Oct. 15, 1968 F. J. DOKA 3,405,970

CONVERTIBLE TOP CONTROL LINKAGE

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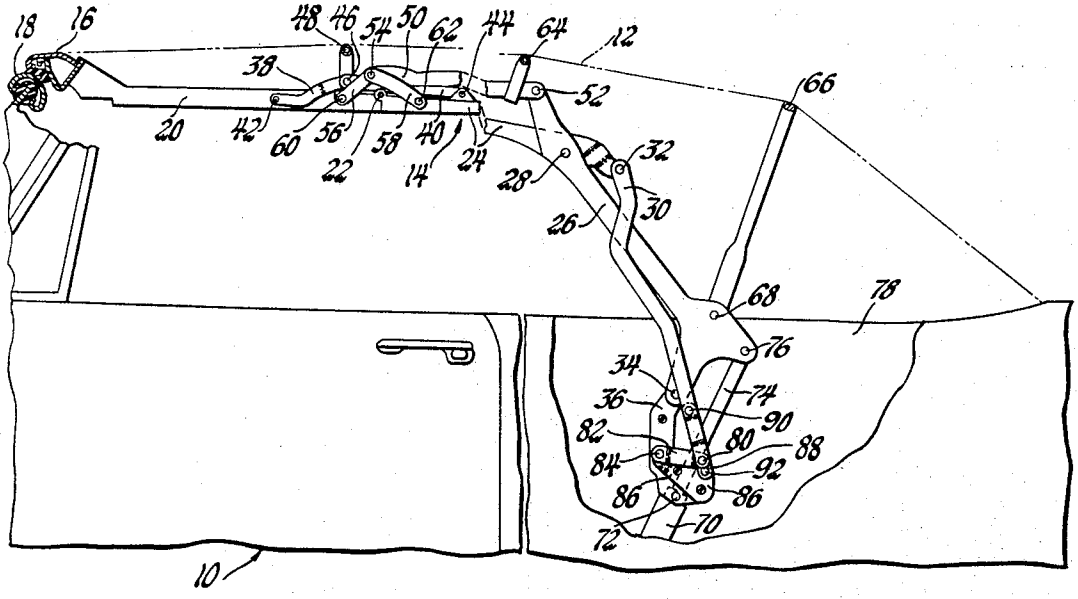


Fig. 1

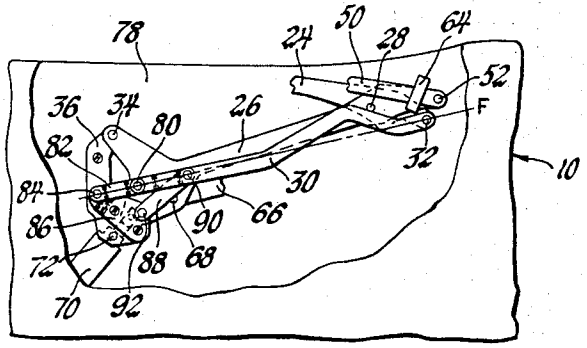


Fig. 2

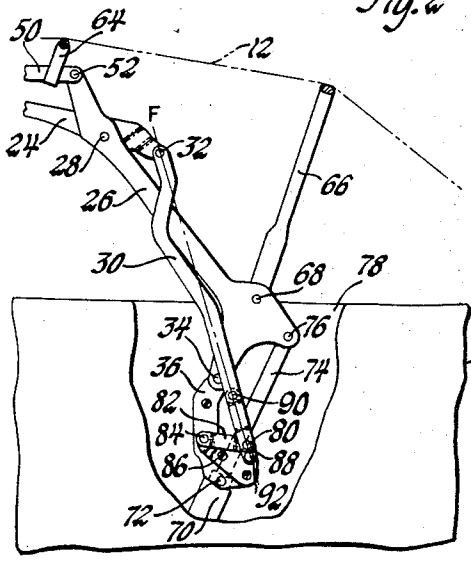


Fig. 4

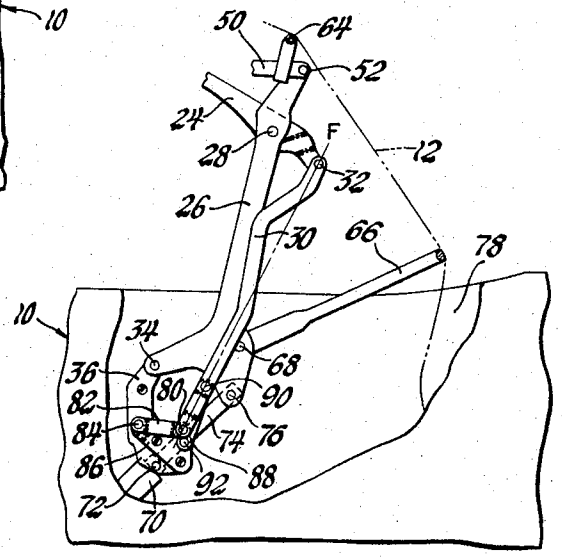


Fig. 3

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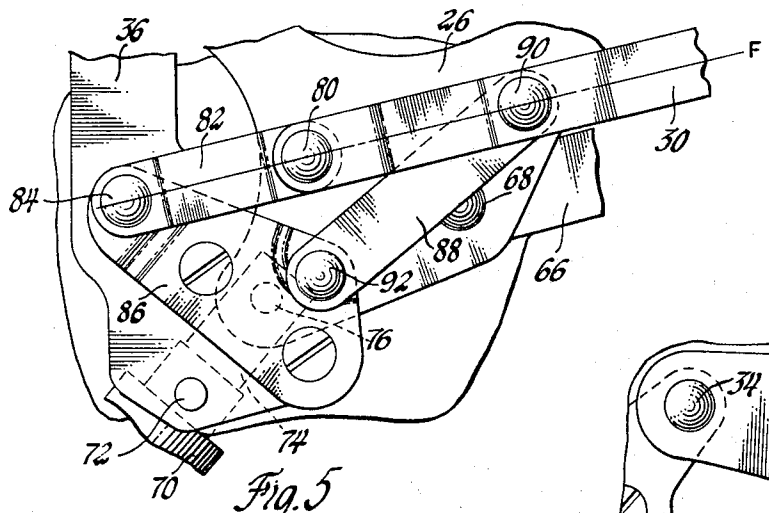


Fig. 5

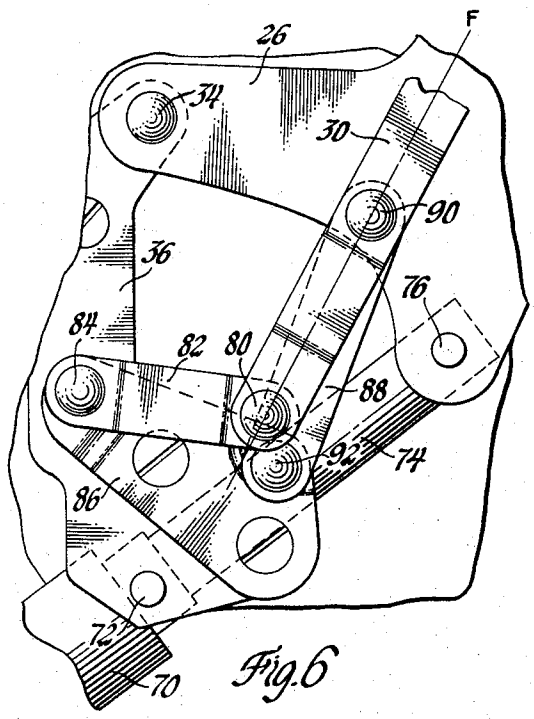


Fig. 6

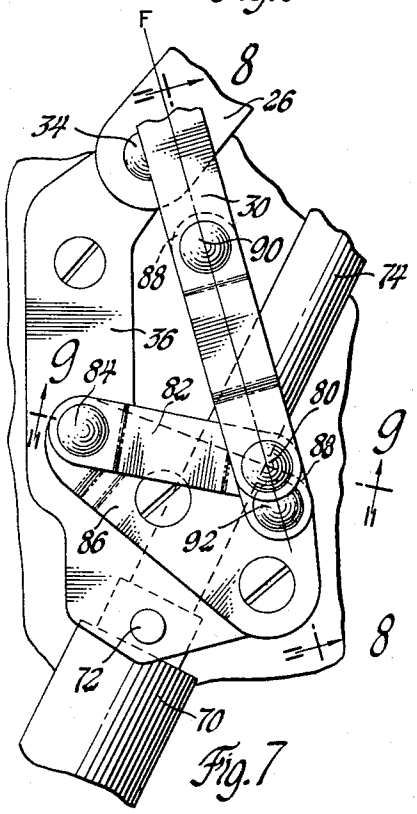


Fig. 7

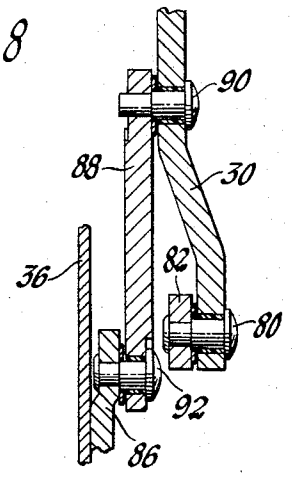


Fig. 8

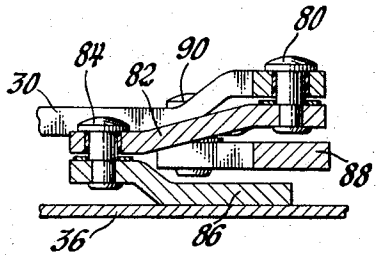


Fig. 9

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CONVERTIBLE TOP CONTROL LINKAGE

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ABSTRACT OF THE DISCLOSURE

A control linkage is provided for moving a convertible top power arm relative to the rear rail to place a variable restraint on the power arm and delay unfolding of the top until the top has been substantially raised.

In conventional power actuated convertible tops, the actuator is required to initiate unfolding of the top while raising the top out of the storage well. This requires a high initial force from the actuator until the top has been raised out of the well and partially unfolded. The high initial force requirement necessitates the use of a high force output actuator to prevent straining and damaging of the actuator. This problem is often aggravated by vehicle styling which necessitates that the top be stored in a much lower position within the storage well than heretofore.

As soon as the top is substantially raised and the unfolding movement initiated, the force requirement of the actuator sharply decreases. Thus, an actuator having an extremely high force output is required during only a small portion of the movement of the top toward raised position.

This invention provides an improved and simplified control linkage which substantially delays the unfolding of the top until the top has been substantially raised, thus reducing the peak force requirement and enabling the use of a lower force output actuator than heretofore.

One feature of this invention is that it provides a control linkage for a power operated convertible top which moves the power arm relative to the rear rail during top raising movement to place a variable restraint on the power arm and substantially delay the unfolding of the top until it has been moved to a substantially raised position by the power actuator.

Another feature is that the control linkage moves the power arm body pivot away from the rear rail body pivot to increase the restraint on the power arm as raising movement of the top progresses and place a more even force requirement on the actuator during raising movement.

Yet another feature is that the control linkage comprises a first link pivotally interconnecting the lower end of the power arm and the body at a first point spaced from the rear rail body pivot and a second link pivotally interconnecting an intermediate portion of the power arm and the body at a second point spaced further from the rear rail body pivot than the first point, the effective body pivot of the power arm being moved from the first point to the second point during raising movement of the top to substantially delay top unfolding.

These and other features of this invention will become readily apparent upon reference to the following detailed description of the attached drawings in which:

FIGURE 1 is a partially broken away view of a convertible vehicle top having a control linkage according to this invention, with the top shown in raised position;

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

FIGURE 3 is a partial view of the top in partially raised position;

FIGURE 4 is a view of a portion of FIGURE 1;

FIGURE 5 is an enlarged view of a portion of the control linkage sghown in a position corresponding to that of FIGURE 2;

FIGURE 6 is a view similar to FIGURE 5 showing the control linkage in a position corresponding to that of FIGURE 3;

FIGURE 7 is a view similar to FIGURE 5 showing the control linkage in a position corresponding to that of FIGURE 4;

FIGURE 8 is a sectional view taken generally on the plane indicated by line 8—8 of FIGURE 7; and

FIGURE 9 is a sectional view taken generally on the plane indicated by line 9—9 of FIGURE 7.

Referring now to FIGURE 1 of the drawings, a vehicle body **10** mounts a fabric top **12** which is supported by a top frame structure **14**. Only the right-hand portion of frame structure **14** is shown and will be described, but it is understood that a symmetrical left-hand portion is included.

Frame structure **14** includes a top header **16** which may be conventionally latched to the windshield header **18** in the top raised position. Header **16** mounts a front side rail **20** which is pivotally attached at **22** to a rear side rail **24**. Side rail **24** is pivoted to a rear rail **26** at **28** and to a power arm **30** at **32**. The lower end of rear rail **26** is pivoted at **34** to a body-mounted bracket **36**. The lower end of power arm **30** is mounted on the body by a control linkage according to this invention, which will be later described.

A pair of links **38** and **40** are pivoted to respective side rails **20** and **24** at **42** and **44**, and are mutually pivoted at **46** to a front top supporting bow **48**. A link **50** is pivoted at **52** to the upper end of rear rail **26** and at **54** to a pair of links **56** and **58** which are pivoted at **60** and **62** to side rails **20** and **24**, respectively. Link **50** mounts an intermediate bow **64**, while rear rail **26** pivotally supports a rear bow **66** at **68**.

A conventional power actuator **70** is pivoted to bracket **36** at **72** and includes an actuator arm or rod **74** that is pivoted at **76** to a portion of rear rail **26**. Rod **74** is retractable to rotate rear rail **26** clockwise about pivot **34** to lower the top frame structure into body storage well **78**. This movement puts power arm **30** in compression to effect folding of the top frame structure, with links **38, 40, 50, 56** and **58** pivoting side rail **20** clockwise about pivot **22** for folding on top of side rail **24** within well **78**, as partially shown in FIGURE 2.

The top structure **14** may be raised from the FIGURE 2 position by extending rod **74** to pivot rear rail **26** counterclockwise about pivot **34**. The top structure **14** will then move through the partially raised position shown in FIGURE 3, to the fully raised position shown in FIGURES 1 and 4.

In convertible top structure of this type, the force requirements placed on the actuator emanate from two sources. The first is the force required to raise the top out of the storage well against the force of gravity. The second is the force required to unfold the top which is transmitted to the actuator by the power arm through the rear side rail and the rear rail.

In conventional convertible tops, unfolding of the frame structure is initiated immediately upon raising movement, thus placing a high initial force requirement on the power actuator to both raise and unfold the top frame structure. This high force requirement continues until the top has been moved to a partially raised position in which the weight of the top frame structure is over the rear rail pivot. Thereafter the gravity force requirement sharply decreases, with the actuator required only to exert sufficient force to further unfold the top frame structure.

It is therefore desirable to reduce the high initial force requirement and place a lower, more constant force requirement on the power actuator so that a lower force output actuator may be used without straining and damage and a smoother top raising movement effected.

One mode of reducing the high initial force requirement is to substantially delay the unfolding of the top frame structure until the structure has been moved to a substantially raised position. Thus the actuator is not required to unfold the structure until the raising force decreases to a point where the actuator output may be diverted to unfolding without strain and damage.

This is accomplished by pivotally connecting the lower end of the power arm to the body by a control linkage according to this invention, as will now be described with reference to FIGURES 5 through 9.

As best seen in FIGURE 5, the lower end of power arm **30** is pivoted at **80** to a first control link **82** which is pivoted at **84** to a bracket **86** conventionally mounted on bracket **36**. A second control link **88** is pivoted to power arm **30** at **90** and to bracket **86** at **92**.

Referring now to FIGURES 2 and 5, the output force of the actuator **70** acts through power arm **30** and is represented by a force denoted F which acts along a line extending between pivots **32** and **80** at a lever arm measured perpendicularly from rear rail body pivot **34**. The greater the lever arm at which force F acts, the greater will be the restraint on the power arm **30** and the force requirements of actuator **70**. In the top lowered position, the line of force F passes through pivot **84** of link **82**.

As the top is raised from the FIGURES 2 and 5 position to the FIGURES 3 and 6 position, rear rail **26** effects a counterclockwise movement of power arm **30** about pivot **90** and pivots link **88** about pivot **92**. During this movement link **82** pivots clockwise about its pivot **84**, thus moving pivot **80** clockwise thereabout and counterclockwise relative to pivot **90** at a fairly rapid rate until top structure **14** reaches the partially raised position of FIGURES 3 and 6 in which the line of force F is intermediate pivots **84** and **92**.

From the FIGURES 3 and 6 position to the fully raised position of FIGURES 4 and 7, pivot **80** swings a small increment of distance at a slowed rate until, in the fully raised position, the line of force F extends through pivot **92**. Throughout this movement, links **82** and **88** are placed in tension by power arm **30**.

If power arm **30** were fixedly pivoted at **84**, the low restraint point, without the control linkage of this invention, insufficient restraint would be placed on actuator **70** to fully unfold the top frame structure. If power arm **30** were conventionally fixedly pivoted at **92**, the high restraint point, unfolding would begin simultaneously with top raising, thus placing a high initial force requirement on the actuator.

Links **82** and **88** swing pivot **80** away from rear rail pivot **34**, thus shifting the effective body pivot point of power arm **30** from pivot **84** to pivot **92** to lengthen the lever arm of force F and increase the restraint on the power arm. During the initial top raising movement from the FIGURES 2 and 5 position to the FIGURES 4 and 7 position, power arm **30** rapidly increases the unfolding force requirement placed on actuator **70** from a low initial point. During this time the actuator output is sufficient to raise the top frame structure without overload of actuator **70**. Between the FIGURES 3 and 6 position and the FIGURES 4 and 7 position, when the raising force requirement has decreased, the unfolding force requirement reaches a peak as the maximum restraint is placed on power arm **30** by the linkage to effect most of the unfolding of the structure.

It is thus seen that control links **82** and **88** provide complete unfolding of the top frame structure, while substantially delaying this unfolding until the structure has been raised to a point where the raising force required of actuator **70** has been substantially reduced. The control linkage variably restrains the power arm **30** to more evenly distribute the force requirements placed on the actuator **70** throughout the raising movement and permits the use of a much lower output actuator than in conventional convertible tops.

Lowering and folding of the top occurs in the reverse sequence to that just described, with links **82** and **88** swinging power arm **30** from an effective pivot at **92** to an effective pivot at **84**.

Although only a preferred embodiment of this invention has been shown and described, obvious modifications thereof are contemplated within the scope of this invention.

I claim:

1. In combination with a convertible vehicle body having a foldable top frame structure movable between raised and lowered positions and including a rear rail pivoted at one end to the body, operating means for swinging the top frame structure between raised and lowered positions, and a power arm having one end pivoted to the top frame structure and operable to place a restraint on the operating means to effect unfolding of the top frame structure during raising movement thereof, the improvement comprising, linkage means independent of the rear rail one end pivotally interconnecting the other end of the power arm and the body for swinging movement relative to the rear rail body pivot, the linkage means swinging the other end of the power arm away from the rear rail body pivot independently of movement of the rear rail one end upon raising movement of the top to place a variable restraint on the power arm and substantially delay the unfolding of the top frame structure until the structure has been substantially raised.

2. The combination according to claim **1**, wherein the linkage means include a first link pivoted to the end of the power arm and pivoted to the body at a first pivot point spaced from the rear rail body pivot, and a second link pivoted to an intermediate portion of the power arm and pivoted to the body at a second pivot point spaced from the first pivot point and from the rear rail body pivot, the power arm being effectively pivotable about the first pivot point in the lowered position of the top frame structure and being effectively pivotable about the second pivot point in the raised position of the top frame structure, the links being operable to swing the power arm lower end during raising movement of the top frame structure to shift the effective pivot point of the power arm lower end from the first point to the second point, thus reducing the initial force required of the operating means to unfold the structure during raising movement thereof.

3. The combination according to claim **1**, wherein the linkage means includes a pair of links pivotally interconnecting spaced pivot points on the power arm and spaced pivot points on the body, the pivot points of one link being aligned with the power arm pivot point of the other link in one position of the top frame structure.

4. The combination according to claim **3**, wherein the pivot points of one of the links are aligned with the power arm pivot point of the other link in the raised position of the top frame structure, and the pivot points of the other link are aligned with the power arm pivot point of the one link in the lowered position of the top.

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