July 28, 1959 J. L. LELLI ET AL 2,897,003

CONVERTIBLE TOP LINKAGE AND ACTUATING MEANS

Filed May 20, 1955 5 Sheets-Sheet 1

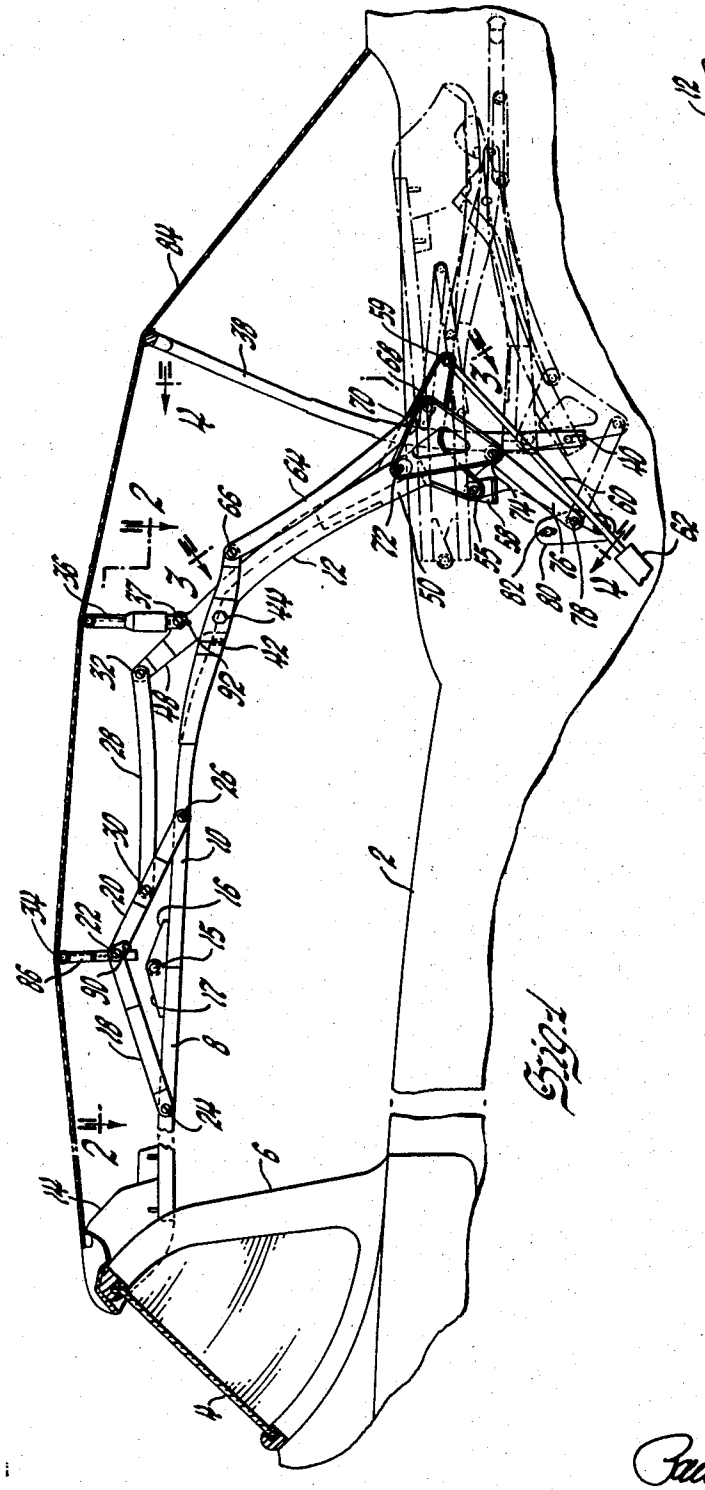


Fig. 1

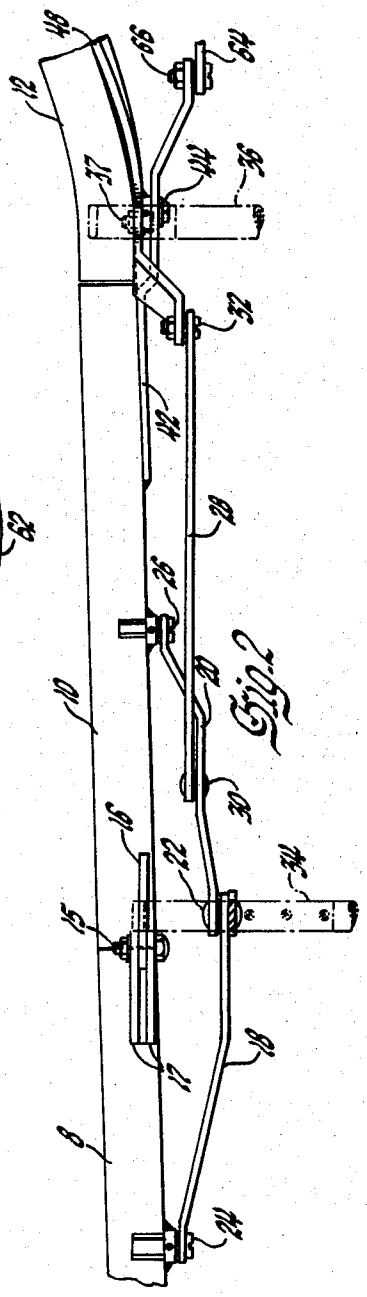


Fig. 2

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Filed May 20, 1955 5 Sheets-Sheet 2

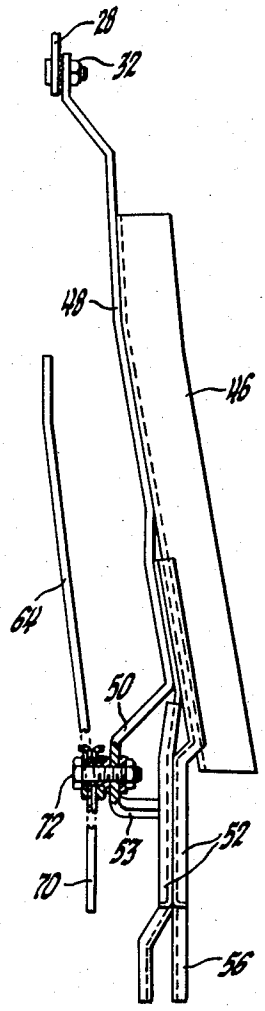


Fig. 3

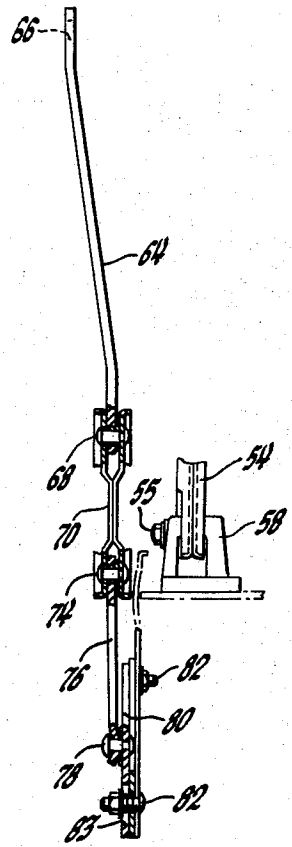


Fig. 4

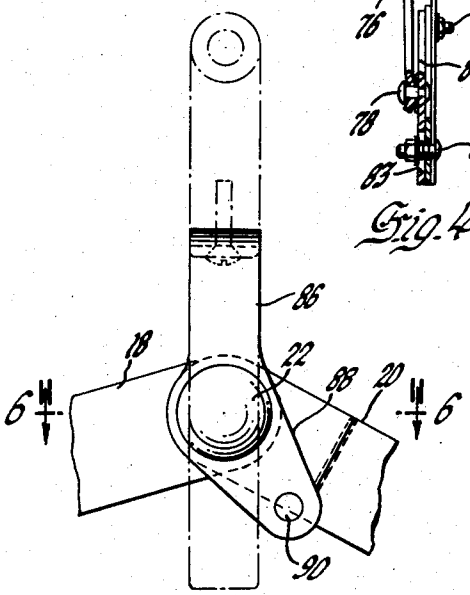


Fig. 5

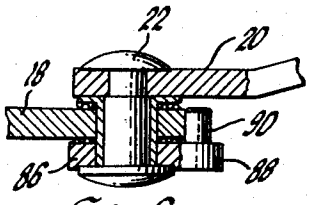


Fig. 6

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CONVERTIBLE TOP LINKAGE AND ACTUATING MEANS

Filed May 20, 1955 5 Sheets-Sheet 3

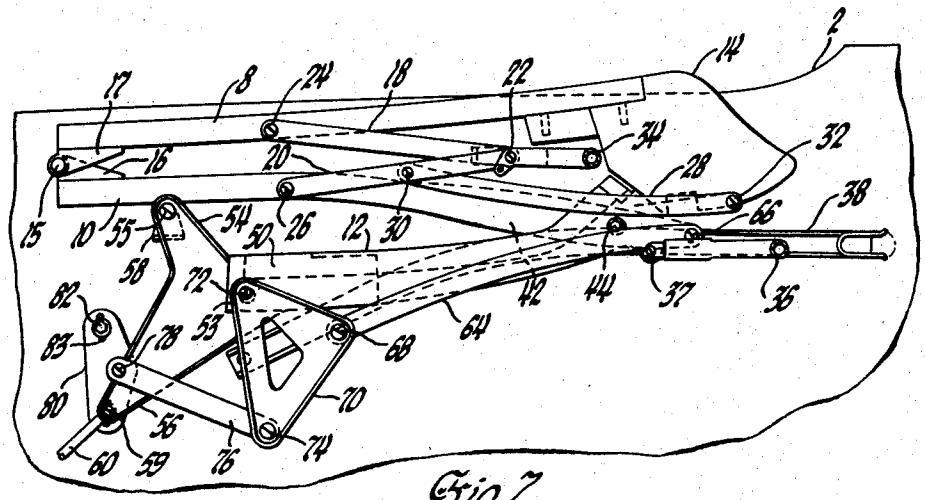


Fig. 7

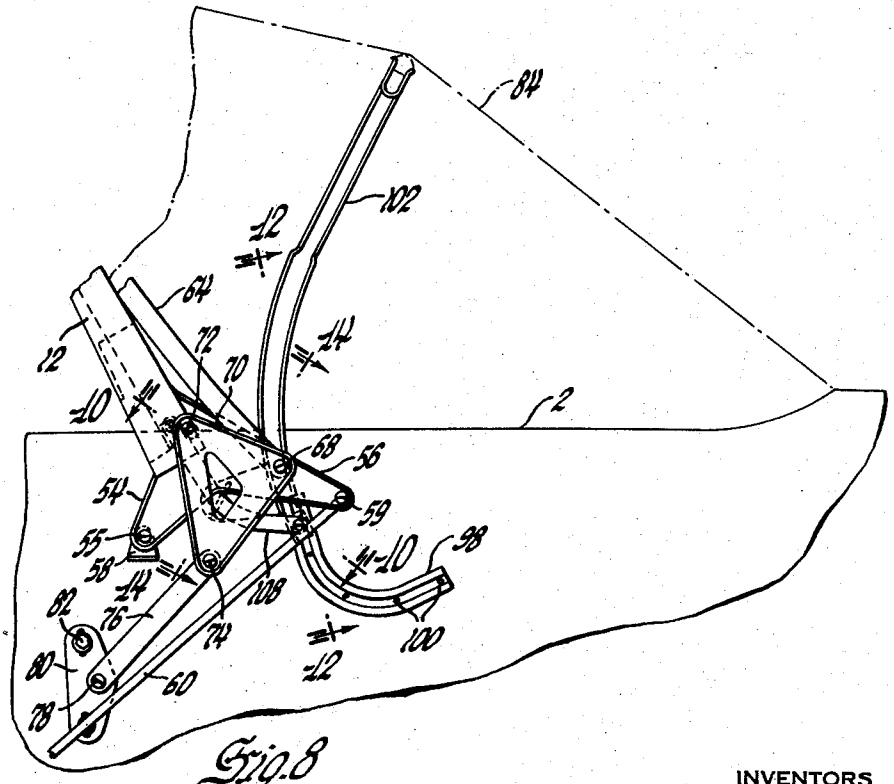


Fig. 8

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CONVERTIBLE TOP LINKAGE AND ACTUATING MEANS

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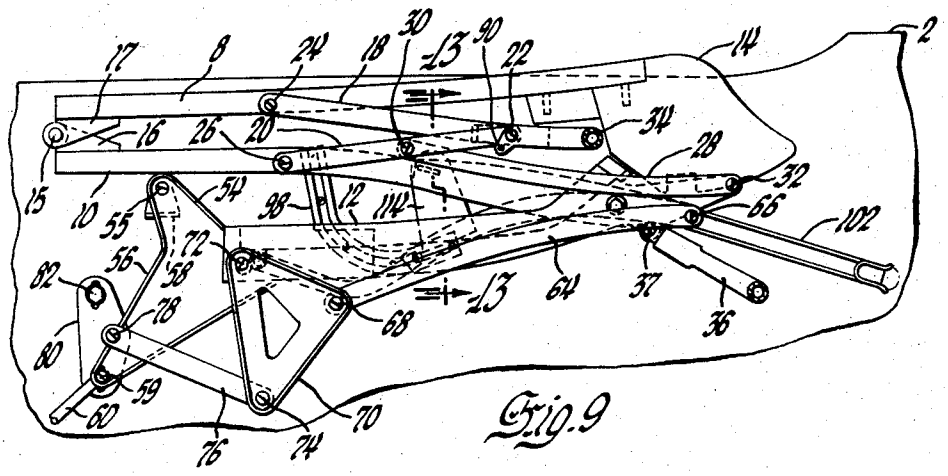


Fig. 9

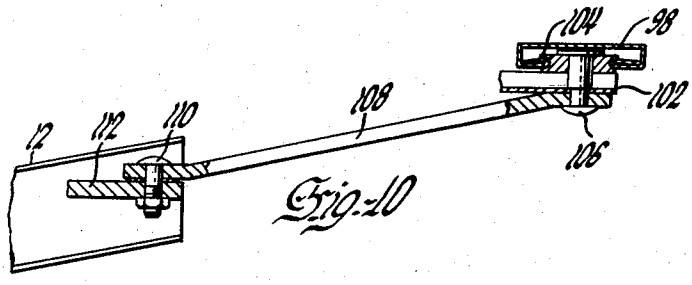


Fig. 10

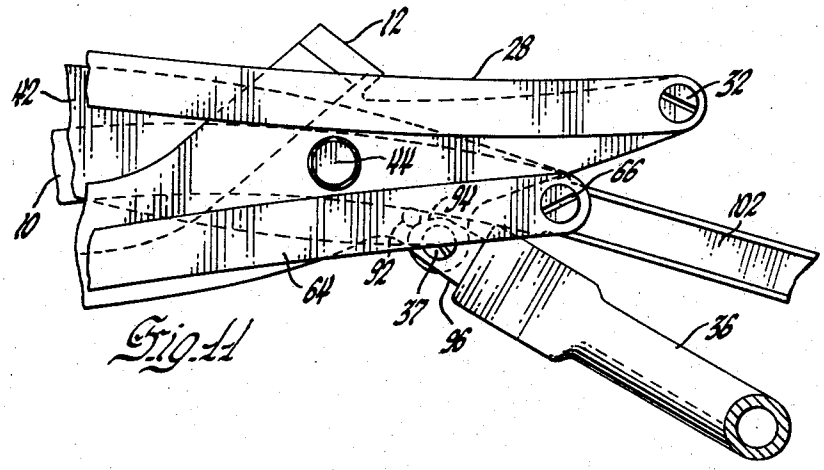


Fig. 11

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CONVERTIBLE TOP LINKAGE AND ACTUATING MEANS

Filed May 20, 1955 5 Sheets-Sheet 5

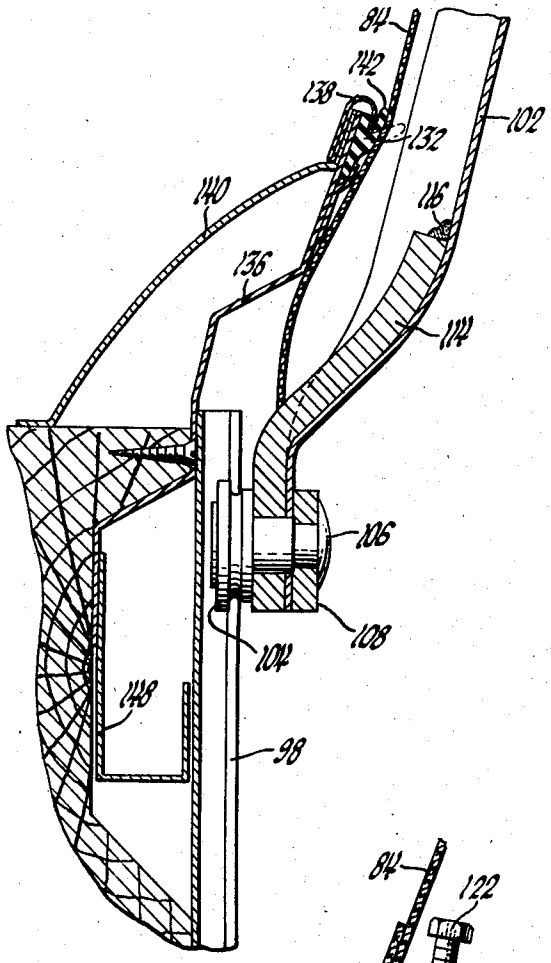


Fig. 12

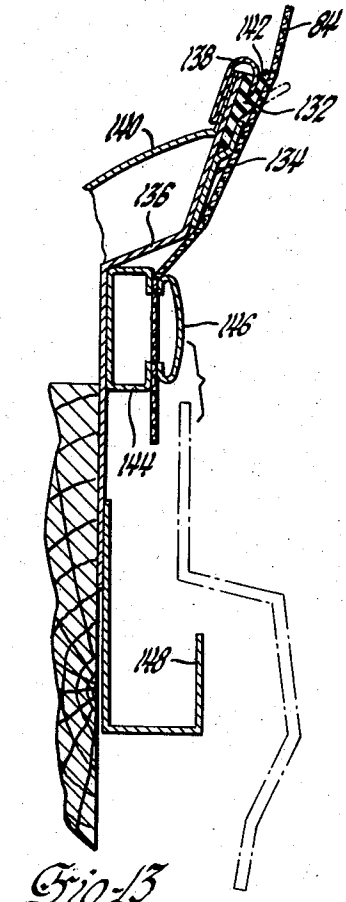


Fig. 13

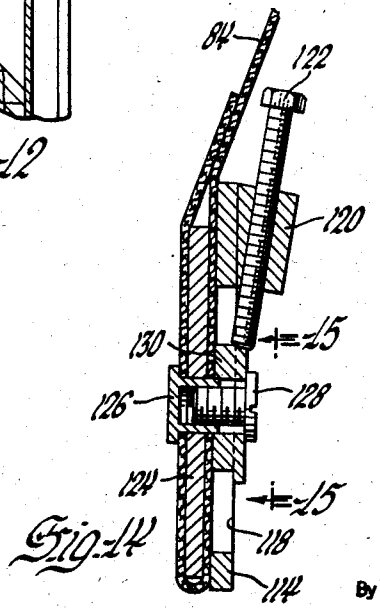


Fig. 14

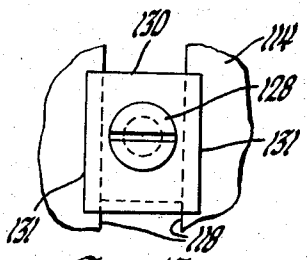


Fig. 15

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CONVERTIBLE TOP LINKAGE AND ACTUATING MEANS

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Application May 20, 1955, Serial No. 509,843

5 Claims. (Cl. 296—117)

This invention relates to a convertible top, and more particularly to a power actuated convertible top.

Heretofore, difficulties have frequently been encountered in power actuated convertible tops because of the large force output required of the power actuator to raise and unfold the top. The forces required have often been greater than the rated force output of the actuator, resulting in an overload on the actuator and frequent repairs. The overload on the actuator also causes an uneven and halting movement of the top out of the body and the top unfolds in spurts rather than the entire operation being smooth and continuous. The uneven movement of the top strains the top linkage and may even bend or break the linkage. In addition, modern styling of the rear quarter area of the body has lowered the body belt line so that the folded top must be stored much lower within the body than before. This increases the force required to raise and unfold the top.

In a convertible top, as in other linkage systems, the moments deteriorates kinetically or progressively decrease as the top is compressed to obtain a low stack height. This decrease of moments in the linkage system requires the power actuator to do more work for a given increment of top travel so that the forces required and the stresses imposed progressively increase. When the rate at which the top linkage requires work to be done is greater than the capacity of the actuator, the system stalls or becomes inoperable.

The improved convertible top of this invention reduces the amount of force required at any given point to operate the top and allows the power actuator to operate within its effective range of force output by delaying the unfolding of the top until the top has been moved to a position where less force is required to continue to raise the top. In addition, the improved top has a low stack height in folded position so that the top need not be stored as low within the body as previous tops despite modern styling of the rear quarter area of the body.

One of the chief reasons for the large forces required of the power actuator in many present convertible tops is that the top starts to unfold as it is being moved out of the body. This requires that the power actuator not only furnish force to raise the folded top out of the body but that it also furnish force to unfold the top at the same time, which overloads the power actuator. In most tops what is termed a "power arm" or a "power link" controls the folding and unfolding movement of the top. As the usual folded top is moved out of the vehicle body, the power arm starts to unfold the top when the top is in a position where a large amount of force is required to raise the top and before the top has been moved to a position where less force is required to raise the top and thus a greater portion of the force output of the actuator is available to unfold the top.

This invention provides mechanism for imparting a variable restraint on the action of the power arm so that unfolding of the top is delayed until the top has been raised to a position where less force is needed to continue

to raise the top. Thus, the unfolding movement of the top of this invention takes place at a controlled lower rate than in many present convertible tops and the power actuator operates within its effective range of force output at all times. If the work required during the cycle of top operation has peaks that approach the capacity of the actuator, the movement of the top will be erratic and the top will labor under the heavy stresses imposed upon it. The top mechanism of this invention levels off the work peaks to reduce the maximum force required of the actuator and the operating stresses in the linkage system. This ensures smooth and continuous movement of the top. The links of the system are located more nearly in co-planar relationship than in many present convertible tops to permit them to transmit operational forces under less stress and to provide a more efficient linkage system.

This invention also provides a convertible top having a low stack height. This is accomplished by mounting the rear bow on the vehicle body instead of on the top so that the folded top fits within the rear bow rather than on top of the bow. In addition, the invention also provides adjustment of the tension in the rear quarter area of the top fabric so that there are no wrinkles in the top fabric when the top is fully raised.

An object of this invention is to provide a new and improved power actuated convertible top. Another object of this invention is to provide a power actuated top which unfolds in a smooth and continuous manner as the top is raised. A further object of this invention is to provide adjustment of the tension in the rear quarter area of the fabric top. Yet another object of this invention is to provide a convertible top having a low stack height without sacrifice of low force requirements and smooth operation. A more specific object of this invention is to provide a variable restraint for the power arm or link controlling the folding and unfolding movement of a convertible top to reduce the force required of the power actuator to raise and unfold the top.

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

Figure 1 is a view of a convertible top according to this invention shown in raised position in solid lines and in folded position in broken lines;

Figure 2 is an enlarged top plan view of a portion of the top taken on the plane indicated by line 2—2 of Figure 1;

Figure 3 is an enlarged rear plan view of a portion of the top taken on the plane indicated by line 3—3 of Figure 1;

Figure 4 is an enlarged rear plan view of a portion of the top taken on the plane indicated by line 4—4 of Figure 1;

Figure 5 is a view of the controlling mechanism for one of the bows;

Figure 6 is a view taken on the plane indicated by line 6—6 of Figure 5;

Figure 7 is a view of the top in folded position within the vehicle;

Figure 8 is a view showing a modified rear bow with the top in raised position;

Figure 9 is a view of the modified rear bow with the top in folded position within the vehicle body;

Figure 10 is a view taken on the plane indicated by line 10—10 of Figure 8;

Figure 11 is an enlarged view of a portion of the top of Figure 9 in folded position;

Figure 12 is a view taken on the plane indicated by line 12—12 of Figure 8;

Figure 13 is a view taken on the plane indicated by line 13—13 of Figure 9;

Figure 14 is a view taken on the plane indicated by line 14—14 of Figure 8; and

Figure 15 is a view taken on the plane indicated by line 15—15 of Figure 14.

Referring now to Figures 1 through 4 of the drawings, a convertible vehicle **2** includes a windshield **4** and a windshield header **6**. The convertible top includes a pair of spaced foldable side rails, one rail being at each side of the vehicle, with each rail having a front rail section **8**, an intermediate rail section **10**, and a rear rail section **12**. The rails and associated structure at only one side of the vehicle will be described. A front header **14** secured to the front rail section **8** engages the windshield header in the raised position of the top, with suitable latches (not shown) being provided to detachably secure the front header to the windshield header. At its rearward end, the front rail section **8** is pivoted to the intermediate rail secion **10** at **15** with the hinge arrangement between these sections including an upstanding lug **16** secured to the intermediate rail section and fitting within a pair of similar lugs **17** (see Figure 2) secured to the front rail section. In addition, the rail sections are connected by links **18** and **20** pivoted together at **22**, with link **18** being pivoted on the front rail section at **24** and link **20** being pivoted on the intermediate rail section at **26**. A link **28** pivoted on link **20** at **30** and on the rear rail section **12** at **32** controls the folding movement of the front and intermediate rail sections.

The side rails at opposite sides of the vehicle are joined by transverse bows **34** and **36**, with bow **34** supported by the pivotal connection **22** and bow **36** pivoted on the rear rail section **12** at **37**. In addition, a rear bow **38** is pivoted on the body at **40**. This allows portions of the folded top to be stored within the rear bow, as can be seen in Figure 7, and reduces the stack height of the top. An arm **42** fixed to the intermediate rail section **10** is pivoted on the rear rail section **12** at **44** to interconnect the intermediate and rear rail sections.

Referring now particularly to Figures 1, 3, 4 and 7 the rear rail section **12** includes a flanged member **46** which is secured to an arm **48** having an offset portion **50**. A pair of flanged sheet metal members **52** secured together in back-to-back relationship are welded to arm **48** and member **46** and also to leg **53** of offset portion **50**. The sheet metal members include a pair of obliquely extending leg portions **54** and **56**, with leg portion **54** being pivotally mounted at **55** within bracket **58**, Figure 4, and leg portion **56** being bifurcated and secured at **59** to piston rod **60** of power actuator **62**. Bracket **58** is secured to the vehicle body and forms the main pivotal support of the covertible top.

A power arm **64** is pivoted at **66** to arm **42** and the lower end of the power arm is pivoted at **68** to bell crank **70**, Figure 7. Bell crank **70** is formed of a pair of flanged sheet metal members secured together in back-to-back relationship, Figure 4, and is fulcrumed on the offset portion **50** of arm **48** at **72**. The bell crank is pivoted at **74** to a link **76** which is pivoted at **78** to bracket **80**. Bracket **80** is bolted to the vehicle body at **82**, with slots **83**, Figure 4, being provided in the bracket for adjustment.

In many prior convertible tops, the power arm **64** is pivoted on the vehicle body and swings about this pivot to control the folding and unfolding movement of the top. Assuming that this were true in the subject top, as the top is lowered, the power arm would be in compression and act on arm **42** to break the alignment of rail sections **8**, **10**, and **12**, so that the rail sections would be folded by the linkage arrangement **18**, **20**, and **28** as the rear rail section is swung downwardly about the main pivot **55** to lower the top. Likewise, when the top would be raised, the power arm would be in tension and act on arm **42** to unfold and align rail sections **8**, **10**, **12** as the rear rail section **12** would be swung upwardly about pivot **55** to raise the top. During this initial movement of the folded top out of the vehicle body, a large amount of power would be required from the power actuator to raise the top. This would be particularly true in many convertible vehicles where the folded top is stored much lower within the body than before in order that the top will be below the modern lowered body belt line. Since the power actuator must also furnish power to unfold the top when it would be raised out of the body, an overload would be placed on the actuator so that the movement of the folded top would be very slow and halting and the unfolding of the top would take place in spurts rather than being a smooth and continuous operation.

In the top of this invention the power arm is not pivoted on the vehicle body but is pivoted on the bell crank **70**. The bell crank fulcrumed on the rear rail section and the swinging link **76** provide a variable restraint on the action of the power arm so that unfolding of the convertible top of this invention is delayed while the top is being moved to a position where less power is required of the power actuator to continue to raise the top.

Referring now to Figure 1, as the top is being lowered and the rear rail section **12** swings clockwise about the main pivotal support **55** on the body, the bell crank **70** is moved counterclockwise about its fulcrum on the rear rail section by the action of link **76**. This places the power arm in compression so that the top will be folded as it is lowered as described above. However, since link **76** swings in an arc, the counterclockwise movement of the bell crank is continuously variable. Thus, the compression which is placed in the power arm is also continuously variable and a variable restraint is placed on the action of the power arm to delay the folding movement of the top as it is lowered and allow the power actuator to operate within its effective range of power output. Link **76** must swing in an arc which is not concentric with the arc of movement of the bell crank fulcrum in order to place the power arm in compression as the top is folded. The entire movement of the bell crank about its fulcrum is defined by the arc of movement of the link **76**. Usually few difficulties are encountered in lowering and folding the top despite the fact that the power actuator has to supply power both to lower and fold the top. However, frequent difficulties are encountered when the folded top is raised out of the body as heretofore explained.

Referring now to Figure 7, as the folded top is raised out of the body, the bell crank is moved clockwise about its fulcrum on the rear rail section by link **76** to place the power arm in tension. The amount of tension placed in the power arm is variable as link **76** swings through its arc so that the unfolding of the top is delayed as the top is moved to a position where less power is required to continue to raise the top. Since the tension placed in the power arm is continuously variable, a variable restraint is placed on the action of the power arm.

As stated hereinbefore, the variable restraint on the action of the power arm is controlled by the arc of movement of link **76**. This arc of movement may also be defined in other suitable manners, such as by a cam channel, and the operation of the power arm will remain as already described.

Referring now to Figures 1, 5 and 6, the top also provides for control of the folded position of the front bow **34** so that the collapsible top fabric **84** will not be pinched in the folded position of the top as shown in Figure 7. The legs **86** of bow **34** include oblique arms **88** having pins **90** mounted thereon and extending inboard of the top. When the bow reaches folded position as shown in Figure 7, pin **90** engages the lower edge of link **18** to hold the bow in a substantially horizontal position so that the top fabric will not be pinched between the bow and the remainder of the folded top and the top will stack lower and more compactly.

Referring now to Figures 1 and 11, the folded position

of the rear bow 36 is also controlled by the top. A stud 92 mounted on arm 48 of the rear rail section 12 is engaged by cam surface 94 on the legs 96 of bow 36 to control the folded position of the bow as shown in Figure 11. A pad or blanket, not shown, is secured along each side of the top to the front header 14, bows 34, 36, and 38, and to the body. The top fabric 84 is placed over the pads and secured to the front header 14, bow 38, and to the body. Thus, as the top folds, the folding movement of bows 34 and 36 is controlled by these pads or blankets.

Referring now to Figures 8, 9, 10, and 12 through 15, the modified rear bow will be described. Like numerals have been used for like parts which have already been described. A pair of cam channels 98 are secured to either side of the vehicle body at 100. The modified rear bow 102 is of channel cross section, and a pair of rollers 104, Figures 10 and 12, mounted on the legs of the bow at 106 are slidably and pivotally mounted within cam channels 98. A link 108 pivoted to each leg of the bow at 106 and pivotally secured at 110 to bracket 112 mounted on the rear rail section 12 provides the power for moving the bow between raised and lowered positions. Thus, the sliding movement of the bow is controlled by both the cam channels and the links 108 and the pivotal movement of the bow is controlled by the top fabric 84 which is secured to the upper portion of the bow. This modified rear bow allows the folded top to be stored within the bow rather than on top of the bow and thus reduces the stack height of the folded top.

In conjunction with the modified rear bow, the convertible top also includes an adjustment of the tension in the rear quarter area of the top fabric to prevent the fabric from wrinkling when the top has been raised. Referring now particularly to Figures 9, 12, and 14, brackets 114 are welded within bow 102 at 116 to reinforce the bow in the area of pivot 106. Each bracket has a central slot 118, and a threaded lug 120 secured to the bracket adjacent the upper edge of the slot mounts a bolt 122. The lower edge of the top fabric 84 is reinforced by a stiffener 124 of kraft board or other suitable material and a barrel nut 126 extends through the top fabric and the stiffener. A bolt 128 mounted on slide 130 fits within the barrel nut. Slide 130 has shouldered edges 131 engaging the sides of the slot to prevent disengagement of the slide from within the slot. If it is desired to adjust the tension in the rear quarter area of the fabric when the top is raised, the bolt 122 is adjusted to adjust the position of slide 130 in slot 118 and adjust the tension in the top fabric.

Referring now to Figure 13, a weather strip 132 is mounted on the body by means of an offset bracket 134 secured to the inner body panel 136 and a molding strip 138 of channel cross section fitting over the marginal edges of the inner body panel and the outer body panel 140. The weather strip extends entirely around the rear portion of the body and terminates slightly forward of the rear rail section 12 when it is in raised position, as shown in Figure 1. The weather strip has a finger portion 142 which is engaged by the top fabric in raised position to provide a seal between the fabric and the body.

The fabric is secured to the upper portion of bow 102 and also to the rear portion of the body. A channel 144 secured to the inner body panel 136 extends around the rear portion of the body and terminates approximately at line 13—13, Figure 9. The top fabric is secured to this channel by a tacking strip 146. Thus, when the top is in raised position, the rear portion of the top is in tension between bow 102 and the body, and the tension in the rear quarter portion of the top is controlled by slide 130 as hereinbefore described. A gutter 148 secured to the inner body panel extends around the rear portion of the body and collects any moisture which enters the body between the weather strip and the fabric top. The gutter is recessed within the body in the areas of the cam channels 98, as can be seen in Figure 12, and terminates slightly forward of the rear bow in raised position, Figure 1.

Thus, this invention provides a new and improved power actuated convertible top which folds and unfolds in a smooth and continuous manner and has a low stack height. The variable restraint on the power arm allows the power actuator to operate within its effective range of power output without any overload to reduce the necessity for frequent repairs to the actuator and the top linkage.

While specific embodiments of this invention have been shown and described, various changes and modifications may be made within the scope and spirit of the invention.

We claim:

1. In a convertible vehicle body, the combination comprising, a foldable top frame including a rear rail section, means swingably mounting said rear rail section on said body to mount said top thereon for movement between raised and lowered positions, operating means for so moving said top frame, power arm means pivotally connected adjacent one end thereof to said top frame for controlling the folding and unfolding movement thereof, lever means pivoted on said rear rail section at a point spaced radially from the pivot of said rear rail section on said body for swinging movement of said lever means with said rail section and swinging movement thereon, means pivotally interconnecting said lever means and said power arm means adjacent the other end of said power arm means, link means swingably mounted on said body at a point spaced radially from the pivot of said rear rail section on said body for swinging movement in the same direction as said rear rail section and in a different arc than said lever means, and means pivotally connecting said link means to said lever means to control swinging movement of said lever means about its pivot on said rear rail section upon swinging movement of said rail section and lever means about the pivot of said rail section on said body, the several pivots of said lever means and link means and the length of said link means being arranged such that said link means biases said lever means in an opposite direction about the pivot thereof on said rear rail section than the direction of swinging movement of said rear rail section to thereby place a variable restraint upon the action of said power arm means.

2. In a convertible vehicle body, the combination comprising, a foldable top frame including a rear rail section, means swingably mounting said rear rail section on said body to mount said top thereon for movement between raised and lowered positions, operating means for so moving said top frame, power arm means pivotally connected adjacent one end thereof to said top frame for controlling the folding and unfolding movement thereof, lever means pivoted on said rear rail section at a point spaced radially above the pivot of said rear rail section on said body for swinging movement of said lever means with said rail section and swinging movement thereon, means pivotally interconnecting said lever means and said power arm means adjacent the other end of said power arm means, link means pivotally mounted on said body at a point spaced radially below the pivot of said rear rail section on said body for swinging movement in the same direction as said rear rail section and in a different arc greater than the arc of swinging movement of said lever means, and means pivotally connecting said link means to said lever means to control swinging movement of said lever means about its pivot on said rear rail section upon swinging movement of said rail section and lever means about the pivot of said rail section on said body, the several pivots of said lever means and link means and the length of said link means being arranged such that said link means biases said lever means in an opposite direc-

tion about the pivot thereof on said rear rail section than the direction of swinging movement of said rear rail section to thereby place a variable restraint upon the action of said power arm means.

3. In a convertible vehicle body, the combination comprising, a foldable top frame including a rear rail section, means swingably mounting said rear rail section on said body to mount said top thereon for movement between raised and lowered positions, power operating means for so moving said top frame, a power arm pivotally connected adjacent one end thereof to said top frame for controlling the folding and unfolding movement thereof, a bell crank lever pivoted on said rear rail section at a point spaced radially above the pivot of said rear rail section on said body for swinging movement of said lever with said rail section and swinging movement thereon, means pivotally interconnecting said lever and said power arm adjacent the other end of said power arm, a link swingably mounted on said body at a point spaced radially below the pivot of said rear rail section on said body for swinging movement in the same direction as said rear rail section and in a different arc greater than the arc of swinging movement of said lever, and means pivotally connecting said link to said lever to control swinging movement of said lever about its pivot on said rail section upon swinging movement of said rail section and lever about the pivot of said rail section on said body, the pivots of said lever to said power arm and link being aligned with the pivot of said link on said body in the raised position of said top frame and being arranged with the length of said link such that said link folds relative to said lever and biases said lever in an opposite direction about the pivot thereof on said rear rail section than the direction of swinging movement of said rear rail section to thereby place a variable restraint upon the action of said power arm upon movement of said top frame from said raised position.

4. In a convertible vehicle having a foldable top frame supported by the vehicle for movement between raised and lowered positions, the combination comprising, a transverse bow, channel means mounted on the vehicle and defining a rearwardly extending curvilinear path, guide means secured to said bow and being pivotally and slidably mounted in said channel means to provide the sole support of said bow on said vehicle, and

means interconnecting said bow and said top frame and providing the sole means for moving said bow rearwardly along said channel means to a lowered position upon movement of said top frame to a lowered position to thereby allow said top frame to be stored forwardly of and within said bow.

5. In a convertible vehicle, the combination comprising, a foldable top frame supported by said vehicle for movement between raised and lowered positions, a collapsible top supported by said top frame, a transverse rear bow including an upper portion and depending leg portions, channel means mounted on said vehicle and defining a rearwardly extending arcuate path, guide means secured to the legs of said bow and being pivotally and slidably mounted in said channel means and providing the sole support of said bow on said vehicle, means interconnecting the leg portions of said bow and said top frame and providing the sole means for moving said bow rearwardly along said channel means to a lowered position when said top frame is moved to a lowered position to allow said top frame to be stored forwardly of and within said bow, means securing said collapsible top to the upper portion of said bow, and means interconnecting said collapsible top and the legs of said bow for adjustably securing said collapsible top to said bow whereby the tension in said collapsible top between the upper portion of said bow and the legs thereof may be adjusted in the raised position of said bow to provide a smooth appearance to said collapsible top.

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