United States Patent [19]

Paradis

[11] E **Re. 29,973**

[45] Reissued **Apr. 24, 1979**

[54] **INSTALLATION TOOL**

[75] Inventor: **Joseph R. Paradis,** Wayland, Mass.

[73] Assignee: **Dennison Manufacturing Company,** Framingham, Mass.

[21] Appl. No.: **935,207**

[22] Filed: **Aug. 21, 1978**

Related U.S. Patent Documents

Reissue of:

[64] Patent No.: **4,047,545**
Issued: **Sep. 13, 1977**
Appl. No.: **780,724**
Filed: **Mar. 24, 1977**

U.S. Applications:

[63] Continuation of Ser. No. 656,489, Feb. 9, 1976, abandoned.

[51] **Int. Cl.**[2] **B21F 9/02**
[52] **U.S. Cl.** **140/123.6;** 140/93.2
[58] **Field of Search** ..... 140/93 R, 93 A, 93.2, 140/123, 123.5, 123.6

[56] **References Cited**

U.S. PATENT DOCUMENTS

3,589,406	6/1971	Moberg	140/93 A
3,735,784	5/1973	Obuch et al.	140/93.2
3,752,199	8/1973	Fekete	140/123.6
3,782,426	1/1974	Morgan et al.	140/123.6
3,810,499	5/1974	Van Dike Benfer	140/123.6
3,830,263	8/1974	Van Dike Benfer	140/93.2
3,891,012	6/1975	Bakermans	140/93 A
3,931,838	1/1976	Bakermans	140/123.6

Primary Examiner—E. M. Combs
Attorney, Agent, or Firm—George E. Kersey

[57] **ABSTRACT**

A tool that is particularly suitable for the installation of objects that require tensioning and severing. A tensioning member is operated through a toggle linkage that collapses when a pre-determined level of tensioning is reached and actuates a cutoff lever. The result is severence of the tensioned object with reduced shock loading. In addition the tool is easy to operate; the tensioning level is accurately and reliably adjustable; and the severed object is controllably ejected from the tool.

18 Claims, 9 Drawing Figures

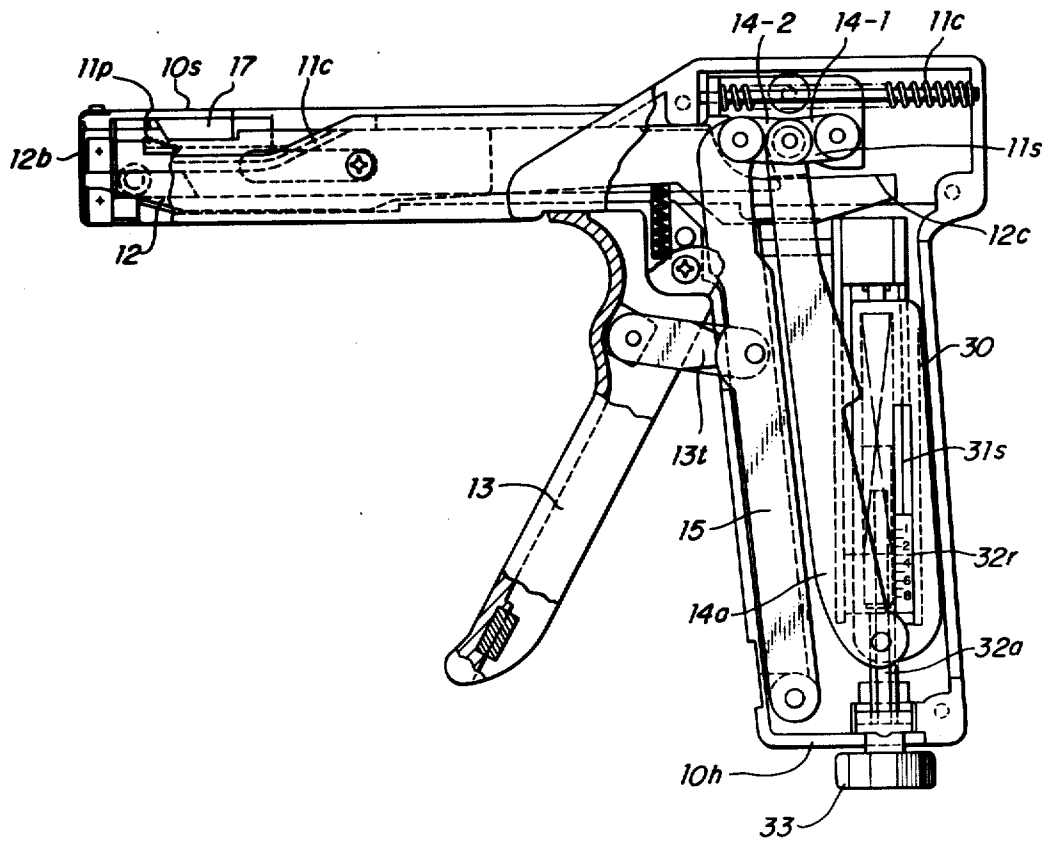


FIG. 1.

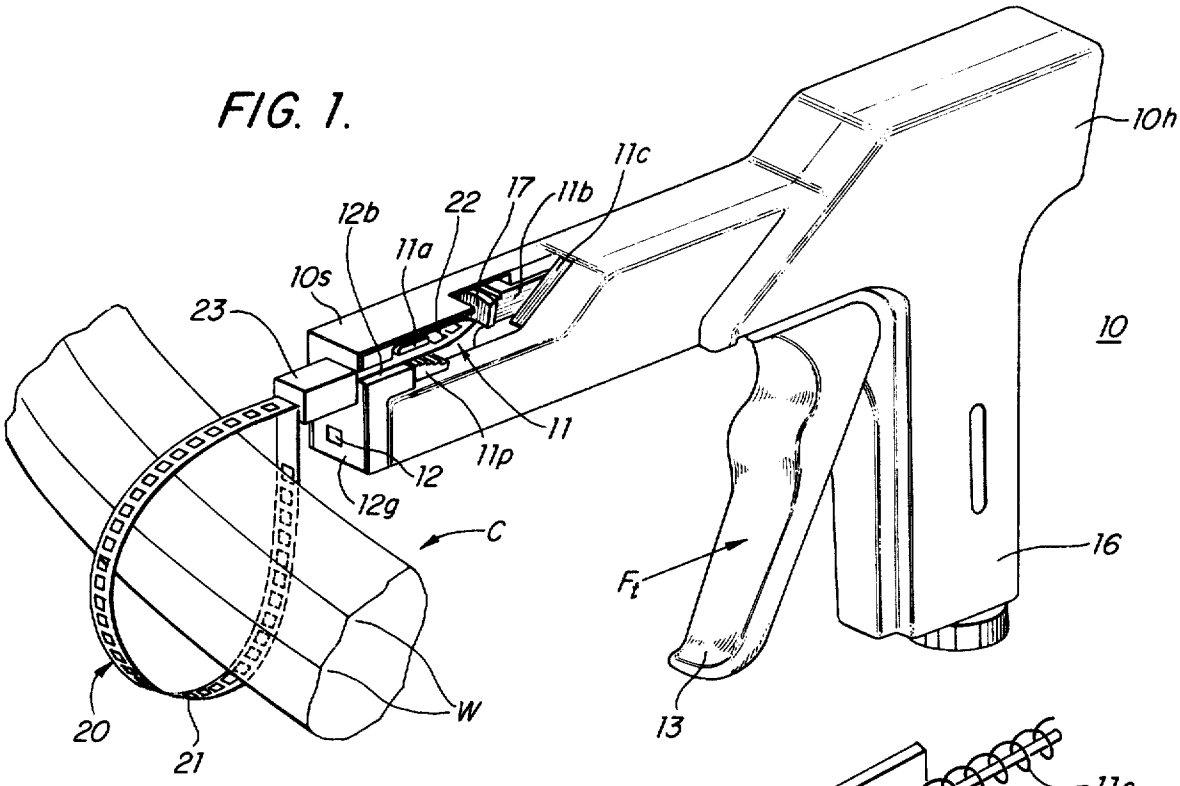
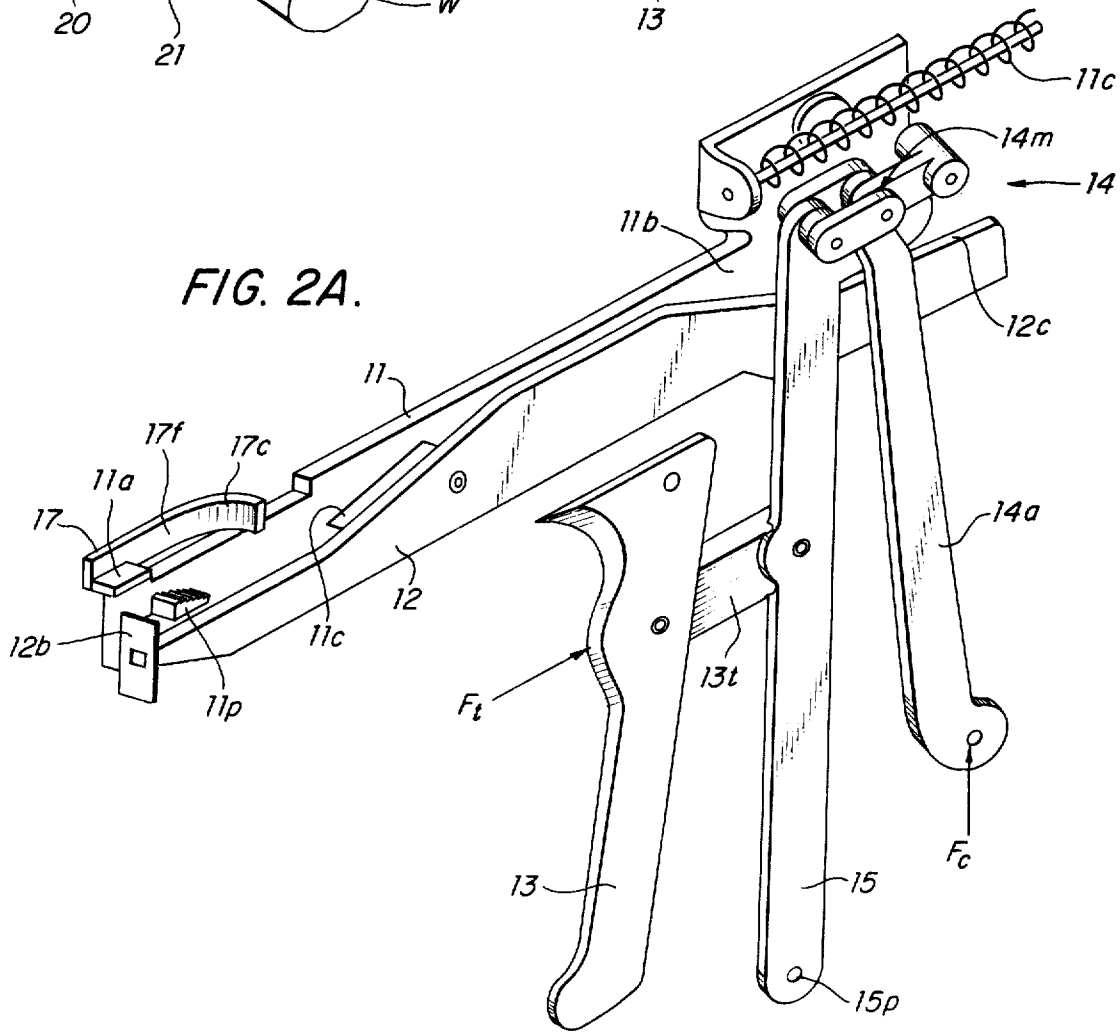

10h
11c
12b
22
17
11b
11a
10s
23
10
11
11p
12
12g
C
16
F_t
13
20
21
W

FIG. 2A.


11c
14m
14
11b
12c
11
17f
17c
11a
17
14a
12b
11c
12
11p
F_t
13t
F_c
13
15
15p

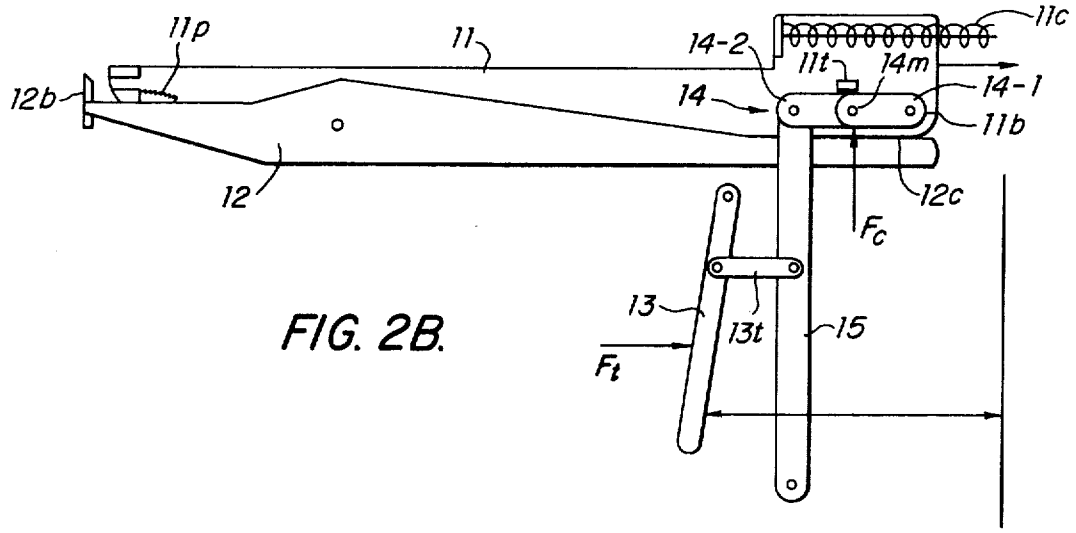


FIG. 2B.

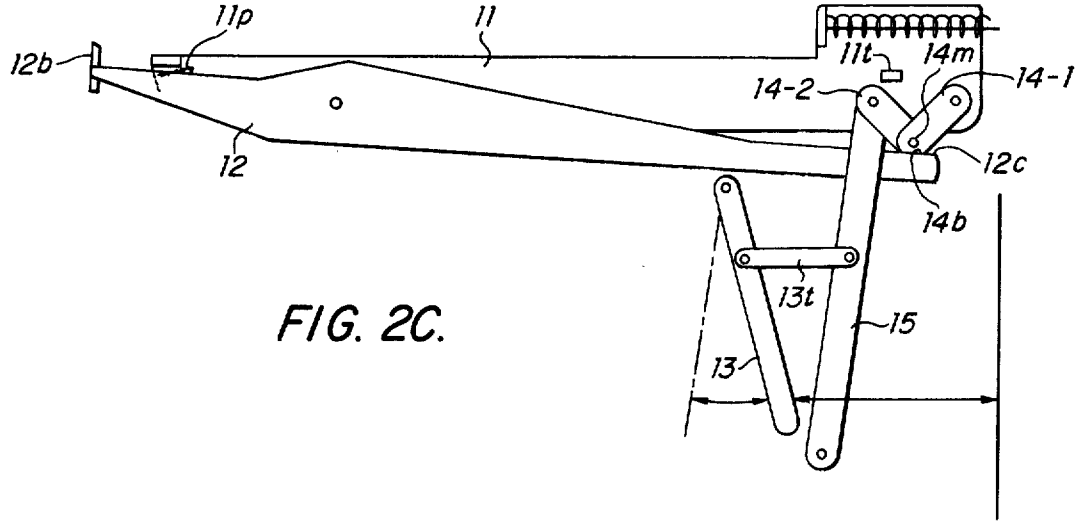


FIG. 2C.

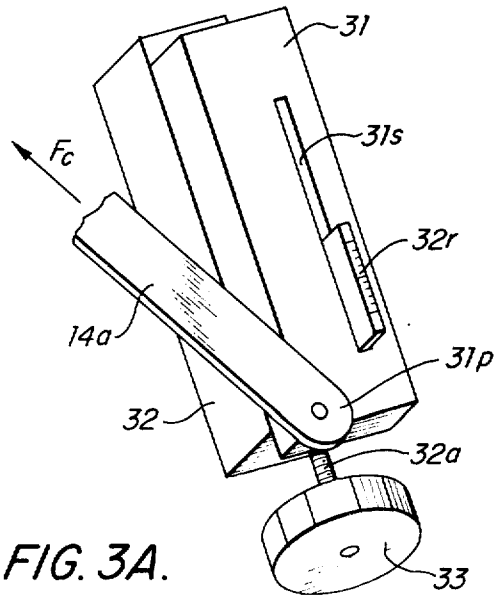


FIG. 3A.

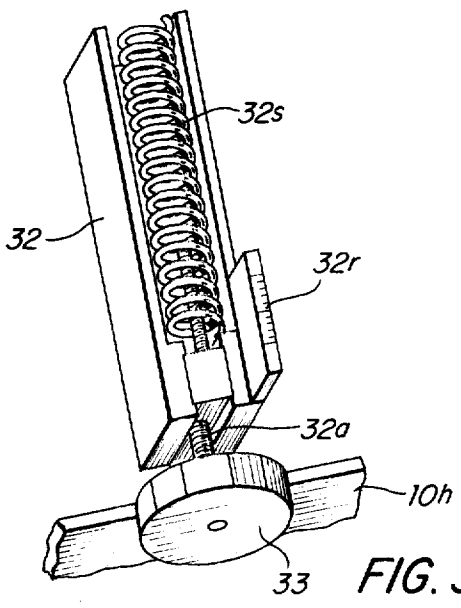


FIG. 3B.

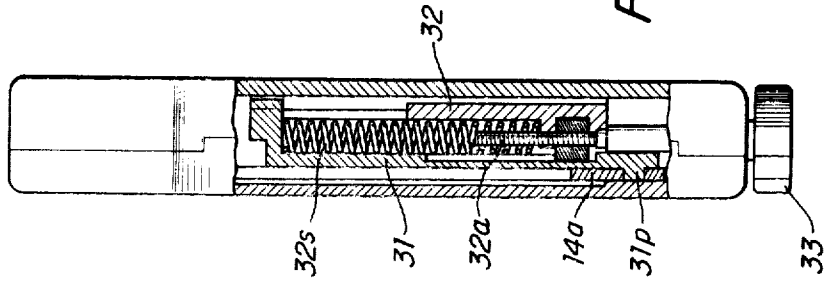


FIG. 4B.

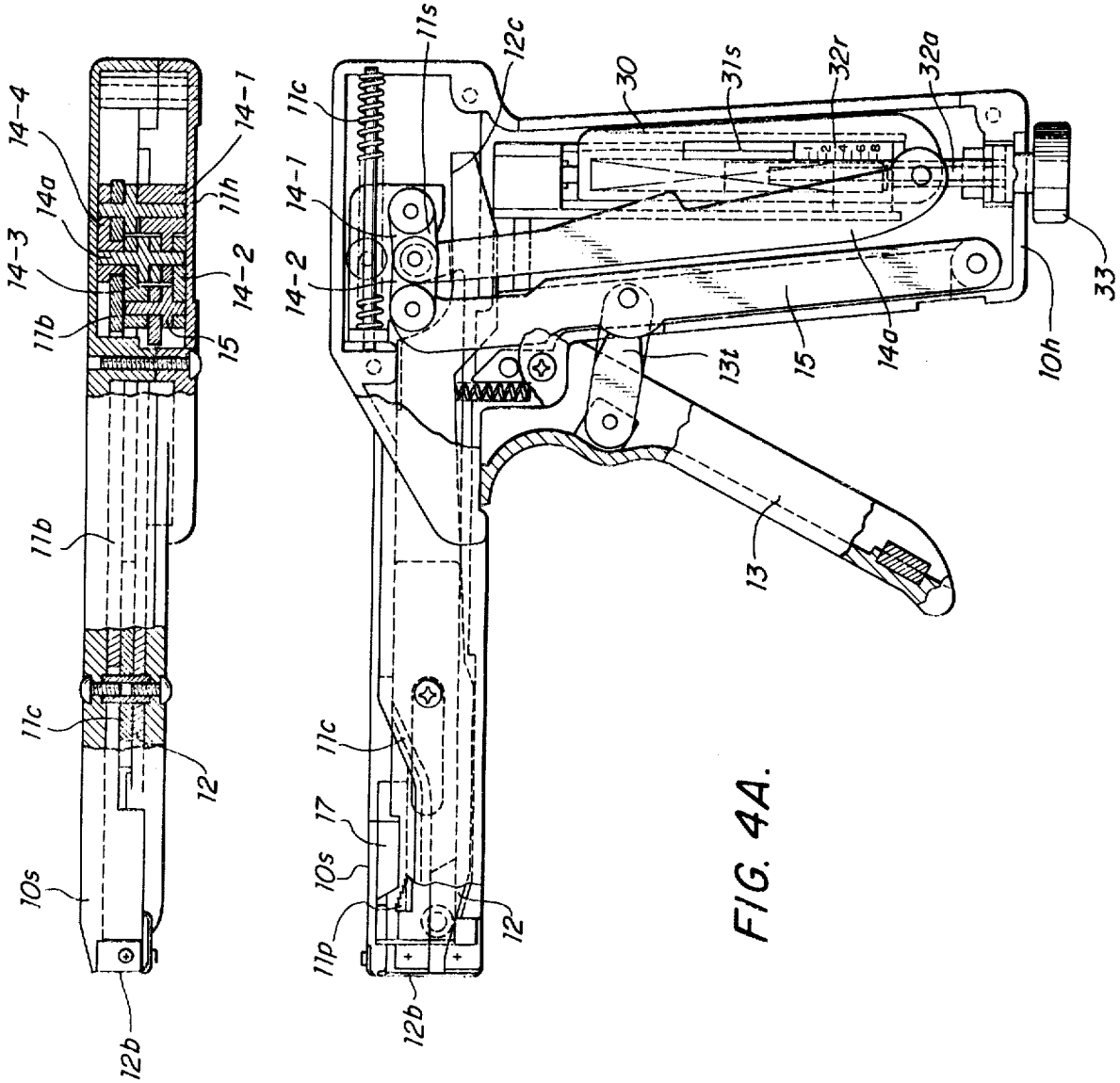


FIG. 4C.

FIG. 4A.

INSTALLATION TOOL

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 is a continuation of Ser. No. 656,489, filed Feb. 9, 1976, now abandoned.

BACKGROUND OF THE INVENTION

This invention relates to a tool for the installation of items that require tensioning and more particularly to a tool for the installation of fasteners such as cable ties.

Cable tie fasteners are commonly installed, for example, by wrapping their straps around groups of articles and then threading the straps through locking heads. The installation is completed by pulling on the free ends of the straps until the articles are securely bundled. To achieve a suitable installation it is desirable to use a tool which grips and tensions the free end of the strap. The free end is then severed in the vicinity of the head when a specified level of tensioning has been reached.

Installation tools in common use contain a trigger actuated mechanism that tensions the strap to a predetermined level and actuates a cutter to sever the strap.

Such tools commonly require the application of a relatively high operating force to the trigger through an appreciable interval. In some cases there is a considerable span between the hand grip of the gun and the trigger. The result is that the tools can be difficult to operate and can cause undue user fatigue.

Another characteristic of existing installation tools is that the cutoff mechanism produces a significant shock effect. At the instant of severing there is a pronounced snap which, at high tension levels, can even sting the user. In addition there is the objectionable tendency for the severed end of the strap to be ejected from the tool towards the user. Another objection is the tension level adjusting mechanism is often unreliable and difficult to operate.

Accordingly, it is an object of the invention to reduce the shock effect associated with the severing of items under tension. A related object is to reduce the shock effect associated with the severing of tensioned fasteners. A further related object is to reduce the shock effect associated with the severing of tensioned cable tie straps.

Another object of the invention is to achieve an installation tool in which an item may be tensioned and severed using a reduced amount of trigger force. A related object is to achieve the tensioning and severing of an item using a trigger which has a comparatively short operating span.

A further object of the invention is to provide an accurate and easily adjustable tensioning level for an installation tool.

Still another object is to avoid the objectionable tendency of items that are severed under tension to fly back and strike the operator.

Illustrative installation tools of the prior art are disclosed in U.S. Pat. Nos. 3,735,784; 3,712,346; 3,661,187; 3,433,275; 3,344,815; 3,332,454; 3,284,076; 3,173,456; 3,169,560 (U.S. Pat. No. Re. 26,492); 3,168,119; 3,154,114; 2,729,994; 2,882,934; and 2,175,478.

SUMMARY OF THE INVENTION

In accomplishing the foregoing and related objects the invention provides an installation tool in which a tensioning assemblage is driven through an intervening toggle linkage that is able to actuate a sever mechanism.

The intervening linkage is prevented from collapsing until a certain level of tensioning is attained by the application of a countervailing force.

In accordance with one aspect of the invention the toggle linkage is drawn through an internally pivoted actuator lever to reduce the amount of operator applied force.

In accordance with another aspect of the invention the countervailing tension is applied by a compression cage.

In accordance with a further aspect of the invention the tool uses an ejector spring to propel severed items away from the user.

DESCRIPTION OF THE DRAWINGS

Other aspects of the invention will become apparent after considering various illustrative embodiments, taken in conjunction with the drawings in which

FIG. **1** is a perspective view of a tool in accordance with the invention being used in the installation of a cable tie;

FIG. **2A** is a perspective view of the tensioning and sever mechanisms in the installation tool of FIG. **1**;

FIG. **2B** is a schematic representation of the tensioning and severing mechanisms of FIG. **2A** during tensioning;

FIG. **2C** is a schematic representation of the tensioning and severing mechanism of FIG. **2A** during severing;

FIG. **3A** is a perspective view of a compression spring cage for the adjustment of tension in accordance with the invention;

FIG. **3B** is a perspective view of the interior of the cage of FIG. **3A**;

FIG. **4A** is a view of the installation tool of FIG. **1** with portions broken away to show the placement of constituents pictured in FIGS. **2A** through **3B**;

FIG. **4B** is an end view of the tool of FIG. **4A**, and

FIG. **4C** is a top view of the tool of FIG. **4A**.

DETAILED DESCRIPTION

Turning to the drawings, an installation tool **10** in accordance with the invention is formed by a split-cover housing **10h** containing a tensioning assemblage **11** and a pivotted cutoff lever **12**, which is visible through a viewing aperture of a cutter guard **12g** and mounts a cutter blade **12b**.

As illustrated in FIG. **1**, the tool **10** can be used to complete the installation of an item such as a cable tie **20**. The strap portion **21** of the tie **20** is wrapped around articles that are to be bundled, for example the individual wires W of a cable C. A free end **22** of the tie **20** is inserted through the head **23** of the strap into the mouth of the tool **10** between gripper constituents **11p** and **11a** of the tensioning assemblage **11**.

When force F_t is applied to a trigger **13** of the tool **10**, it is transmitted through levers and linkages (not visible in FIG. **1**) to the tensioning assemblage **11**, causing the assemblage to be drawn towards the rear of the gun. This frees a pivotted and spring-loaded pawl **11p** which rotates against the portion **22** of the strap and grips it with respect to a stud **11a**.

The initial rearward motion of the tensioning assemblage **11** caused by the force Ft tightens the portion **21** of the strap around the wires W of the cable C, with the head **23** of the cable tie **20** in close abutment with the tool **10**. Further movement of the tensioning assemblage **11** increases the tension applied to the gripped portion **22** of the tie **20** until a predetermined tension level is reached. At that point, as explained below, the force transmitted to the tensioning assemblage **11** from the trigger **13** causes a collapse of the intervening linkage which acts upon the cutoff lever **12** and pivots it upwardly, bringing the blade **12b** into sever position with respect to the gripped end portion **22** of the cable tie **20**.

In the typical operation of an installation tool the sever action produces a significant shock impact. However, in accordance with the invention this impact is significantly reduced because of the particular way in which the cutoff lever **12** is operated, as explained in conjunction with FIGS. 2A through 2C.

A perspective view showing the relationship between the tensioning assemblage **11** and the cutoff lever **12** is given in FIG. 2A. The tensioning assemblage **11** is maintained in a normally forward position in the tool **10** by a compression spring **11c**. The tensioning assemblage is connected to the trigger **13** through a set of actuator linkages including toggle linkages **14** and an internal actuator lever **15**.

When the trigger force F_t is applied, it is transmitted through a trigger link 13_t to the actuator lever **15** which is pivotally mounted within the handle **16** of the tool **10**. The upper portion of the actuator lever **15** is pivotally connected to the toggle linkages **14**, which are, in turn, pivotally connected to the bar **11b** of the tensioning assemblage **11**. To maintain the toggle linkages **14** in position to transmit the trigger force F_t, a countervailing force F_c is applied to the midpoint **14m** of the toggle through a toggle arm **14a**.* When the tensioning force applied from the trigger **13** exceeds the countervailing force F_c, the toggle collapses by pivoting with respect to both the actuator lever **15** and the tensioning bar **11b** and engages a cam surface **12c** of the cutoff lever **12**. Since the operation of the cutoff lever takes place while the actuator lever is moving to the rear, there is, in effect, a cushioned impact of the collapsed toggle linkages **14** against the cutoff lever **12**. It is believed that this cushioning limits the shock loading that is produced when the strap **22** is severed.

*The toggle is never completely straight; there is always a slight angular inclination, in the rest position, towards the force F_c.

In addition, an ejector spring **17**, in the form of a leaf **17f** with a curvature **17c** extending into the mouth of the tool, is included to reduce any tendency for the severed end of the strap to be propelled toward the user.

As the tensioning bar **11b** is drawn towards the rear of the gun **10**, the curved portion **17c** of the ejector spring **17** tends to be flattened against the adjoining housing wall. When the pawl reaches a cam surface **11c** (shown in FIGS. **1** and 2A), with the strap **22** under tension, the cam acts upon the pawl and partially releases it. In addition, as noted in FIG. **1**, the housing **10h** has a shield **10s** that extends at the top of the gun to the vicinity of the ejector spring **17**. Consequently when the strap is under tension, with the pawl **11p** partially released and the spring **17** partially deflected, and the cutter blade **12b** is operated to sever the strap, the severed portion tends to be propelled laterally out of the housing, instead of towards the user. The desired lateral propulsion is promoted by contributions from the shield **10s**, the partial pawl release provided by the cam **11c** and the ejector spring **17**. This is by contrast with the tools of the prior art in which the pawl tends to be fully embedded in the leading portion of the strap at the moment of sever and there is no shield **10s**, or ejector spring **17**, so that when the strap is severed the accompanying release of tension tends to pivot the severed portion of the strap about the pawl and towards the user.

A schematic representation of the tensioning and sever operation is illustrated in FIGS. 2B and 2C. Initially as shown in FIG. 2B the individual links of the toggle assemblage **14** are in alignment. For simplicity the toggle assemblage **14** in FIG. 2B is formed by the first link **14-1** that is pivotaly connected to the tensioning bar **11b** and a second link **14-2** that is pivotally connected to the actuator lever **15**. The actuator and sever links **14-1** and **14-2** are in turn pivotally joined. It is at this point of joinder **14m** that the countervailing force F_c is applied. To keep the countervailing force from driving the links **14-1** and **14-2** of the toggle assemblage out of alignment, the illustrative tensioning bar **11b** in FIG. 2B includes an integral stop **11t**. For the embodiment of FIG. 2A, the upward motion of the linkages is limited by the use of a slot **11s** in the draw bar **11b** as shown in FIG. **4A**. The various ways of applying the countervailing force F_c to the toggle assemblage **14** are discussed below.

When the tension applied to the strap by the bar **11b** exceeds the value of the countervailing force F_c applied at the pivot center **14m** of the toggle assemblage **14**, that latter collapses as shown in FIG. 2C. This collapse brings a bearing surface **14b** of the toggle into engagement with a cam surface **12b** at the rear of the cutoff lever **12**. Since the toggle assemblage **14** is formed by pivotally connected members, the force transmitted to the cutoff lever is composed of both horizontal and vertical components, by which a cushioned impact is applied to the cutoff lever **12**, instead of a direct impact, so that impact shock loading is avoided.

In addition, as is evident from FIG. 2B, the use of the trigger **13** in conjunction with the actuator lever **15** provides a mechanical advantage so that the amount of operator force applied to the toggle is considerably less than that needed with conventional installation tools. The use of the actuator lever **15** also permits the desired tensioning force to be applied over a relatively small arc of operation of the trigger **13**.

The countervailing force F_c that is applied to the toggle **14** may be realized in a wide variety of ways. As shown in FIG. 2A the force F_c is applied at the end of the toggle arm **14a**. This upward component of countervailing thrust may be achieved by the use of a spring (not shown) which is hooked to the end of the linkage **14a**. However, such a spring tends to be mechanically unreliable and in accordance with the invention the desired countervailing force F_c can be realized using a compression spring cage **30** of the kind shown in FIGS. **3A** and **3B**. As indicated in FIG. **3A** the end of the toggle linkage **14a** is connected by a pivot pin **31p** to an upper part **31** of the cage **30**, which is slideably movable with respect to a lower part **32**. Since the upper part **31** of the cage **30** applies the desired countervailing force F_c to the toggle arm **14a** and is therefore relatively immovable, since the arm initially cannot push the toggle links **14** beyond their co-liner position.

As noted in conjunction with FIG. 2B the upward movement of the toggle linkage **14** is controlled by a stop member **11t** which is an integral part of the tensioning bar **11b**. To adjust the tension applied through the toggle arm **14a** an adjusting member **32a** is threaded into the bottom portion **32** of the cage **30** as shown in FIG. 3B by rotation of a tension control knob **33**. This moves the lower portion **32** of the cage **30** of FIG. 3A upwardly with respect to the upper portion **31** and carries with it the indicator **32r** that moves within a slot **31s** of the upper portion **31** and simultaneously causes compression of the springs **32s** which controls the countervailing force F_c applied to the toggle assemblage. This arrangement achieves precise control over tension and a high degree of mechanical stability.

A partial sectional view of the entire installation tool of FIG. **1** is shown in FIGS. **4A** through **4C** to indicate the relative positioning of the internal constituents of the tool, as well as the interrelations among those constituents.

Thus in the tool **10** as shown in FIGS. **4A** and **4B** the toggle assemblage **14** is formed by four linkages (FIG. **4C**) **14-1** through **14-4**. The link **14-1** is seated on a hub **11h** of the tensioning bar **11b**. The link **14-1** is in turn pivotally connected to the arm **14a** that extends to the compression cage **30**. The arm **14a** is connected to the lever **15** by a link **14-2**, as well as by a further link **14-3**. There is also pivotal connection between the hub **11h** of the tensioning bar **11b** and the arm **14a** by a link **14-4**. It is the latter link that limits the upward movement of the toggle assemblage due to the application of the compression force F_c through the arm **14a**. This is because the fourth linkage **14-4** (FIG. **4C**) rides in a slot **11s** (FIG. **4A**) of the tensioning bar **11b**. Initially with the full compression force F_c applied to the arm **14a** the individual links of the toggle assemblage are in alignment and the link **14-4** is seated in the upper part of the recess **11s**. When the tension applied to the strap exceeds the countervailing force F_c the toggle assemblage collapses as described previously and the link **14-4** moves out of the slot **11s** to contact the cam surface **12c** and operate the sever lever **12**.

Also indicated in FIGS. **4A** and **4B** is the placement of the cam **11c** that provides partial release of the pawl **11p** before sever.

Details of the compression cage **30** are illustrated in FIGS. **4A** and **4C**.

While various aspects of the invention have been set forth by the drawings and the specification, it is to be understood that the foregoing detailed description is for illustration only and that various changes in parts, as well as the substitution of equivalent constituents for those shown and described, may be made without departing from the spirit and scope of the invention as set forth in the appended claims.

I claim:

1. A tool for tensioning an item having a free end, comprising

means for gripping and drawing the free end of the item;

means for severing an end portion of said item;

first and second pivotally connected links connected to the drawing means;

means for applying force to said drawing means through said first and second links to apply tension to the end of said item; and

means for maintaining said links in relative alignment until the applied force reaches a prescribed level whereupon said links pivot out of alignment and operate the severing means.

2. A tensioning tool in accordance with claim **1** wherein

the maintaining means comprises means for applying force to said first and second links at an angle with respect to the force applied through said links.

3. The tensioning tool of claim **2** wherein said maintaining means comprises a lever arm with force applied to one end and said first and second links pivotally connected to the other end.

4. A tensioning tool in accordance with claim **1** wherein the first link is pivotally connected to said drawing means;

the second link is pivotally connected to said first link and to the force applying means

and the means for maintaining said links in relative alignment comprises means for applying a prescribed force to the pivotal connection of said first link with said second link.

5. A tensioning tool in accordance with claim **4** further including means for limiting the movement of said first and second links when force is applied thereto.

6. A tensioning tool in accordance with claim **5** wherein

the limiting means comprises a slot in said drawing means.

7. A tensioning tool in accordance with claim **3** wherein

said first and second links, when pivoted out of alignment act upon a cam surface of said sever mechanism.

8. An installation tool in accordance with claim **3** wherein

said first and second links are operated by a lever pivotally connected thereto and the housing of said tool.

9. An installation tool in accordance with claim **8** wherein

said lever is driven by a trigger which is pivotally connected between the pivotal connection of said lever to said housing and to said first and second links.

10. An installation tool according to claim 1 comprising means for gripping, tensioning and severing an item; and means for limiting the ejection of the severed item in the direction of tensioning.

11. An installation tool in accordance with claim 1 wherein the limiting means comprises means for deflecting the item thus severed in a direction that is lateral to the direction of tensioning.

12. An installation tool in accordance with claim 1 wherein the item is gripped by a pawl and the limiting means includes means for partially releasing the grip of said pawl after tension is applied to said item.

13. An installation tool in accordance with claim 1 wherein the limiting means includes a shield overlying the item to be severed.

14. An installation tool in accordance with claim 1 wherein the limiting means includes an ejector spring that is mounted for applying lateral pressure to said item with respect to direction of tensioning.

15. An installation tool in accordance with claim 1 comprising a compression cage formed by relatively movable parts with a compression spring therein for applying force to a tensioning assemblage.

16. An installation tool in accordance to claim 1 comprising means for gripping and drawing an item along a

prescribed path, means for severing said item after it has been drawn along said prescribed path, and means mounted on the drawing means for collapsing and operating said sever means when the force applied thereto exceeds a prescribed level.

17. An installation tool in accordance with claim 16 wherein the collapsing means comprises means for cushioning the shock effect produced when said item is severed.

18. An installation tool according to claim 16 wherein the collapsing means comprises a three point toggle linkage pivotally connected (a) at one point to the gripping means (b) at another point to means for applying an actuating force and (c) at a third point to means for applying a countervailing force, and the severing means is operated by said toggle linkage when the actuating force exceeds said countervailing force.

* * * * *