Oct. 21, 1969 R. A. BRACEY ET AL 3,473,842

CONVERTIBLE TOP MECHANISM

Filed June 27, 1967 3 Sheets-Sheet 1

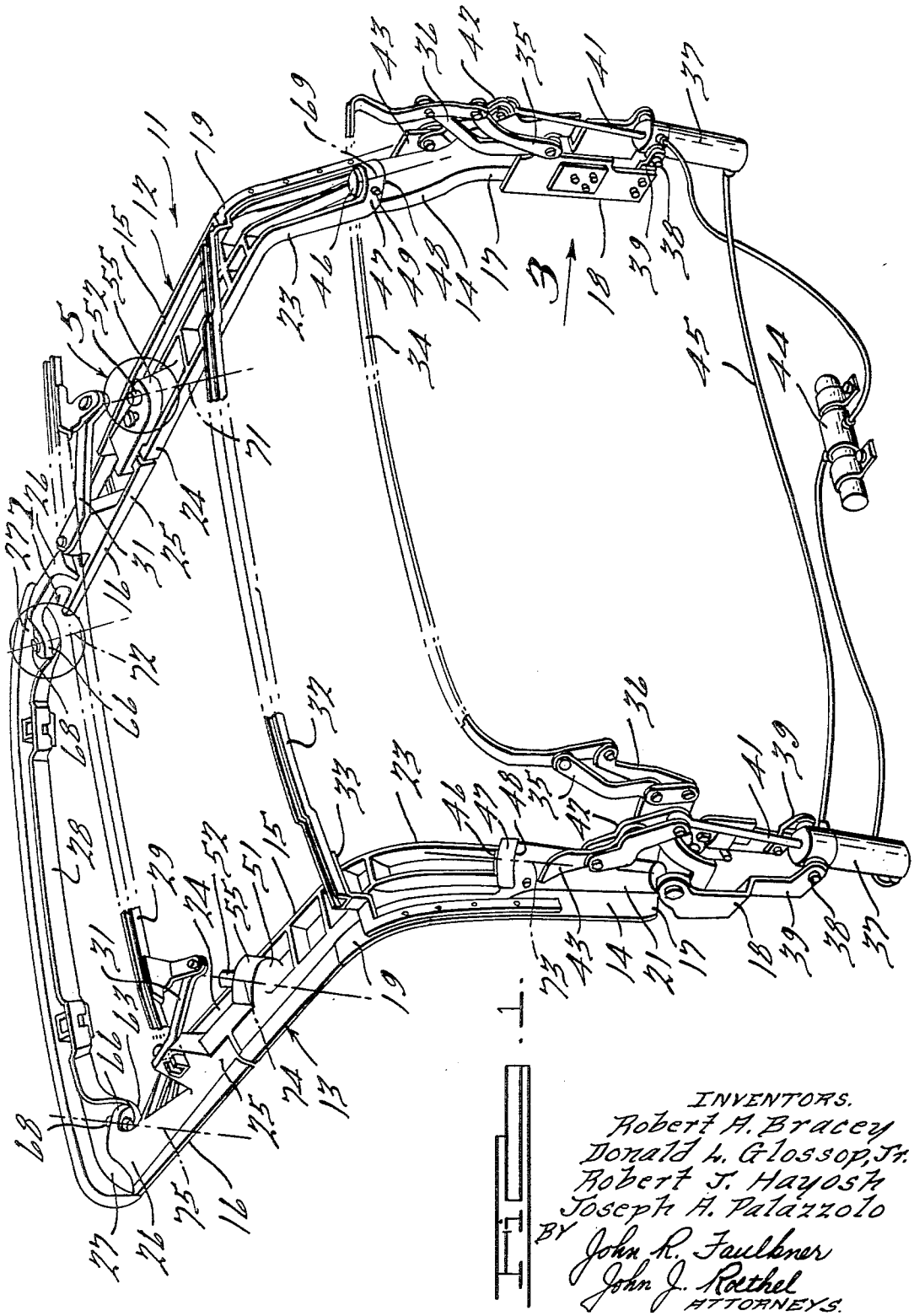


FIG. 1

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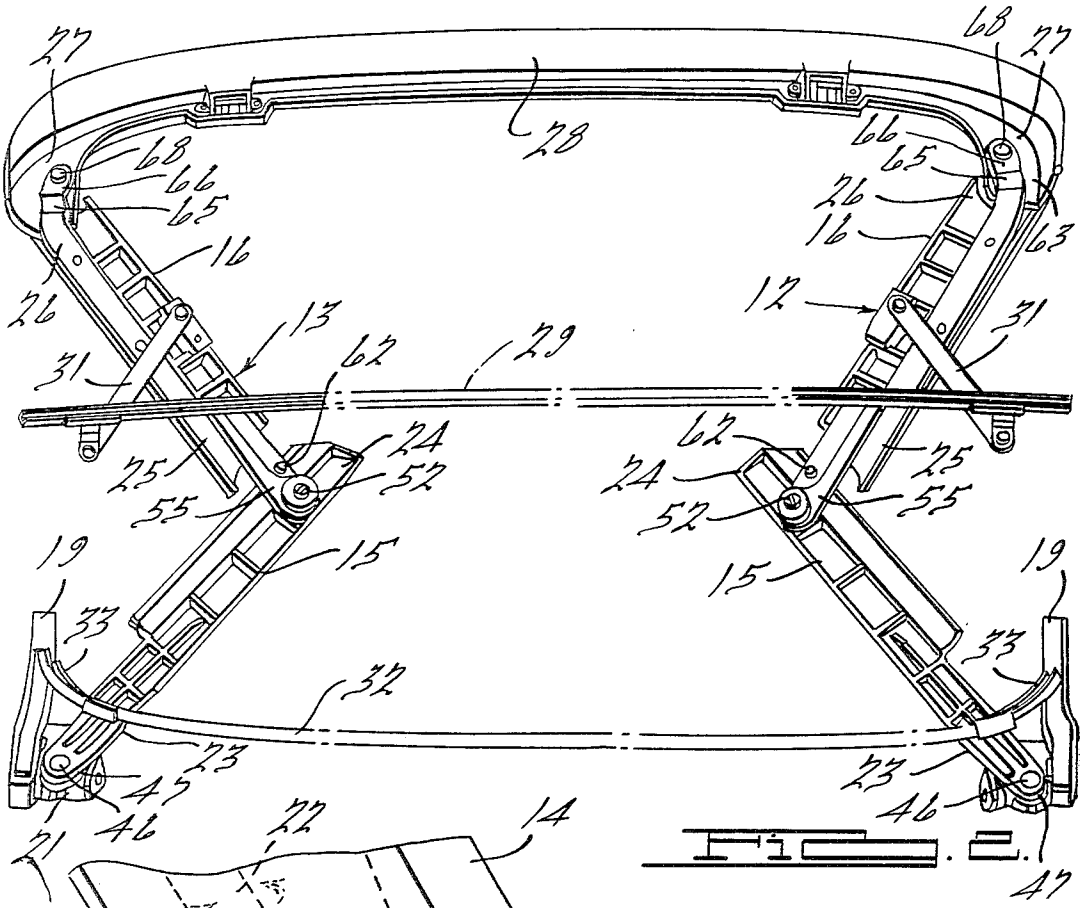


FIG. 2.

FIG. 3.

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CONVERTIBLE TOP MECHANISM

Filed June 27, 1967 3 Sheets-Sheet 3

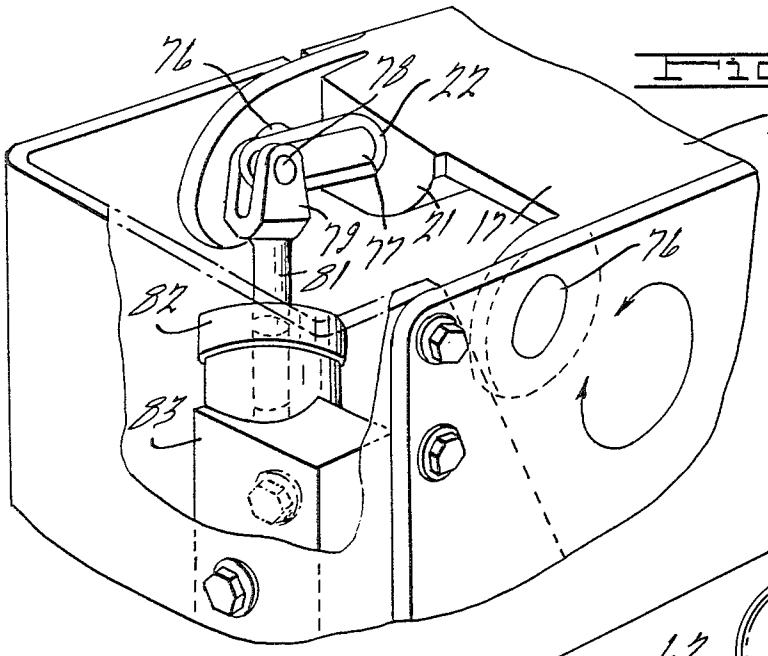


Fig. 4.

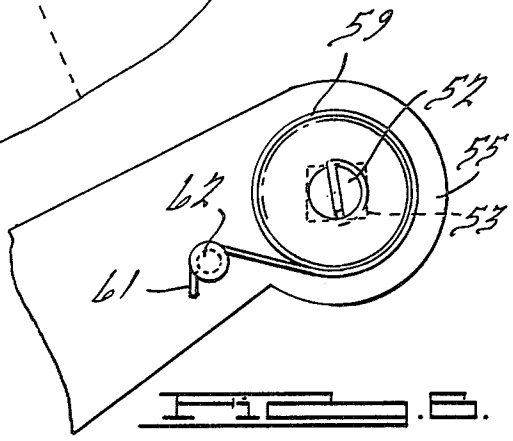


Fig. 6.

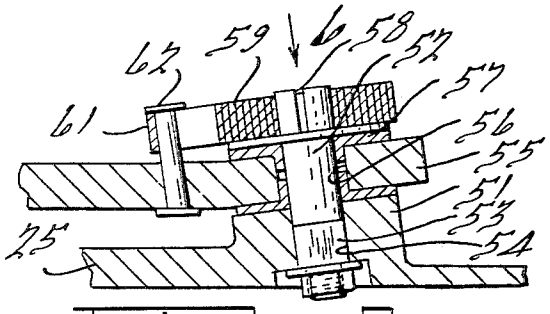


Fig. 5.

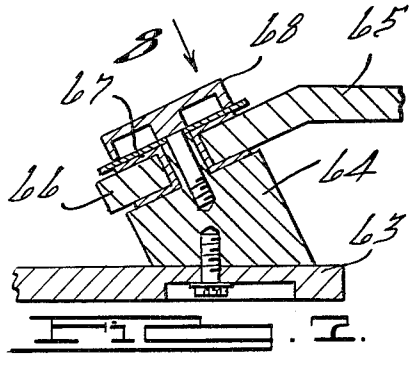


Fig. 7.

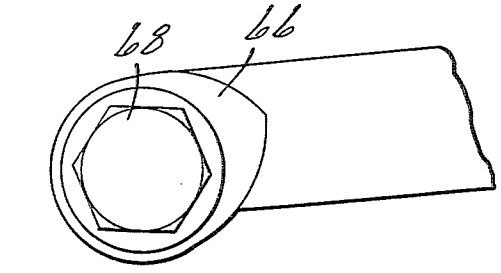


Fig. 8.

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CONVERTIBLE TOP MECHANISM

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U.S. Cl. 296—116 4 Claims

ABSTRACT OF THE DISCLOSURE

A foldable top structure in which the side rails have pivotally interconnected sections which, except for the rearmost section, are inwardly foldable about parallel pivot axes. The pivot axes along each side rail in top raised and extended position define planes which intersect above the vehicle body. Inward folding movement is derived from torsional drive means each coupled at one end to the vehicle body and at its other end to a side rail section pivoted to the front end of the rearmost side rail sections.

Background of the invention

The design of foldable top structures for vehicle bodies of the type conventionally known as convertibles has always presented a most difficult engineering challenge. The major problem has been the packaging of the top so that it will present a minimum of degree of encroachment into the passenger compartment area when in a folded or collapsed condition. This problem has been compounded by the necessity of maintaining the vertical stack height of the folded or collapsed top linkage at a minimum. This necessity arises from the desire to keep the top stack height from protruding above the belt line of the vehicle body.

One solution that has been proposed a number of times is to have the side rail sections fold inwardly rather than to have them swing vertically one on top of the other from an extended to a folded position. Such structures have not proven commercially acceptable because of the difficulty in driving and in guiding the inwardly folding rail sections so that the top will be folded and unfolded with a predetermined uniformity of movement each and every time it is lowered or raised. Only with uniformity of movement can the top when raised be properly aligned with the latch devices carried on the windshield header or when lowered be properly aligned with the storage compartment into which it must fit.

It is an object of the present invention to provide convertible or foldable top structures having inwardly foldable rail sections and a unique mechanism for folding and unfolding the rail sections as the top is lowered or raised.

Description of the drawing

Other objects, advantages and features of construction of the present invention will be made more apparent as this description proceeds, particularly when considered in connection with the accompanying drawings, wherein:

FIG. 1 is a perspective view of a foldable top structure for a convertible vehicle body shown without the top covering material;

FIG. 2 is a plan view of the foldable top structure in partially folded condition;

FIG. 3 is a fragmentary enlarged view in the direction of the arrow 3 in FIG. 1 of the torsional drive means in top raised position for causing inwardly folding movement of the top structure side rails;

FIG. 4 is a view in part similar to FIG. 3 illustrating the torsional drive means in top lowered position;

FIG. 5 is a vertical sectional view of the rail section pivot means within the circle 5 in FIG. 1;

FIG. 6 is a view taken in the direction of the arrow 6 in FIG. 5.

FIG. 7 is a vertical sectional view of the rail section pivot means within the circle 7 in FIG. 1;

FIG. 8 is a view taken in the direction of the arrow 8 in FIG. 7.

Description of preferred embodiment

Referring now to the drawings, FIG. 1 illustrates the foldable top structure, generally designated 11, in top extended and raised position. The top structure is shown without the conventional canvas or vinyl fabric covering material. Also, no portion of the vehicle body is shown since the relationship of the foldable top structure to the convertible vehicle body follows conventional practice.

The top structure 11 comprises a pair of symmetrical side rails 12 and 13. Each side rail 12 or 13 has a plurality of rail sections consisting of a rear side rail section 14, a center side rail section 15 and a front side rail section 16.

Each rear side rail section 14 comprises a member which is upwardly and forwardly inclined when in top raised position, as shown in FIG. 1. At its lower end 17 it is pivotally journalled on a bracket 18, see FIG. 3. The bracket 18 is adapted to be secured to the convertible body structure. At its upper end 19, the rear side rail section 14 is curved so that in top raised position it lies in a substantially horizontal plane.

The rear face of rear side rail section 14 (the side visible in FIG. 1 or from the rear of the vehicle in top raised position) has a semi-cylindrically contoured portion 21 which provides a journal for a shaft 22, the function of which will be explained. The portion 21 extends from the lower end 17 of the rear side rail section 14 to approximately half way up the latter. From the termination of the rail portion 21 to the terminal end of the upper end 19 of the rail section 14, the rail section is about half the width of the lower half. The half width portion of the rear side rail section 14 is adapted to mate laterally with the lower portion 23 of the center side rail section 15.

The center side rail section 15 is a curved member following the longitudinal contour of the upper half of rear side section 14 and then extending in a substantially horizontal direction forwardly of the latter at an increased width as best seen in FIG. 2. The forward end 24 of the center side rail section 15 is contoured to abut the rear end 25 of front side rail section 16. The front end 26 of front side rail section 16 in turn abuts the adjacent terminal end 27 of the front header or number one roof bow 28. The front header or number one roof bow 28, as in conventional convertible structures, extends laterally of the passenger compartment and is contoured to overlie the windshield header (not shown). It functions to tie and maintain in proper lateral spaced relationship the forward ends of the side rails 12 and 13. The rear ends of the side rails 12 and 13, being journalled in brackets mounted on the vehicle body, are automatically held in proper spaced lateral relationship to each other.

In addition to the number one roof bow 28, there are additional roof bows as required to support the convertible top material. In the illustrated embodiment of the present invention, there are three of these additional roof bows.

These are the number two roof bow 29 supported on links 31 pivotally journalled on the front side rail section 16, the number three roof bow 32 rigidly fixed at each of its ends to a bracket 33 secured to the respective rear side rail sections 14, and the number four roof bow 34 carried on links 35 and 36 pivotally supported on extensions 37 of the brackets 18. The link system utilizing the links 35

and 36 permits the number four roof bow 34 to collapse beneath the top structure as the latter is driven to a stored position.

The power means for driving the top structure from a raised and extended position to a collapsed and stacked or stored position or vice versa is illustrated as comprising a pair of hydraulic cylinders 37. The cylinders 37 are supported by trunnions 38 journalled in side wall extensions 39 of brackets 18. The piston rod 41 of each cylinder 37 is coupled by links 42 to a flange or web 43 extending from the rear side rail section 14. Operating fluid for the hydraulic cylinders is derived from a hydraulic fluid pump 44 (adapted to be mounted on the vehicle body floor) connected to the cylinders by supply and return conduits, such as the conduit 45 in FIG. 1.

As described so far, the convertible foldable top structure 11 appears to be quite similar to a conventional foldable top structure. One distinction has been briefly noted, however, and this was with respect to the semi-cylindrical contoured portions 21 of the rear side rail sections 14. Each of these semi-cylindrical contoured portions 21 has been described as journalling a shaft 22. The upper end 46 of each shaft 22 projects through a boss 47 on the lower end 23 of the respective center side rail section 15. Each boss 47 has bearing engagement with the end face 48 of the semi-cylindrical portion 21 of the contiguous rear side rail section 14. Each shaft end 46 and related center side rail boss 47 are coupled to each other by a pin 49 or the like. Appropriate rotation of the respective shafts 22, in a manner to be explained, causes the center side rails 15 to swivel inwardly toward the center of the vehicle body (see FIG. 2) when the top is to be collapsed.

The forward end 24 of each center side rail 15 has an upstanding boss 51 which carries a pivot stud 52 (see FIG. 5). The pivot stud 53 has a square shank portion 52 adapted to fit into a square portion of the aperture 54 in the boss 51 so that the stud 52 is nonrotatable.

The rear end 25 of the front side rail section 16 has an extension 55 adapted to overlie the boss 51 in the center side rail 15. The extension 55 is apertured as at 56 to receive bushing elements 57. It is thus seen that the center side rail section 15 and the front side rail section 16 are pivotally coupled to each other. The upper end of the pivot stud 52 is provided with a slot or kerf 58 adapted to receive the inner end of a spiral spring 59, the free end 61 of which is hooked over a pin 62 carried on the extension 55 of the front side rail 16.

The pivotal connections or couplings between the front header bow or number one bow 28 and the front end 26 of each front side rail section are best explained with reference to FIGS. 7 and 8. The front header 28 has at each end an extension portion 63 carrying an inclined boss 64. Each front rail section 26 also has an extension 65 terminating in an inclined end portion 66 adapted to overlie the respective front header boss 64. Suitable bushing devices 67 ensure low friction between the adjacent surfaces of the boss 64 and rail section end portion 66 and between the adjacent surface of the latter and the large headed bolt 68 providing the pivotal coupling means.

An important feature of the present invention is the alignment of the three pivot axes for each side rail 12 or 13 defined by the respective shafts 22, pivot studs 52 and bolts 68. In top raised position, as shown in FIG. 1, the pivot axes for the rail sections 14, 15 and 16 of the right side rail 12 are parallel to each other and lie in a common plane. These pivot axes are represented by the lines 69, 71 and 72. Correspondingly, pivot axes for the rail sections 14, 15 and 16 of the left side rail 13, as represented by the lines 73, 74 and 75, also are parallel to each other and lie in a common plane. The planes defined by the respective pivot axes 69, 71, 72 and 73, 74, 75 are inclined to intersect over the longitudinal center line of the foldable top structure.

The lower end of the rear side rail section 14 pivots on the bracket 18 about a horizontal pivot axis as indicated by the stub shafts 76 (see FIGS. 3 and 4).

As has been mentioned, the upper end 46 of the shaft 22 which extends through the semi-cylindrical contoured portion 21 of the rear side rail section 14 is pinned to the end portion 23 of the center side rail section 15. This applies to the shaft 22 on each side of the foldable top structure. Thus, if a clockwise twisting force is applied to the shaft 22 on the left side of the foldable top structure 11, as viewed in FIGS. 1 and 2, and if a counterclockwise force is applied to the shaft 22 on the right side of the foldable top structure, the center side rail sections 15 of the respective side rails 12 and 13 will be swung inwardly from the FIG. 1 position to the position shown in FIG. 2. The manner in which the twisting or torsional forces may be applied to the shafts 22 now will be explained.

Referring now to FIG. 3, it will be noted that the lower end 77 of the shaft 22 is formed as a tongue pivotally coupled by a pin 78 to the clevis end 79 of a shaft 81. The shaft 81 is journalled for free rotation in a bushing 82 carried on a mounting block 83 secured to the inner wall of the bracket 18 at one corner thereof. The shafts 22 and 81 are thus angularly coupled to each other. The shaft 81 lies at an angle to the horizontal pivot axis of the rear side rail section 14 whereas the axis of shaft 22 lies in a plane vertically intersecting the horizontal rear side rail section pivot axis. As was pointed out above, the upper end of the shaft 22 is nonrotatably coupled to the center side rail section 15. As a result of this relationship, when the rear side rail section 14 is swung in a clockwise direction from its upright position as viewed in FIG. 3 by actuation of the hydraulic cylinder 37, a torsional force is exerted on the shaft 81 in a counterclockwise direction as viewed in FIG. 3. Because of the angular relationship of the shaft 81 with the shaft 22, this torsional force is transmitted to the shaft 22 tending to rotate the latter in a counterclockwise direction as viewed in FIG. 3. This counterclockwise torsional movement of the shaft 22 is transmitted through its end 46 to the center side rail section 15 of the side rail 12 causing the latter to be swung in a counterclockwise direction as viewed in FIG. 2.

Simultaneously the same action is occurring on the other side of the top except that the directions of the various forces and rotational directions of the various shafts are reversed. The center side rail section 15 of the side rail 3 is swung in a clockwise direction so that the two center side rail sections 15 will swing inwardly toward each other. As the center side rail sections 15 swing inwardly toward each other they pull the front side rail sections 13 rearwardly and inwardly. This results in the front bow 28 being pulled toward the rear bow 32. The second bow 29 is also moved inwardly. Since it is mounted on the inwardly moving front side rails 16, the bow 29 must swing on its supporting links 31 otherwise the front side rail sections could not move inwardly. The third bow 32 being mounted on the rear side rail sections which are being swung rearwardly about their horizontal pivot axis are merely carried backwardly in an arc to a collapsed position above the rear bow 34. The latter being mounted on the links 35, 36 merely folds itself under the folding side rail sections as the rear side rail sections are moved to a substantially horizontal position as shown in part in FIG. 4.

It will be understood that as soon as the lower halves 17 of the rear side rail sections 14 are swung from a forwardly inclined position as shown in FIG. 3 to a position in which they assume a rearward inclination, the weight of the top structure will shift in a direction to abet the inward folding movement of the center side rail sections 15 and front side rail sections 16.

When the top structure is raised from the collapsed or stored position, the weight of the top structure will resist the unfolding of the rail sections. But as shown in

FIGS. 5 and 6, the spirit springs 59 are so positioned that they will be wound up as the side rail sections 15 and 16 on each of the side rails 12 and 13 move into an overlying position as they are moved to a top stored or collapsed position. As the side rail sections 15 and 16 are driven into longitudinal alignment upon the raising of the top structure, the energy stored in the spiral springs 59 will assist in the alignment of the side rail sections 15 and 16 relative to each other.

The unique features of the present invention may be briefly summarized as follows:

(1) Arrangement of top rail geometry for improved packaging:

(A) Rear side rails fold straight back.

(B) Center side and front side rails fold inboard.

(2) Angulation of side pivots to provide:

(A) Improved packaging and top down position.

(B) Stability during top folding cycle.

(3) Application of unique torsional drive means to effect inward folding of the center side and front side rails from rear rail rotation or swinging movement.

We claim:

1. A foldable top structure for a vehicle body;

a pair of spaced foldable side rails having a plurality of rail sections,

the rearmost rail section of each side rail being pivotally supported on the vehicle body for swinging movement about a substantially horizontal pivot axis;

a plurality of pivot means positioned on each side rail to interconnect its rail sections,

said pivot means defining parallel pivot axes about which the respective side rail sections other than the rearmost sections are inwardly foldable,

said parallel pivot axes on each side rail lying in a plane when the foldable top is in a raised and extended position,

the respective planes being inclined to intersect above the vehicle body;

and torsional drive means for each side rail,

each torsional drive means including a drive member journalled on a rearmost rail section with one end forming the pivotal interconnection of the respective rearmost rail section with the contiguous side rail section,

and coupling means coupling the other end of said drive member to the vehicle body contiguous to the horizontal pivot axis about which the respective rearmost rail section is swingable,

said torsional drive means being responsive to swinging movement of the rear rail section to effect inward folding of said side rail sections.

2. A foldable top structure according to claim 1 in which:

a power means is coupled to each of the rearmost rail sections to swing the latter from an upwardly and forwardly inclined position in top raised position to a substantially horizontal and rearwardly extending position in top lowered position.

3. A foldable top structure for a vehicle body, comprising:

a pair of spaced foldable side rails each having a rear side rail section, a center side rail section and a front side rail section,

each rear side rail section being pivotally supported at its rear end on the vehicle body for swinging movement about a substantially horizontal pivot axis,

and each rear side rail section in top raised position being upwardly and forwardly inclined and in top lowered position extending in a substantially horizontal and rearwardly extending direction;

pivot means connecting the rear end of each center side rail section to the front end of the contiguous rear side rail section,

and pivot means connecting the rear end of each front side rail section to the front end of the contiguous center side rail section;

a front header extending between the front ends of the front side rail sections and pivotally connected by pivot means thereto;

the several pivot means, except the pivot means defining the horizontal pivot axis about which each rear rail section swings, defining pivot axes about which the respective center and front side rail sections are inwardly foldable,

the parallel pivot axes on each side rail lying in a plane when the foldable top is in a raised and extended position,

the respective planes being inclined to intersect above the vehicle body;

and torsional drive means for each side rail,

each torsional drive means including a drive member journalled on a rear side rail section with one end forming the pivotal interconnection of the respective rear side rail section with the contiguous side rail center section,

and coupling means coupling the other end of said drive member to the vehicle body contiguous to the horizontal pivot axis about which the respective rear side rail section is swingable,

said torsional drive means being responsive to swinging movement of the rear side rail section to effect inward folding of said side rail sections.

4. A foldable top structure according to claim 3, in which:

a power means is coupled to each of the rear side rail sections to swing the latter from an upwardly and forwardly inclined position in top raised position to a substantially horizontally and rearwardly extending position in top lowered position.

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