and advantages will be readily apparent from the following specification and drawings wherein:

FIGURE 1 is a partially broken way view of a convertible body embodying a top according to this invention, with the top being shown in raised position;

FIGURE 2 is a partial plan view of the top in raised position;

FIGURE 3 is a partial plan view of the top in lowered position; and

FIGURE 4 is a sectional view taken generally along the plane indicated by line 4—4 of FIGURE 1.

Referring now particularly to FIGURE 1 of the drawings, a convertible vehicle body **10** generally includes a windshield **12** and a windshield header **14**. Body **10** further includes a pair of front doors **16** to provide access to and egress from the body. Although a convertible body of the two door type is shown, the invention is not necessarily limited to a body of this type but is equally adaptable to four door type convertible bodies.

A convertible top **18** according to this invention is mounted on the body **10** for movement between a raised position, as shown in FIGURES 1 and 2, and a lowered or stored position, as shown in FIGURE 3, wherein the top is located rearwardly of the rear seat of the automobile within the top well and generally between the wheel houses, not shown, of the body. Since the right-hand and left-hand side rails or rail assemblies of the top are generally of the same construction, although of different hand, only the right-hand rail assembly **20** will be particularly described and it will be understood that the left-hand rail assembly is of the same construction unless otherwise noted.

Rail assembly **20** generally includes a front rail section **22** having its forward end pivoted by a conventional single axis butt type hinge means **24** to a stub rail or extension **25** of the top header **26** which rests on the windshield header **14** in the raised position of the top and may be secured thereto by suitable latch means, not shown. The hinge butts of hinge means **24** are pivotally interconnected by a hinge pin **28**. The rear rail section **30** has a forward end portion disposed in adjacent side by side relationship to a rearward end portion of the front rail section **22**, and the rail sections **22** and **30** are pivotally interconnected by hinge means **32** which generally comprise a pair of side by side disposed hinge butts secured to the respective rail sections and pivotally interconnected by a hinge pin **34**.

Body **10** includes a rear seat panel **36** which joins to a raised floor panel section or kickup panel **38** located rearwardly of the rear seat and between the wheel houses, not shown, of the body. A generally U-shaped bracket **40** is secured to the panel **38** and the legs of the bracket receive the rearward end of the rail section **30** and are pivoted thereto by a hinge pin **42** to provide the rear hinge means. A conventional hydraulic power actuator **44** has its lower end pivoted at **46** to a bracket **48** and has the piston rod **50** thereof provided with a clevis **52** which is pivoted at **54** to a pair of links **56** and **58**. Link

56 is pivoted at 60 to the rear rail section 30 and link 58 is pivoted at 62 to an extension 64 of the bracket 40. Although a power actuator of the hydraulic type is shown, it will be understood that other power actuators may be used.

Upon reference to FIGURES 1 and 2 of the drawings, it will be noted that the pivotal axis B defined by the hinge pin 28, the pivotal axis C defined by the hinge pin 34, and the pivotal axis D defined by the hinge pin 42 converge and intersect at point A which is located inwardly of the rail assembly 20. When the top is moved to a lowered position, as shown in FIGURE 3, the piston rod 50 of the actuator 44 is retracted within the cylinder to swing the rear rail section 30 of the rail assembly rearwardly of the body about the axis D. The front rail section 22 folds with respect to the rear rail section 30 about axis C and with respect to the front header 26 about axis B, the header 26 remains substantially parallel to the body header 14, and the top moves to its lowered position within the top well, as shown in FIGURE 3.

As will be apparent from the following description, the convergent point A for or respective to the rail assembly 20 may be located at various places with respect to the body and rail assembly depending on certain factors, either practical or limit, which must be kept in mind. One limit factor is that the lengths of the rail sections 22 and 30 must be proportioned with respect to each other so as to permit the rail assembly to be folded while permitting the front hinge means 24 to remain a substantially equal distance from the center line of the body so that the header 26 is not bent or the top cannot be folded. Thus, an extremely short front rail section 22 should ordinarily not be used with an extremely long rear rail section 30.

To establish the point A, a length of rear rail section is selected, then located in the desired stored position within the top well, and a point E through which the axis D will ultimately run is then selected on rail section 30. The header is then placed in the desired stored position within the top well, the header being of a fixed length, a length of stub rail 25 is then selected, and a point F through which the axis B will ultimately run is then selected on rail 25. This, then, fixes the length of the front rail section 22 and a point G on section 22 through which axis C will ultimately run is then selected. Thus, points E, F and G can now be located in both the raised and lowered positions of the top. However, it must be kept in mind that the lengths of the front and rear rail sections must be so proportioned as to permit folding movement of the rail sections with respect to each other, as previously set forth, and that the initially selected lengths may have to be changed if not of the proper proportion with respect to each other. It might also be mentioned that all of the lengths selected are straight line distances between the various points.

A line, not shown but hereinafter referred to as H, is now drawn between the points F in the raised and lowered positions of the top, and this line is bisected by a plane, not shown but hereinafter referred to as J, located normal to the line H and which will contain the convergent point A. A line, not shown but hereinafter referred to as K, is drawn between the points G in the raised and lowered positions of the top and a plane, not shown but hereinafter referred to as L, bisecting and normal to line K, is then constructed. The intersection of plane L with the aforementioned plane of bisection J will result in a vertically disposed line, not shown but hereinafter referred to as M. The projection of the point G in the raised position of the top inwardly of the body to this vertically disposed line M will result in establishment of the convergent point A. However, there are certain practical factors which must be kept in mind in establishing the location of the point A on line M. If the point selected is too high, or in other words, located too great a distance above the horizontal or ground, the rear rail section 30 will initially swing outboard of the body before

it begins to swing inboard of the body when the top is lowered, and this may cause the roof rail weatherstrip to be deformed or destroyed by engagement with the rear quarter window of the body if the window is in closed position. In certain tops, such as the top disclosed herein, the roof rail weatherstrip is mounted on a depending flange or shoulder of the rear rail section and selection of a point too high will result in an inoperative top or a broken rear quarter window if the rear rail section swings outboard of the body and the window is closed. If the convergent point A selected is too low, the rear rail section 30 will swing through the space which is normally occupied by the heads of the rear seat passengers so that the rear seat passengers will have to duck when the top is lowered. Axes B, C and D result from connecting points F, G and E, respectively, with point A.

Thus, the selected point A which lies on line M must permit the rear rail section 30 to swing above the heads of the rear seat passengers and must also permit the rear rail section to initially swing substantially parallel to the longitudinal center line of the body or inboard thereof so that this rail section will merely wipe across the rear quarter window of the body, if closed without binding between the rear quarter window and the roof rail weatherstrip.

It will be understood, of course, that various convergent points A will result from projecting the point on the hinge means 34 to various points on the vertical line M resulting from the intersection of the aforementioned planes of bisection J and L. However, it has been found that if the lengths of the front and rear rail sections are chosen within the aforenoted limit factors, any chosen convergent point A within the aforenoted practical factors will result in an operative structure. It has also been found that if the convergent point A is located above a line connecting the points E and F in the raised position of the top, the front and rear rail sections will start to unfold before they start to fold. It has also been found that the greater the distance below this line the convergent point A lies, the greater the initial rate of folding movement of the front and rear rail sections with respect to each other. These factors should also be kept in mind when choosing a converging point A.

The left-hand rail assembly 20′ is the same as the right-hand rail assembly 20 although the parts are of different hand and, accordingly, like prime numerals have been used for like parts in FIGURES 1 and 3 of the drawings. The foregoing considerations are, of course, equally applicable to the left-hand rail assembly as well as the right-hand rail assembly.

It will also be remembered that the convergent points A and A′ of the right-hand and left-hand rail assemblies, respectively, may be located in various relationships with respect to each other. If it is desired that the rails fold symmetrically, then the convergent points A and A′ can be coextensive with each other and located on the center line or in the center line plane of the body, or equally spaced from the center line plane and on either side of this plane, so that a single point will suffice for both the right-hand and the left-hand rail assemblies. If it is desired that the rails be stored in a staggered relationship, as shown in FIGURE 3, this can be accomplished by varying the true lengths of the rail sections of each rail assembly so that the rail assembly having the shorter rear rail section and the longer front rail section will be stored forwardly of the rail assembly having the longer rear rail section and the shorter front rail section.

It will also be noted upon reference to FIGURE 3 that the convergent points A, A′ of the respective rail assemblies need not be located the same distance or on the same side with respect to the center line or center line plane of the body. This also results in a staggered relationship of the rails with respect to each other. Generally, the shorter the distance that the convergent point is located to its respective rail assembly, the greater the

distance forwardly of the body or upwardly of the body or both that the center hinge means 34 will be located in the stored position. Thus, in FIGURE 3, the convergent point A is located closer to the body center line toward its respective right-hand rail assembly than is the convergent point A' so that the right-hand rail assembly 20 is stored forwardly of the left-hand rail assembly 20'.

It should also be noted that there is no limitation on the location of the convergent point of a respective rail assembly other than that this point must lie inboard of its respective rail section and be located short of infinity.

The hinge arrangement of this invention permits the use of single or unitary axis hinges at each joint in a convertible top mechanism and also permits the members of each side rail of the top to be revolved about an axis respective thereto but yet passing through a single or common point in space respective to the side rail and remote from the members of the rail. This arrangement may be termed "cone hinging" and in order to use the arrangement, in its simplest form, the mechanism requires at least two groups, with each group comprising at least three hinge axes, with the axes of each group intersecting or converging at a common or single point in space short of infinity. Thus in the convertible top 18, previously described herein, each side includes a group of three hinge axes which intersect at a convergent point A or A' in space short of infinity. The line which joins the convergent points, such as a line through points A–A', defines the axis of rotation of the top header which is the member physically joining the side rails together. Each hinge axis of each side rail, when revolving about an adjacent hinge axis which intersects the one hinge axis, generates a portion of a cone, although it will be understood that movement of each of the hinge axes about the convergent points A or A' does not generate a cone but, rather, each hinge axis generates a portion of a cone.

From the foregoing description, it will be apparent that various relationships of the rail sections of each rail with respect to each other and also various relationships of the rail assemblies with respect to each other can be had by either changing the true lengths of the rail sections or by locating the convergent points of the rail sections in various relationships with respect to each other.

Thus, this invention provides a new and improved convertible top of the inwardly folding side rail type.

I claim:

1. In combination with a vehicle body, a convertible top movable between raised and lowered positions comprising, a pair of spaced foldable side rails, each rail including a plurality of rail sections, means pivotally interconnecting the sections of each rail for movement of the sections relative to each other about a single pivotal axis, means pivotally mounting one rail section of each rail on said body for folding each of said rails, the pivotal axes of said interconnecting means and said mounting means respective to each side rail meeting at a convergent point located short of infinity.

2. The combination recited in claim 1 wherein the convergent points for each side rail are coextensive.

3. The combination recited in claim 1 wherein the convergent points are located inwardly of their respective side rails.

4. The combination recited in claim 1 wherein the convergent points are located on the center line of the vehicle body.

5. The combination recited in claim 1 wherein the convergent points are located on opposite sides of the center line of the body.

6. The combination recited in claim 1 wherein the convergent points are located at unequal distances with respect to the center line of the body.

7. The combination recited in claim 1 wherein the convergent points are located on the center line of the body and spaced from each other.

8. The combination recited in claim 1 wherein the convergent points are spaced with respect to each other and with respect to the center line of the body.

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