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[54] **BIASED HINGES**

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[22] Filed: **Aug. 29, 1979**

Related U.S. Patent Documents

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Issued: **Mar. 20, 1973**
Appl. No.: **744,268**
Filed: **Jun. 17, 1968**

U.S. Applications:

[63] Continuation-in-part of Ser. No. 689,390, Dec. 11, 1967.

[51] **Int. Cl.**³ **E05D 7/00**

[52] **U.S. Cl.** **16/293**

[58] **Field of Search** .... 16/128 R, 145, 180, 16/184, 150, DIG. 13; 24/173; 223/93

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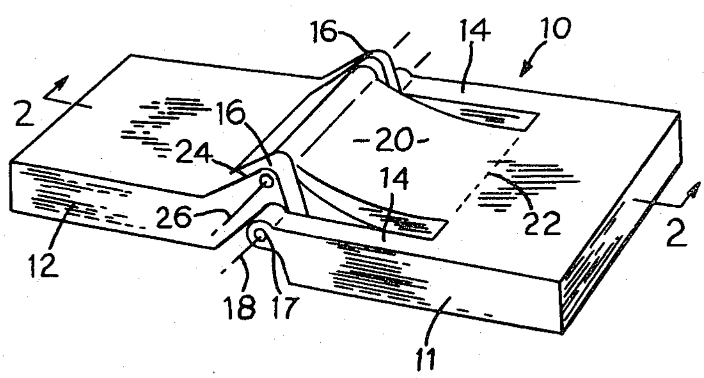
Primary Examiner—Doris L. Troutman
Attorney, Agent, or Firm—Kane, Dalsimer, Kane, Sullivan and Kurucz

[57] **ABSTRACT**

A snap-hinge in which two hinge members are hinged together about a first hinge line. A resilient connecting link is joined at one end integrally to one of the hinge members at a second hinge line and is hinged at the other end to the other hinge member at a third hinge line. The connecting link is capable either of compression or [of expansion] *deformation* as between its two ends, and tends to maintain the hinge members in a given angular relationship, and to return the hinge members to that relationship if they depart from it.

15 Claims, 22 Drawing Figures



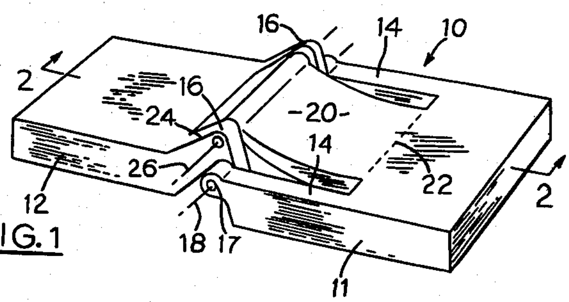


FIG. 1

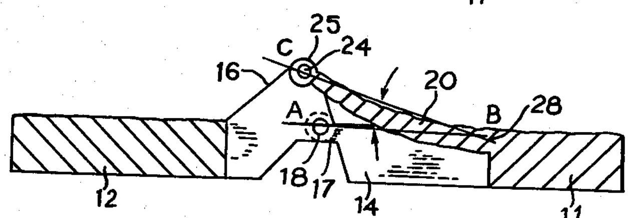


FIG. 2

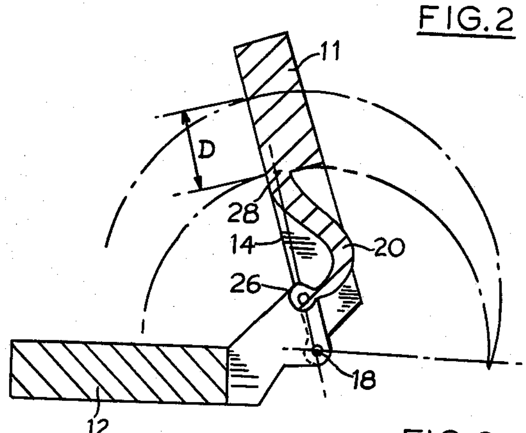


FIG. 3

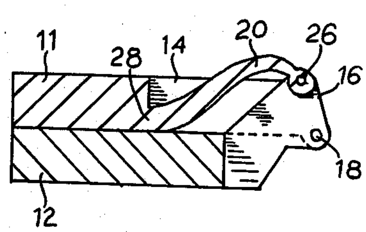


FIG. 4

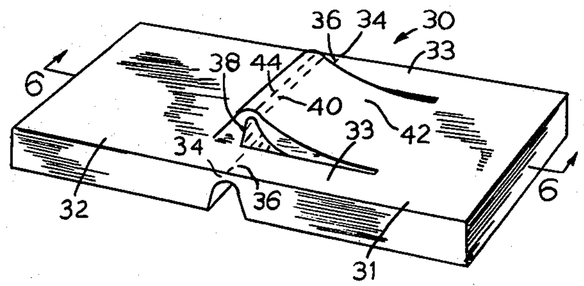


FIG. 5

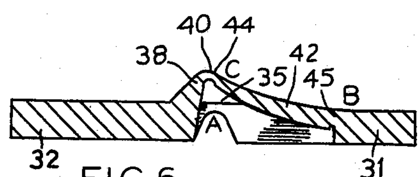


FIG. 6

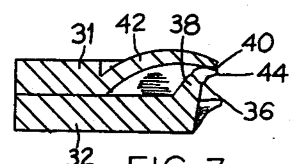


FIG. 7

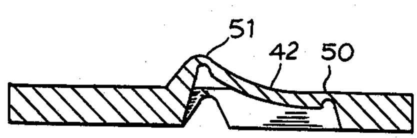
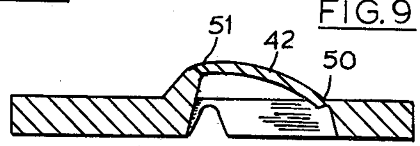


FIG. 8

FIG. 9



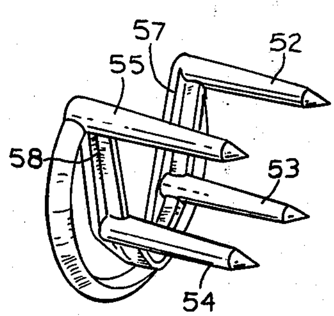


FIG. 10

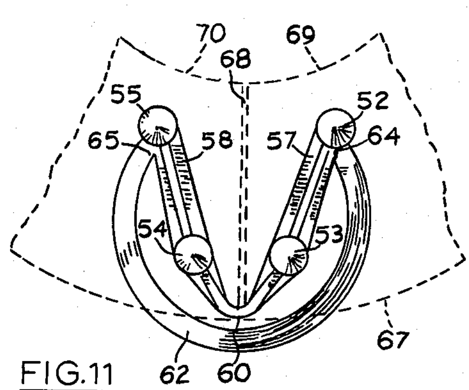


FIG. 11

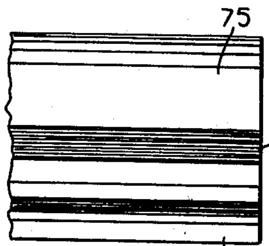


FIG.12

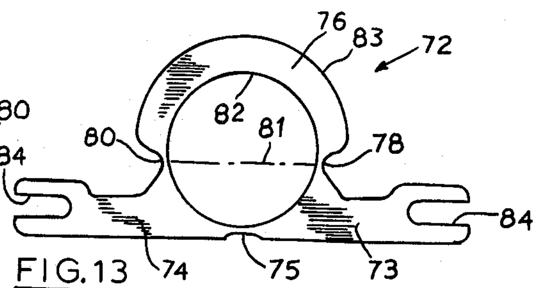


FIG.13

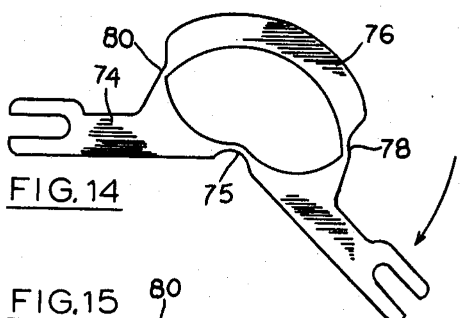


FIG.14

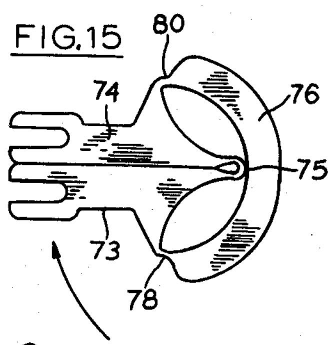


FIG.15

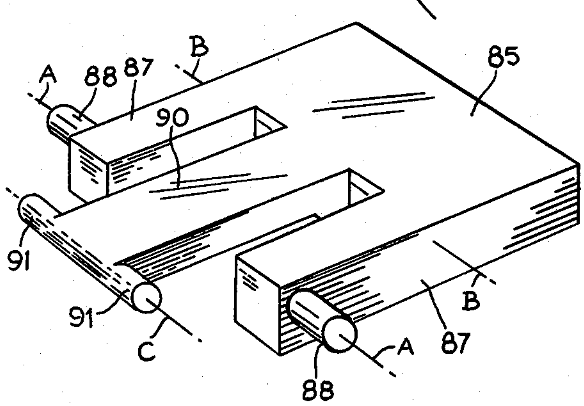


FIG.16

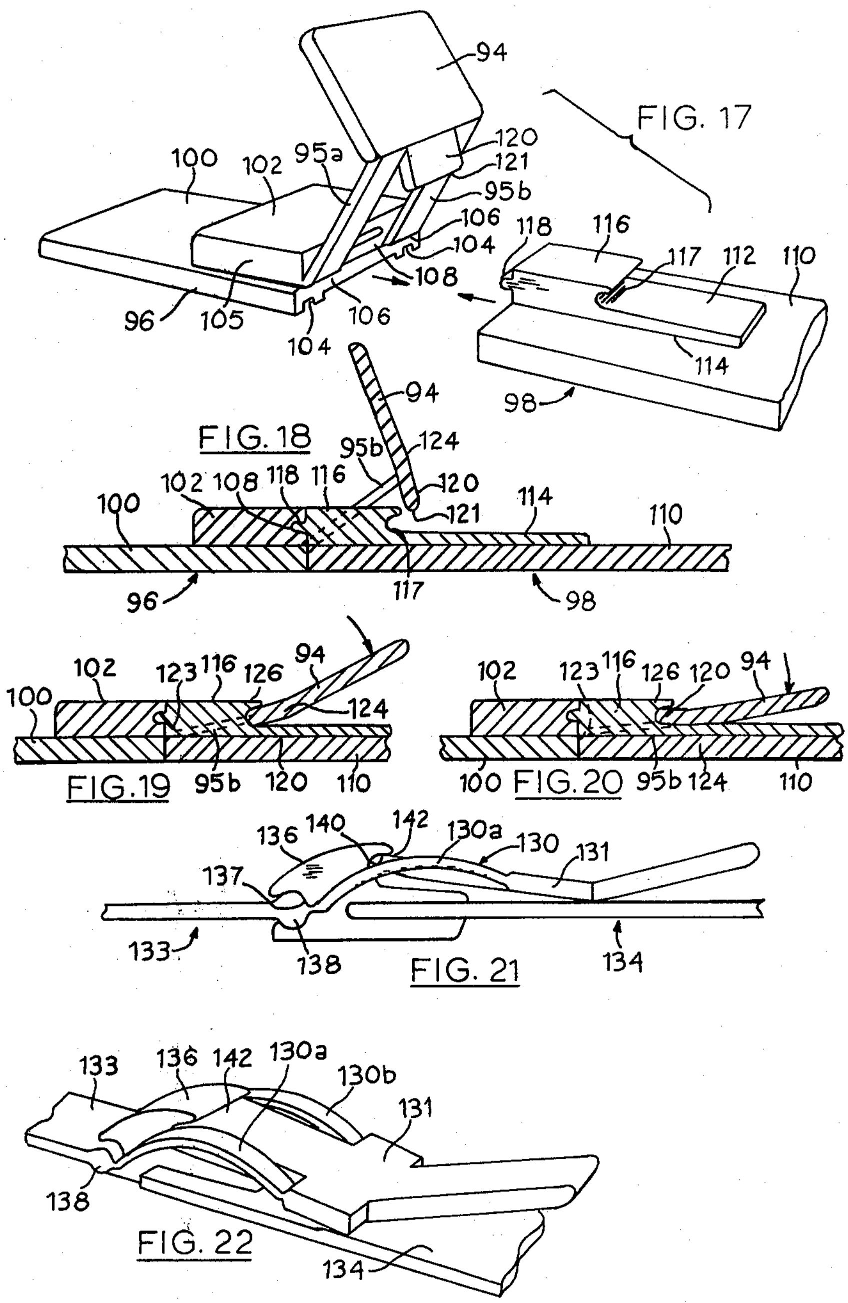


FIG. 17
94
120
121
95b
106
104
108
100
102
95a
105
96
106
104
118
116
117
112
110
114
98
FIG. 18
94
124
95b
120
121
102
108
118
116
114
110
100
96
117
98
FIG. 19
102
123
116
126
94
124
100
95b
120
110
FIG. 20
102
123
116
126
120
94
100
95b
124
110
FIG. 21
136
140
142
130a
130
131
137
133
138
134
FIG. 22
133
136
142
130a
130b
131
138
134

BIASED HINGES

Matter enclosed in heavy brackets [ ] appears in the original patent but forms no part of this reissue specification; matter printed in italics indicates the additions made by reissue.

This application is a continuation-in-part of U.S. application, Ser. No. 689,390, "Improvements in Biased Hinges," filed Dec. 11, 1967, Alois A. Krawagna.

This invention relates to biased hinges, or "snap-hinges" as they are sometimes called, in which the hinge tends to hold itself in a closed position and/or an open position.

Snap-hinges of the type to which this invention relates include two hinge members hinged to one another, and a biasing member extending between and hinged to both hinge members at points spaced from the hinge line between the hinge members. In accordance with the invention, two basic types of biasing member can be utilized: the first is a biasing member adapted to undergo compression as between its two ends; the second is a biasing member adapted to undergo [expansion] *deformation* as between its two ends. With regard to both the compression and the [expansion] *deformation* types of biasing members, this invention provides that at least one end of the biasing member be integral with its particular hinge member.

In accordance with one embodiment of this invention, the two hinge members are pivoted together, and the biasing member is adapted to undergo compression. The biasing member is pivoted to one of the hinge members but integral with the other. This permits the hinge member with which the biasing member is integral to be moulded as a single unit adapted for use with one of a variety of rigid members constituting the other hinge member.

In accordance with the second embodiment of this invention, the two hinge members are integral with one another through a web constituting the hinge line about which the hinge members articulate, and the biasing member is integral with one of the hinge members through a web constituting a second hinge line, and is integral with the other hinge member at a point constituting a third hinge line, the biasing member being adapted to undergo compression. With this arrangement, the compression force on the biasing member tends to urge the two hinge members away from one another when the hinge is articulated. This feature is particularly advantageous in that it places the web portion joining the two hinge members in tension, and avoids the danger of shearing which accompanies compression in the web.

In accordance with a fourth embodiment of this invention, there is provided a one-piece, integral snap-hinge wherein the biasing member undergoes [expansion] *deformation*, the two hinge members being connected through an integral web constituting the hinge line about which the hinge members articulate. The biasing member has its opposite ends integral with the two hinge members through webs constituting further hinge lines. The further hinge lines are spaced from the first hinge line.

In accordance with a forth embodiment of this invention, there is provided a snap-hinge in which one of the hinge members consists of two separate but interlocking parts. The other hinge member is a one-piece unit, and

the construction of the whole is such that the biasing member links the one-piece hinge member with one part of the other hinge member, and the one-piece hinge member is adapted to engage the other part of the other hinge member to hold the two parts firmly in interlocking engagement with one another. The one-piece hinge member can be removed from engagement with the other part, thereby permitting the two parts of the two-part hinge member to be separated completely from one another.

This invention also provides a method for making by the extrusion method a snap-hinge in which the biasing member undergoes [expansion] *deformation.*

Specifically, this invention provides a snap-hinge, comprising: a first hinge member, a second hinge member hinged to said first hinge member about a first hinge line, a resilient connecting link joined at one end integrally to said first hinge member at a second hinge line and hinged at the other end to said second hinge member at a third hinge line, the resilient connecting link tending resiliently to maintain its two ends apart at a given spacing, said second hinge line being spaced at an invariable distance from said first hinge line, said third hinge line being spaced at an invariable distance from said first hinge line, the snap-hinge having a position in which stress in the connecting link is at a minimum, the snap-hinge being at rest in said position, a small departure from which increases the stress in the connecting link, which tends to restore the snap-hinge to said position.

The embodiments of this invention are shown in the accompanying drawings, in which like numerals denote like parts throughout the several views, and in which:

FIG. **1** is a perspective view of one embodiment of this invention;

FIG. **2** is a sectional view taken along the line **2**—**2** in FIG. **1**;

FIG. **3** is a sectional view of the hinge shown in FIG. **2**, with one hinge member hinged to an intermediate position with respect to the other hinge member;

FIG. **4** is a sectional view of the hinge shown in FIGS. **2** and **3**, with the hinge members closed together;

FIG. **5** is a perspective view of the second embodiment of this invention;

FIG. **6** is a sectional view taken at the line **6**—**6** in FIG. **5**;

FIG. **7** is a sectional view of the hinge shown in FIG. **5**, with the hinge members closed against one another;

FIG. **8** and **9** show two modifications of the second embodiment of this invention;

FIG. **10** is a perspective view of one form of the third embodiment of this invention;

FIG. **11** is a frontal view of the embodiment shown in FIG. **10**;

FIG. **12** is an elevational view of an extruded form of the third embodiment of this invention;

FIG. **13** is a cross-sectional view of the extruded third embodiment shown in FIG. **12**;

FIG. **14** is a view similar to FIG. **13**, showing the two hinge members at an intermediate angular position;

FIG. **15** is a view similar to FIGS. **13** and **14**, showing the two hinge members closed against one another;

FIG. **16** is a perspective view of a special form of the first embodiment of this invention;

FIG. **17** is a perspective view of one variant of the fourth embodiment of this invention, showing the two portions of the two-part hinge member in spaced relation;

FIG. **18** is a vertical, longitudinal sectional view of the embodiment shown in FIG. **17**, with the two portions of the two-part hinge member engaged with one another;

FIG. **19** is a view similar to FIG. **18**, showing the locking hinge member at its balance point, about to be urged to the over-toggled locking position;

FIG. **20** is a view similar to FIGS. **18** and **19**, showing the locking hinge member in the locked position;

FIG. **21** is an elevational view of another variant of the fourth embodiment of this invention, wherein the biasing member is bowed in order to increase its capacity for expansion; and

FIG. **22** is a perspective view of the variant shown in FIG. **21**.

FIG. **1** shows a hinge **10**, generally comprising a first hinge member **11** and a second hinge member **12**. The first hinge member **11** has two parallel arms **14** extending leftwardly from the hinge member **11**, the arms **14** being rigid with respect to the hinge member **11**. The second hinge member **12** has two rightwardly protruding appendages **16**, which are rigid with respect to the hinge member **12**. The arms **14** each carry a pivot pin **17** (only one visible in FIG. **1**) by which the arms **14** are pivoted to the appendages **16**. Thus, the second hinge member **12** is hinged to the first hinge member **11** about a first hinge line **18**, which constitutes the common axis of the pins **17**. The first hinge member **11** has a resilient connecting link **20** integral therewith between the arms **14**, and extending leftwardly toward the second hinge member **12**. It will be noted that the location **22** at which the resilient connecting link **20** is integral with the hinge member **11** is spaced from the first hinge line **18**.

The resilient connecting link **20** has a pin **24** passing therethrough at its left-hand end, and the ends of the pin **24** are pivoted to the appendages **16** at a location spaced from the first hinge line **18**. The axis of the pin **24** constitutes a second hinge line **26**. It is essential to this invention that the first and second hinge lines **18** and **26** be spaced rigidly from one another.

Turning now to FIG. **2**, it will be seen that the right-hand end of the connecting link **20** is rigidly integral with the first hinge member **11**, since the connecting link **20** does not decrease in thickness to form a flexible web where it joins the hinge member **11**. By comparison, a glance at FIGS. **8** and **9** shows the connecting link to be hingedly integral with the hinge member, due to the flexible web portion connecting them.

Returning to FIG. **2**, it is assumed here that the position of the hinge members **11** and **12** shown is the normal "at-rest" open position for the hinge, with the hinge members being 180° apart. In this position, the connecting link **20** is subject to the least compression bowing stress of any position between FIG. **2** and FIG. **4**. If the first hinge member **11** is formed with the integral connecting link originally parallel with the arm members **14**, some bowing stress will be introduced into the link **20** when its left-hand end is raised and pivoted to the appendages **16** along the second hinge line **26**. Alternatively, the first hinge member **11** can be formed with the resilient connecting link **20** already in the slightly curved configuration shown in FIG. **2**. It will be noted that the arms **14** and the hinge member **11** are considerably thicker in the vertical direction than is the connecting link **20**. The purpose of the relative difference in thicknesses is to make the connecting link **20** a relatively resilient or bendable member, as compared to the more rigid hinge member **11** and arms **14**, even though the hinge member **11**, the arms **14** and the connecting link **20** are all formed of the same material.

As the first hinge member **11** begins to pivot in the counter-clockwise direction with respect to the second hinge member **12**, it will be obvious that, due to the spacing between the hinge lines **18** and **26**, the ends of the resilient connecting link **20** will be urged together to place the link in compression, and the result will be a compression bowing in the connecting link **20**.

FIG. **3** shows the bowing of the resilient connecting link **20** at its maximum, and this is determined by the alignment of the hinge lines **18** and **26** and the point **28**, which can be considered the approximate point of attachment between the resilient connecting link **20** and the first hinge member **11**. The geometry of the system is such that the two ends of the resilient connecting link **20** are closest when the point **28** is lined up with the hinge lines **18** and **26**. The amount by which the rectilinear distance between the ends of the connecting link is shortened in FIG. **3** is shown as D. As the first hinge member **11** moves leftwardly in the counter-clockwise direction past the FIG. **3** position, the resilient connecting link **20** begins to straighten out, but it is still not completely relieved of compression bowing stress when the hinge members **11** and **12** have closed upon one another. The reason for this is the fact that the hinge line **26** is slightly to the left of the hinge line **18**. Explanations of this intentional residual compression spring loading and other angular travel relationships are contained in later paragraphs.

Returning to FIG. **2**, it will be appreciated that, because the hinge line **26** is spaced upwardly from the hinge line **18**, as soon as the hinge member **11** begins to pivot in the counter-clockwise direction above the hinge line **18** and compress the resilient connecting link **20**, the latter will exert a force on the first hinge member **11** tending to return it to the FIG. **2** position. The torque T tending to return the first hinge member **11** to its FIG. **2** position will be given by the relationship:

$$T = FL\ (\sin\phi)$$

where L is the distance between the hinge line **18** and the point **28**, F is the compressive force exerted on the resilient connecting link **20**, and ϕ is the angle in the vertical plane subtended at the point **28** by the hinge lines **18** and **25**. The angle ϕ is shown in FIG. **2**.

It will be appreciated that, when the first hinge member **11** has reached the FIG. **3** position, where the point **28** is lined up with the hinge lines **18** and **26**, the angle ϕ drops to zero, and the restoring torque T likewise drops to zero. Thus, when the hinge is in the FIG. **3** position, it is in a condition of unstable equilibrium. As the first hinge member **11** moves past the FIG. **3** position in the counter-clockwise direction, the angle ϕ increases from zero to a finite value, and causes a torque in the counter-clockwise direction which is also given by the expression above. Because the resilient connecting link **20** is still under some compression in the FIG. **4** position, the hinge members **11** and **12** are urged together in the FIG. **4** position.

It will be appreciated that the second hinge member **12** need not be in the exact shape shown, since its sole function is to provide connecting portions for the pivot pins **17** and **24**.

Turning now to FIG. **5**, which shows the second embodiment of this invention, it will be seen that a hinge shown generally at **30** comprises a first hinge member **31** and a second hinge member **32**. The first hinge member **31** has two arm members **33** extending toward the second hinge member **32**, and each of the arm members **33** is integral, at its left-hand end, with the second hinge member **32** through a web **34**, the thin central portion of which defines a first hinge line **36**. Between the two webs **34**, the second hinge member **32** has a rigid upstanding extension **38**, of which the upper portion is integral through a web **40** with the left-hand end of a resilient connecting link **42**, of which the right-hand end is rigidly integral with the first hinge member **31**, as best seen in FIG. **6**. The web **40** defines a second hinge line **44**, and the point **45** is the approximate point of attachment between the link **42** and the member **31**. The same expression for the opening or closing torque T applies for this embodiment as for the embodiment shown in FIGS. **1** to **4**. The second embodiment of the hinge has not been shown in a position similar to FIG. **3**, since the same configuration would result and the geometric considerations would be the same. FIG. **7** shows the second embodiment in the position corresponding to FIG. **4** for the first embodiment, and it will be appreciated again that, since the second hinge line **44** is located slightly to the left of the first hinge line **36**, the resilient connecting link **42** is still under some compression in the FIG. **7** position, and thus there will be a force tending to urge the hinge members **31** and **32** together in the FIG. **7** position.

In this second embodiment, it will be appreciated that the action of the resilient connecting link **42** is at all times to place the web **34** in tension. This is an advantage because if the web **34** were in compression, there would be a danger of overlapping and shearing with repeated flexings.

FIGS. **8** and **9** show alternative designs for the resilient connecting link **42**. In FIG. **8**, the link **42** is slightly bowed concave upwardly in its unstressed position, and there is a web **50** at the right-hand end as well as a web **51** at the left-hand end where the link **42** joins the projection **38**. FIG. **9** is similar to FIG. **8**, except that the resilient connecting link is convex upwardly in its unstressed condition. Again, there is a web **50** at the right-hand end of the link **42**, with a web **51** at the left-hand end.

In the discussion that follows the snap-hinges shown in FIGS. **1** through **9** will be considered to have three parallel bending lines: line A, representing the lines **18** and **36**; line B, representing the lines **28** and **45**; and line C, representing the lines **26** and **44**. The letters A, B and C are shown in FIGS. **2** and **6**. For purposes of this description, bending lines A and B are located in the same initial horizontal plane. As pointed out earlier, the location of bending line C to the left of bending line A results in residual compressive stress in the resilient connecting link when the hinge is in the closed position, because mechanical interference between the first and the second hinge member prohibits rotation of the first hinge member to the other location of completely relieved compression bowing stress. The obvious advantage of clamping closure force between the hinge members results. FIGS. **4** and **7** illustrate this condition of rotation, mechanically stopped at 180° travel of the first hinge member.

It will be further realized that as bending line C is angularly displaced in the counter-clockwise direction, with bending lines A and B still in the same horizontal plane, a configuration will be arrived at wherein the first hinge member reaches closure (mechanical interference) just as the bending lines A, C and B become aligned (angle ϕ=zero). This configuration will be determined by the initial angulation of the hinge members and the location of the bending line C. These conditions describe an "always open" compression hinge. Another way of putting it is to say that the first hinge member, because of mechanical interference, never goes beyond a position of unstable equilibrium.

Still further analysis of the positional relationship of the bending lines contemplated by this invention reveals that as bending line C moves clockwise and goes to the right of the vertical at the bending line A, it is possible to select specific values of angular travel between 0° and 180° for the first hinge member. Also, as C moves counter-clockwise to the left with respect to the vertical at bending line A, unstopped angular travel of the first hinge member will be greater than 180° and specific values between 180° and 360° may be selected. "Unstopped angular travel" is a hypothetical situation in which no mechanical interference between the two hinge members takes place. Bending line C, it will be noted, is always located on the bisector of the angle describing unstopped first hinge member travel. Assuming the moment of inertia and the modulus of elasticity of the connecting link to be known, spring force may also be computed.

It will thus be appreciated that, when the snap-hinge is formed in manufacture with the hinge members at a designated angular relationship, and rotation of the first hinge member is intended to bring the two hinge members together, it is possible to provide a predetermined closure force to be exerted by the connecting arm, by selecting the appropriate material and dimensions for the latter. Also, when the hinge members are formed at a designated angular relationship and rotation of the first hinge member brings it to only a portion of the initial angulation before it reaches an "at-rest" position, a determination of this second "at-rest" position can be made.

Those skilled in the art will appreciated that in the event the two hinge members are formed with an angular relationship less than approximately 30° or more than 330°, certain manufacturing complexities will be encountered in the webbed embodiment. Further, an initial angular relationship approaching zero as the limit is of little or no value as far as the purposes of this invention are concerned.

Turning now to FIGS. **10** and **11**, there is shown one form of a third embodiment of this invention, in which the connecting link is adapted to undergo **[**expansion**]** *deformation* as between its two ends. The hinge shown in FIGS. **10** and **11** is adapted for use with pipe insulation, which is usually available as two semi-cylindrical portions adapted to be clamped together around the pipe. Sometimes the two portions of insulation are joined along one edge by an outer skin bridging between the portions, such that the portions can hinge about that point. In other cases, the two portions are made separately, without any connection or hinge means between them. The hinge device shown in FIGS. **10** and **11** is adapted to be inserted into one end of a length of split insulation, with two prongs **52** and **53** inserted into one portion of the insulation and two prongs **54** and **55** inserted into the other portion thereof. The prongs **52** and **53** project integrally from a first hinge member **57**, while the prongs **54** and **55** project integrally from a second hinge member **58**. As best seen in FIG. **11**, the two hinge members **57** and **58** are integral with one another through a flexible web **60**, which is considered to constitute a first hinge line. Both hinge members **57** and **58** are moulded with a cross-section in the shape of a "T," in order to give rigidity to the members **57** and **58**. The prongs **52–55** are slightly tapered and pointed, for ease of insertion into the insulation material, which is usually either fiberglass or cellular plastic. A connecting link **62** of circular configuration is joined integrally at one end to the hinge member **57** through an integral web **64** constituting a second hinge line, and is joined at the other end to the second hinge member **58** through a further integral web **66** constituting a third hinge line. The connecting link **62** has, as shown in FIG. **10**, a roughly triangular cross-section, although this is not essential.

The position of the snap-hinge of FIG. **10** with respect to the split pipe insulation with which it is used is shown in FIG. **11**, in which the pipe insulation has been shown in broken lines. The snap-hinge is positioned with the web **60** lying adjacent the intersection of the outer periphery **67** of the pipe insulation and the split line **68** between the two portions **69** and **70** of the pipe insulation. The prongs **52–55** are symmetrically arranged with respect to the split line **68**, and inserted into the insulation material. The snap-hinge thus acts as a hinge between the two portions **69** and **70**, which articulate about the web **60**, while the connecting link **62** serves as a spring tending to maintain the two portions **69** and **70** in their closed position (that shown in broken lines in FIG. **11**).

If it were desired to have a positive closure force exerted on the portions **69** and **70** when they are in the closed position, the hinge members **57** and **58** would be spread apart to some extent before insertion of the prongs **52–55**, such that the rectilinear distance between the prongs **52** and **55** is greater than the distance between them in the unstressed condition.

If the two portions **69** and **70** of the pipe insulation, with the pronged snap-hinge of FIG. **10** inserted in one end as described above, were now to be gradually spread apart, articulating about the web **60**, the connecting link **62** would be resiliently [expanded] *deformed*, and would try to urge the two portions back together. If, however, the two portions **69** and **70** were spread far enough apart that the prongs **52**, **53**, **54** and **55** were brought into line with one another, the force exerted by the connecting link **62** would no longer urge the portions **69** and **70** together, since the snap-hinge would be in a state of unstable equilibrium. If the portions **69** and **70** were expanded beyond the position in which unstable equilibrium occurs, the connecting link **62** would urge the portions **69** and **70** toward an open position.

Thus, by applying a snap-hinge of the type shown in FIG. **10** to the end of a length of split pipe insulation (or two: one at either end), the length of split pipe insulation would have a "hold-closed" and a "hold-open" position.

FIG. **13** shows, in cross-section, an extruded form of the third embodiment of this invention. The cross-section of the extrudate shown generally at **72** in FIG. **13** is composed of two opposed portions **73** and **74** joined by a relatively thin portion **75** constituting a first web in the extrudate. A curved portion **76** is joined to both of the opposed portions **73** and **74** at points spaced from the first web **75**. The curved portion **76** is joined to the portion **73** through a thin portion **78** constituting a second web in the extrudate, and is joined to the portion **74** through a thin portion **80** constituting a third web in the extrudate. The curved portion **76** lies to one side of the hypothetical line **81** joining the second web **78** and the third web **80**. The first web **75** lies on the other side of the hypothetical line **81** and is spaced therefrom. The characteristics described above are essential to a hold-open, hold-closed extruded snap-hinge in which the connecting link undergoes [expansion] *deformation*. As can be seen, the curved portion **76** has a circular curvature, although this is not essential. What is essential is that the straightened length of the curved portion **76** be at least as long as the sum of the rectilinear distance between the first web **75** and the second web **78** plus the rectilinear distance between the first web **75** and the third web **80**. Otherwise the hinge would not be a "-snap-hinge," because the curved portion **76** would be incapable of sufficient [expansion] *deformation* to permit the first, second and third webs **75**, **78** and **80** to become aligned. It will be understood that this position of alignment will constitute the state of unstable equilibrium for the snap-hinge, without which the hinge would be able to maintain only one position. The straightened length of the curved portion **76** will lie somewhere between the length of the inside arc **82** and the length of the outside arc **83**.

FIGS. **14** and **15** show the extruded snap-hinge in, respectively, an intermediate hinged position, and the closed position in which the portions **73** and **74** are closed against one another. It will be noted that, in FIG. **14**, the curved portion **76** [is expanded] *deforms* to a radius of curvature greater than that which it has in either FIG. **13** or FIG. **15**.

The opposed portions **73** and **74** are each equipped with a slot **84** capable of receiving and gripping an appropriate plate-like element, the two plate-like elements so gripped being snap-hinged together by the extruded snap-hinge about the web **75**.

The method according to this invention involves the steps of extruding an integral extrudate from stiff but resilient material such as polypropylene, which extrudate has a cross-section meeting the criteria set out above, and cutting the extrudate transversely to obtain a section thereof.

FIG. **16** shows a special form of the first embodiment of this invention. Only the first hinge member **86** is shown. The hinge member **86** has two spaced-apart arms **87** supporting outwardly projecting pivot pins **88** at their extremities. Between the arms **87** is a connecting link **90** which has two opposed, aligned pivot pins **91** at its end. The connecting link **90** is thinner than the arms **87**, such that the connecting link **90** is resilient by comparison with the arms **87**. The hinge member **86** is adapted to be pivotally connected to another rigid hinge member (not shown) through the pivot pins **88**, the common axis of which constitutes the first bending line A. The connecting link **90** is also adapted to be pivotally connected to the other rigid hinge member through the pivot pins **91**, the common axis of which constitutes the third bending line C. The line B in FIG. **16** represents the approximate point of attachment between the connecting link **90** and the hinge member **86** and is considered to be the second bending line of the hinge. In the "at-rest" position the lines A, B and C are in alignment, with A intermediate B and C. This arrangement gives a 360° hinge configuration, in which the connecting link **90** begins to undergo compression as soon as the hinge member **86** begins to pivot with respect to the other hinge member, regardless of the direction of pivoting. It will be appreciated that this hinge configuration has only one "at-rest" position, and that the position of unstable equilibrium arises at 180° displacement from the "at-rest" position.

Turning now to FIG. **17**, the first variant of the fourth embodiment of this invention is seen to include a first hinge member **94**, a split biasing member consisting of two portions **95**a and **95**b, and a second hinge member consisting of a first part **96** and a second part **98**. In one application of the fourth embodiment of this invention, the parts **96** and **98** constitute, respectively, the two free ends of a split sealing ring adapted to close the periphery of tape reels against the entry of dust and other foreign material. These sealing rings, and the tape reels with which they are used, are widely employed in the data-processing field. Thus, while the following description assumes that the parts **96** and **98** are distinct, separate items, this does not preclude an arrangement wherein the two parts are linked remotely, as in a circular sealing ring of the above type.

Attention is now directed specifically to the part **96**, which consists of a base portion **100**, and a surmounting portion **102**. The base portion **100** is a flat, band-like, elongated element having two parallel grooves **104** which are adapted to receive the peripheries of the two circular plates constituting a tape reel (not shown). The surmounting portion **102** can be either formed integrally with the base portion **100**, or affixed thereto by some other conventional means, such as glueing, welding, or mechanical attachment. The surmounting portion **102** consists essentially of a block-like element **105** to which the portions **95**a and **95**b of the biasing element are hingedly connected along integral webs **106** which are collinear. As is evident in FIG. **17**, the two portions **95**a and **95**b of the biasing element are spaced apart, and the block-like element **105** has, between the portions **95**a and **95**b, a groove **108** of which the purpose will presently be explained.

The part **98** consists of a base portion **110** which is identical in cross-section to the base portion **100** of the part **96**, surmounted by a locking element **112**. Again, the locking element **112** can be either formed integrally with the base portion **110**, or affixed thereto by means of glue, welding, mechanical attachment, etc. The locking element **112** consists of a lower portion **114**, and an upstanding portion **116**. The breadth of the upstanding element **116** is less than the lateral distance between the portions **95**a and **95**b of the biasing element, such that the portions **95**a and **95**b can lie on either side of the upstanding portion **116**. The portion **116** defines a groove **117** opening remotely from the part **96**. Integral with the upstanding portion **116** is a horizontal protuberance **118** which is adapted for complementary engagement with the groove **108**.

It will be appreciated that, while in the embodiment shown, the base portions **100** and **110** have identical cross-sections, this is due merely to the particular application of the fourth embodiment to the two free ends of a split sealing ring. Obviously, the base portions **100** and **110** could be replaced with any other abutting members.

The first hinge member **94** has a tongue **120** extending therefrom between the portions **95**a and **95**b of the biasing element.

FIGS. **18** to **20** show sequential steps in the operation of locking the two parts **96** and **98** together by means of the biased hinge. FIG. **18** shows the two base portions **100** and **110** abutting one another, with the protuberance **118** lodged in the groove **108**. When this complementary abutment has taken place, it is then possible to swing the first hinge member **94** downwardly so that the end **121** of the tongue **120** projecting from the hinge member **94** can lodge inside the groove **117** to create a hinge axis between the first hinge member **94** and the part **98** of the second hinge member. It is considered that the two parts **96** and **98** of the second hinge member can be taken as a single member when they are in the abutting relationship shown in FIGS. **18** to **20**. Thus, it is permissible to speak of a hinging relation between the first hinge member **94** and the second hinge member (parts **96** and **98**) when the tongue **120** is lodged in the groove **117**.

FIG. **19** shows the first hinge member **94** after it has been rotated in the clockwise direction to the point of unstable equilibrium, which arises when the two points **123** and **124**, representing the hinge lines along which the biasing element **95** is attached to the surmounting portion **102** and to the first hinge member **94** respectively, are aligned with the point **126**, the latter representing the line along which the tongue **120** bears against the surface of the groove **117**, thereby defining an instantaneous axis of rotation of the first hinge member **94** with respect to the second hinge member comprising parts **96** and **98**.

The design of the biasing portions **95**a and **95**b is such that they are in a state of longitudinal tension in the over-toggling position of unstable equilibrium shown in FIG. **19**. Although actual stretching in the biasing portions **95**a and **95**b is minimal, the integral web connection between the biasing portions **95**a and **95**b and both the surmounting portion **102** and the first hinge member **94** will stretch or deform to a larger degree. It is important, of course, so to design the biasing members **95**a and **95**b that the webs aforementioned will not be stretched to rupture.

Further clockwise rotation of the hinge member **94** with respect to the composite hinge member comprising parts **96** and **98** will bring the first hinge member **94** to the FIG. **20** position, in which the hypothetical line joining points **123** and **124** has gone past the point **126**. It will be apparent that, in the FIG. **20** position, the stress in the biasing portions **95**a and **95**b will be less than in the FIG. **19** position, and this situation will ensure that the first hinge member **94** remains biased to the FIG. **20** position. Thus, the residual tension in the biasing portions **95**a and **95**b will hold the two parts **96** and **98** in a tightly abutting relationship.

Another variant of the fourth embodiment of this invention is shown in FIGS. **21** and **22**, in which it will be noted that the two portions **130**a and **130**b of the biasing element **130** are curved in the vertical plane. The other elements are similar to those of FIGS. **17** to **20**, and include a first hinge member **131**, a second hinge member consisting of a first part **133** and a second part **134**, the part **134** being affixed to or integral with a grooved portion **136** which has a first groove **137** in which the rounded end **138** of the first part **133** is adapted to lodge, and a second groove **140** in which the tongue **142** of the first hinge member **131** is adapted to be received. It will be appreciated that the curved biasing portions **130**a and **130**b are capable of absorbing a greater deflection under tension than is the case with the straight biasing portions **95**a and **95**b in FIGS. **17** to **20**. For this reason, the dimensional design criteria in the variant shown in FIGS. **21** and **22** are not so critical.

In the variant shown in FIGS. **17** to **20**, the hinge axis denoted by the point **126** is analogous to the hinge represented by the web **75** in FIG. **13**, the hinge axis denoted by the point **124** is analogous to the hinge represented by the web **78** in FIG. **13**, and the hinge axis denoted by the point **123** is analogous to the hinge represented by the web **80** in FIG. **13**.

It will be evident that the same over-toggling considerations hold for the second variant shown in FIGS. **21** and **22** as for the first variant shown in FIGS. **17** to **20**. It is not considered necessary to show the hinge axes in the second variant of the fourth embodiment.

It will be appreciated that the fourth embodiment of this invention lends itself to integral moulding techniques, such that the element **112** could be moulded integrally with the second part **98**, and such that the first hinge member **94**, the biasing portions **95**a and **95**b and the surmounting portion **102** could all be formed integrally with the first part **96**.

In the appended claims, the word "hinged" is intended to cover both an integral web hinge and a hinge employing a pivot pin. The word "pivoted" is to be construed as covering only those hinge arrangements in which some sort of pivot pin is utilized. "Pivoted" does not include an integral web hinge. The term "hingedly integral" describes the flexible web connection which is shown in FIGS. **8** and **9** between the connecting link **42** and both hinge members. The term "rigidly integral" describes the non-flexible connection which is shown in FIG. **2** between the connecting link **20** and the first hinge member **11**.

While preferred embodiments of this invention have been disclosed herein, those skilled in the art will appreciate that changes and modifications may be made therein without departing from the spirit and scope of this invention as defined in the appended claims.

What I claim as my invention is:

[[**1**. A snap-hinge comprising:

a first hinge member,

a second hinge member hinged to said first hinge member about a first hinge line,

a curved resilient connecting link of uniform cross-section joined at one end integrally to said first hinge member at a second hinge line and joined at the other end integrally to said second hinge member at a third hinge line, the resilient connecting link tending resiliently to maintain its two ends apart at a given spacing, said second hinge line being spaced at an invarible distance from said first hinge line, said third hinge line being spaced at an invariable distance from said first hinge line, the snap-hinge having a first position and a second position, in each of which stress in the connecting link is at a minimum, the snap-hinge being at rest in each of said positions, a small departure from either of which increases the stress in the connecting link, which tends to restore the snap-hinge to the respective position, the connecting link being capable of resilient expansion between its one end and its other end, the snap-hinge being adapted to articulate between said first-mentioned position and said second position in such a way that the connecting link is resiliently expanded in positions intermediate said first-mentioned position and said second position, the maximum expansion of said connecting link representing a state of unstable equilibrium for the snap-hinge, departure from which in either direction causes said connecting link to urge the snap-hinge further in that direction to return the snap-hinge to one of said positions.]]

[[**2**. A snap-hinge as claimed in claim **1**, in which said second hinge line and said third hinge line are equidistant from said first hinge line.]]

[[**3**. A snap-hinge as claimed in claim **1**, in which said first hinge member is integral with said second hinge member through a flexible web defining said first hinge line, in which said one end of said resilient connecting link is integral with said first hinge member through a flexible web defining said second hinge line, and in which said other end of said resilient connecting link is integral with said second hinge member through a flexible web defining said third hinge line.]]

[[**4**. A snap-hinge as claimed in claim **3**, in which said first and second hinge members and said resilient connecting link are made of a thermoplastic material.]]

[[**5**. A snap-hinge as claimed in claim **4**, in which said thermoplastic material is polypropylene.]]

6. A snap-hinge comprising:

a first hinge member,

a second hinge member hinged to said first hinge member about a first hinge line,

a curved resilient connecting link of uniform cross-section, the link being joined at one end integrally to said first hinge member at a second hinge line and joined at the other end integrally to said second hinge member at a third hinge line, the link being curved and said ends of substantially uniform cross-section intermediate its ends, the resilient connection link tending resiliently to maintain its two ends apart at a given spacing, said second hinge line being spaced at an invariable distance from said first hinge line, said third hinge line being spaced at an invariable distance from said first hinge line, the snap-hinge having a first position and a second position, in each of which stress in the connecting link is at a minimum, the snap-hinge being at rest in each of said positions, a small departure from either of which increases the stress in the connecting link, which tends to restore the snap-hinge to the respective position, the connecting link being capable of resilient deformation between its one end and its other end when the distance between the ends changes, the snap-hinge being adapted to articulate between said first-mentioned position and said second position in such a way that the connecting link is resiliently deformed in positions intermediate said first-mentioned position and said second position when the distance between the ends of the link changes, the maximum deformation of said connecting link representing a state of unstable equilibrium for the snap-hinge, departure from which in either direction causes said connecting link to urge the snap-hinge further in that direction to return the snap-hinge to one of said positions.

7. A snap-hinge as claimed in claim 6, in which said first hinge member is integral with said second hinge member through a flexible web defining said first hinge line, in which said one end of said resilient connecting link is integral with said first hinge member through a flexible web defining said second hinge line, and in which said other end of said resilient connecting link is integral with said second hinge member through a flexible web defining said third hinge line.

8. The snap-hinge as claimed in claim 6, wherein when said snap-hinge is in the rest position, the distance between the second hinge line and the third hinge line is less than the distance at which the maximum stress exists in the connecting link.

9. A snap-hinge as claimed in claim 8 wherein as the snap-hinge proceeds from the first position to the second, the distance between the second hinge line and the third hinge line increases, deforming said connecting link with said deformation continuing until a maximum point is reached, prior to reaching this maximum point the first hinged member is biased towards the first position, after exceeding this maximum point the distance between the second hinge line and the third hinge line decreases and the first hinge member is biased towards the second position, eventually realizing said position.

10. A snap-hinge as claimed in claim 8, wherein as the snap-hinge proceeds from the second position to the first position, the distance between the second hinge line and the third hinge line increases, deforming said connecting link with said deformation continuing until a maximum point is reached, prior to reaching this maximum point the first hinge member is biased towards the second position, after exceeding the maximum point the distance between the

second hinge line and the third hinge line decreases and the first hinge member is biased towards the first position, eventually realizing said position.

11. A snap hinge as claimed in claim 6 wherein said resilient connecting link is curved throughout its entire length.

12. A snap hinge as claimed in claim 6 wherein said resilient connecting link is of uniform cross-section throughout its entire length.

13. A snap-hinge as claimed in claim 6, in which said second hinge line and said third hinge line are equidistant from said first hinge line.

14. A snap-hinge as claimed in claim 7, in which said first and second hinge members and said resilient connecting link are made of a thermoplastic material.

15. A snap-hinge as claimed in claim 13, in which said thermoplastic material is polypropylene.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : Reissue 30,861

DATED : February 9, 1982

INVENTOR(S) : ALOIS A. KRAWAGNA

It is certified that error appears in the above—identified patent and that said Letters Patent is hereby corrected as shown below:

Column 1, line 55, "fourth" should be "third".

Column 7, line 51, "expanded" should be placed in brackets and --separated-- added thereto.

Column 12, line 28, delete "said ends".

Signed and Sealed this

Fifth Day of *April 1983*

[SEAL]

Attest:

GERALD J. MOSSINGHOFF

Attesting Officer *Commissioner of Patents and Trademarks*