

METHOD OF ASSEMBLING MATTRESSES USING PLASTIC TAB FASTENERS

Technical Field

[0001] This invention generally relates to systems and method for constructing
5 mattresses.

Background

[0002] Spring mattresses have been in use for over 100 years. Existing spring
mattresses use a variety of spring types to form their inner core. Perhaps the most
common is the traditional wire spring assembly having a set of interconnected wire
10 spring coils. Another type of spring assembly is the so-called Marshall construction that
was developed in the late 1890's by Marshall Mattress of Toronto, Canada. The Marshall
design utilizes fabric pockets to encapsulate each spring. In this way, the coils may flex
separately from each other.

[0003] Generally, mattresses are formed with a mattress central portion surrounded
15 by a mattress border construction. The mattress central portion may include a series of
coil springs (Marshall springs) connected together, which can be enclosed in fabric
pocket. Alternatively, the mattress central portion may comprise polyurethane or latex
foam layers or synthetic or natural fibers, optionally in combination with springs. To
provide sufficient support and to make the mattress more robust, mattress manufacturers
20 have introduced mattresses with a foam-encased innercore that gives greater edge
support. The foam edge is typically glued to a support layer and the coil unit is joined to
the support layer by a border wire and hog rings. The sleeping surface of the mattress is
typically covered with a quilted fabric.

[0004] When manufacturing the mattress, the innerspring unit is typically attached to
25 a lower border wire and that border wire is joined to the support layer. The foam edge is

glued in place around the innerspring unit. The quilted fabric is then attached to side panels by sewing.

[0005] It should be noted that conventional high-end mattress manufacturing techniques employ an adhesive to secure together components of the mattress (and, in particular, foam encasement components) prior to sewing the outer layer of quilted cotton material around the remainder of the mattress. Specifically, one or both of the contact surfaces of adjacent foam encasement components are sprayed with an adhesive. With the adhesive sprayed onto one or both of the contact surfaces of adjacent layers, the components are first aligned and then drawn into contact with one another.

[0006] Components of the foam encasements, which are traditionally glued together, present the following disadvantages. The use of adhesives to secure together foam encasement components of a mattress results in a significant level of waste. Specifically, if the components of material are secured misaligned, there is no means to separate them and attempt to re-secure the foam encasement components. As a result, foam encasement components which are misaligned are often discarded as waste, thereby increasing manufacturing costs, which is highly undesirable.

[0007] As a second drawback, the use of adhesives to secure together foam encasement components of a mattress may create an unpleasant amount of fumes and mess, which is undesirable.

[0008] As a third drawback, the use of adhesives to secure together foam encasement components of a mattress often creates audible crackling sounds as the adhesives age, which is highly undesirable.

[0009] Although traditional mattresses and manufacturing processes work well, there is a need in the art for improved techniques for manufacturing mattresses that are easier to manufacture by enabling efficient assembly of the foam encasement components before the mattress is sewn closed.

Summary of the Invention

[0010] The system and methods described herein address the deficiencies of the prior art by providing a method of manufacturing a mattress that includes the steps of

5 providing a mattress core, providing a plurality of foam encasement components and affixing the plurality of foam encasement components together by inserting tab fasteners through or into the foam encasement components. In various implementations, the foam encasement components comprise side rails, and optionally, include a top or bottom upholstery foam cover.

10 [0011] In one aspect, the mattress includes a foam encasement comprising foam side rails which are affixed to one another using tab fasteners. According to some embodiments, the foam encasement has a top or bottom foam deck which is attached to the side rail with the tab fasteners.

15 [0012] According to another aspect, a mattress includes a mattress core, at least one side rail joined to the mattress core by one or more tab fasteners that have a strength sufficient to maintain a relative position between the mattress core and the side rail. In some configurations, plastic tab fasteners affix a plurality of side rails together to form a frame around the mattress core.

20 [0013] Embodiments of the invention may include, among other things, top or bottom foam decks which serve to encase the mattress core. The mattress may include an upholstery layer defining a sleep surface and applied over the top foam deck. The upholstery layer may be permanently secured to the at least one side rail by a mechanical fastener.

25 [0014] According to one feature of the invention, plastic tab fasteners can be used to affix flange material associated with top and bottom finished panels to the foam encased unit.

[0015] According to certain implementations, the plastic tab fastener may be, but not necessarily, in the form of a conventional heavy duty plastic tab fastener, as is known in the art. The plastic tab fastener may comprise a 8 cm plastic member which includes a first end shaped to define a cross-bar. The plastic tab fastener may further include a second end similarly shaped to define a cross-bar.

[0016] In certain embodiments, the plastic tab fastener can be mass-produced in a unitary form known commonly as fastener stock. The fastener stock is constructed in a clip-type assembly in which individual plastic tab fasteners are arranged in a spaced, side-by-side orientation, with the respective cross-bars parallel to one another.

[0017] Optionally, plastic tab fasteners are disposed with the foam encasement elements by a conventional plastic tab fastener dispenser. For example, a plastic tab fastener dispenser may be employed for attachment of: (1) flange material associated with top and bottom finished panels to the foam encased unit, (2) top upholstery foams to pocket coil innerspring units and foam side rails, (3) bottom upholstery foam and pocket coil innerspring units and foam side rails, (4) foam or other side rails to encase a mattress core unit, and (5) side rails to other side rails in corners of a mattress.

[0018] The mattress core can be an open coil mattress core, a fabric-encased spring coil mattress core, or springs disposed in foam mattress core. Alternatively, the mattress core can be one or more blocks of resilient foam that can have different firmness.

[0019] This technique may eliminate the need for hot melt spray adhesives, water and solvent spray glues, and acrylic adhesive films which present safety hazards for operators. This technique further reduces the need for mechanical fasteners, hook and loop fastening, and any other techniques requiring additional hardware or additional assembly time in the mattress manufacturing process. The mattress described herein are less costly to manufacture while offering more consistency in the manufacturing processing.

[0020] Further features and advantages will be apparent from the following description of preferred embodiments and from the claims.

Brief Description of the Drawing

5 [0021] These and other features and advantages of the invention will be more fully understood by the following illustrative description with reference to the appended drawings, in which like elements are labeled with like reference designations and which may not be to scale.

10 [0022] Figure 1 is an illustration of the pocketed coil innerspring unit framed by foam side rails according to an illustrated embodiment of the invention;

[0023] Figure 2 is a three quarter view of a corner joint being secured with plastic tab fasteners according to another illustrated embodiment of the invention;

[0024] Figure 3 is a three quarter view depicting the attachment of bottom foam decking using plastic tab fasteners and the result according to Figure 2;

15 [0025] Figure 4 is a three quarter view illustrating the attachment of top foam decking using plastic tab fasteners and the result according to Figure 2;

[0026] Figure 5 is a top longitudinal view of bottom foam decking being secured with plastic tab fasteners according to an illustrated embodiment of the invention.

20 [0027] Figure 6 is a top three quarter view exemplifying the attachment of side panels of a quilted top cover to the side rails of a mattress assembly;

[0028] Figure 7 is a front, bottom perspective view of a tool for dispensing a plastic tab fasteners with a clip of two fasteners loaded therein;

[0029] Figure 8 is a front, bottom, right end perspective view of the tool shown in Figure 7 with a clip of fasteners loaded therein; and

[0030] Figure 9 is an enlarged, front perspective view of the fastener guide assembly shown in Figure 8.

Illustrative Description

5 [0031] As described above in summary, the invention is generally directed to mattress construction and a manufacturing process for a mattress that facilitates securing various mattress components before the mattress is closed by sewing. The following illustrative embodiments are described with respect to methods for securing side rails and top and bottom foam decking or rails using plastic tab fasteners. However, the article of
10 manufacture and methods may be used to secure any suitable component of the foam encasement using any suitable plastic fastener.

[0032] A mattress spring unit typically includes an upper frame and a lower frame which are spaced slightly apart and which are arranged in a substantially parallel configuration. Each frame (also commonly referred to as a wire box) includes a rigid and
15 durable wire, or rod, which is formed into a substantially rectangular design, the wire defining the outer periphery of its associated frame. In addition, a mattress spring unit typically comprises a plurality of uniformly spaced apart metal springs, or coils, which extend between the upper and lower frames. Each spring includes a longitudinal axis which extends substantially at a right angle relative to the upper and lower frames. As
20 can be appreciated, the plurality of springs enables the upper frame to move, or give, towards the lower frame when a downward force is applied onto the upper frame. As a result, when an individual rests on the upper frame of the spring unit, the body weight of said individual is uniformly absorbed by the plurality of springs, which is highly desirable.

25 [0033] The collective plurality of springs, called the mattress core, is surrounded by foam rails more specifically. The outer periphery of the mattress core is framed by a plurality of foam side rails. Typically, the mattress core is secured by the foam side rail

frame which is adhered thereto. The mattress core encasement is completed by the addition of floor and ceiling foam sheets or layers which are disposed below and above, respectively, the mattress core. Top and bottom foam decking is secured to the mattress core by adhering the foam decking to the foam side rails. A foam encasement, as disclosed herein, can be any or all elements of the mattress core encasement. For example, the foam encasement can include side rail, a perimeter, or a top deck affixed to one or more side rails.

[0034] To provide an overall understanding of the invention, certain illustrative practices and embodiments will now be described, including a manufacturing process for a mattress that attaches an innerspring or coil unit to a plurality of side rails and top or bottom foam decks before the mattress is closed by sewing. However, it will be understood by one of ordinary skill in the art that the systems and methods described herein can be adapted and modified and applied in other applications and that such other additions, modifications and uses will not depart from the scope hereof.

[0035] Figure 1 depicts an exemplary side rail frame 10 and a pocketed innerspring unit 16 (mattress core) having pocketed (Marshall) coil springs arranged in rows. Instead of pocketed coil springs, the innerspring unit can also have an open coil mattress core or a foam mattress core. The outer rows of the coil springs of the pocketed innerspring unit 16 borders the side rail frame 10.

[0036] Side rail frame 10 includes a plurality of foam side rails 12a-d. Foam side rails 12a-d are made, for example, of polyurethane foam having a selected ILD or another suitable material known to those skilled in the art. In one embodiment, such as the one illustrated in Figure 1, the corners of foam side rails 12a-d are mitered to facilitate coupling. However, the interface between the foam side rails 12a-d can take on any suitable shape or relationship, such as, a flat abutment or a saw tooth configuration.

[0037] Foam side rails 12a-d are secured to one another with plastic tab fastener 14a-d. For example, the mitered interfaces of foam side rails 12a, 12b are secured to one another with plastic tab fastener 14a. Similarly, foam side rails 12b, 12c are secured via plastic tab fastener 14b. Mitered faces of foam side rails 12c, 12d are secured to one another with plastic tab fastener 14c. Likewise, foam side rails 12c, 12d are secured via plastic tab fastener 14d.

[0038] Referring now to Figure 2, there is shown a perspective, overhead view of a side rail frame constructed according to the teachings herein. More particularly, Figure 2 illustrates the process by which the side rail frame 10, as depicted in Figure 1, is assembled. Side rail frame 10, at least in part, comprises foam side rails 22a, 22b. In practice, foam side rails are assembled using plastic tab fastener dispenser 24. Plastic tab fastener dispenser 24, which will be described in more detail later, comprises plastic tab fastener clip 28 and insertion tip 26. The insertion tip penetrates foam side rails 22a, 22b and disposes a plastic tab fastener from the plastic tab fastener clip 28. General descriptions of the plastic tab fastener and dispenser will be discussed in more detail below.

[0039] It should be noted that additional layers may be inserted into the foam side rail framing. For example, on or more additional layers of foam can be penetrated by insertion tip 26 during the securing process of the foam side rails 22a, 22b.

[0040] Figure 3 illustrates an exemplary mattress assembly wherein, foam decking is being secured to a side rail frame, according to another embodiment of the present invention. Specifically, Figure 3 shows a perspective view of a mattress assembly, with bottom foam deck 36 being attached to three side rails 34a, 34b, and 34c which encloses an innerspring unit 35. Those skilled in the art will appreciate that the plurality of side rails 34a, 34b, and 34c can be provided to substantially surround the lateral sides of the innerspring unit 35. Alternatively, the side rail surrounding the innerspring unit 35 may

be made of a single piece made, for example, by an extrusion process without diverging from the spirit of the present embodiment.

[0041] Side rails 34a, 34b, and 34c are secured pursuant to the process elucidated in Figure 2. In particular, side rails 34a, 34b, and 34c comprise mitered ends and are secured using plastic tab fasteners. Specifically, side rails 34a, 34b are coupled together by plastic tab fasteners 32c, 32d using a plastic tab fastener dispenser (not shown). Side rails 34b, 34c are similarly secured using plastic fasteners 32a, 32b.

[0042] After the side rails 34a, 34b, and 34c (and a fourth side rail, not shown) are secured together thereby forming a frame around the periphery of the innerspring unit 20, the bottom foam deck 36 is secured to the side rail frame. Bottom foam deck 36 is adhered to the mattress assembly using a plastic tab fastener dispenser which will be discussed in greater detail below. Plastic tab fasteners 38a, 38b, 38c, and 38d secure bottom deck foam 36 to side rail framing. (Plastic tab insertion will be discussed in greater detail below.) Specifically, plastic tab fasteners 38a, 38b secure bottom foam deck 36 by insertion of plastic tab fasteners 38a, 38b into side rail 34a. Similarly, plastic tab fasteners 38c, 38d secure bottom foam deck 36 by insertion of plastic tab fasteners 38c, 38d into side rail 34c.

[0043] Referring to Figure 4, after the bottom foam deck 36 is secured to the mattress assembly, top foam deck 46 is applied. Figure 4 shows a perspective view of a mattress assembly, with top foam deck 46 being attached to three side rails 44a, 44b, and 44c which encloses an innerspring unit 35. It can be appreciated that the plurality of side rails 44a, 44b, and 44c can be provided to substantially surround the lateral sides of the innerspring unit 35. Alternatively, the side rail surrounding the innerspring unit 35 may be made of a single piece made, for example, by an extrusion process.

[0044] Side rails 44a, 44b, and 44c are secured pursuant to the process elucidated in Figure 2. Particularly, side rails 44a, 44b, and 44c comprise mitered ends and are secured

by plastic tab fasteners. Side rails 44a, 44b are coupled together by plastic tab fasteners 42c, 42d using a plastic tab fastener dispenser (not shown). Side rails 44b, 44c are similarly secured by plastic fasteners 42a, 42b.

5 [0045] After the side rails 44a, 44b, and 44c (and a fourth side rail, not shown) are secured together thereby forming a side rail frame around the periphery of the innerspring unit 20, the top foam deck 46 is secured the side rail frame. Top foam deck 46 is adhered to the mattress assembly using a plastic tab fastener dispenser which will be discussed in greater detail later in the disclosure. Plastic tab fasteners 48a, 48b, 48c, and 48d secure top foam deck 46 to side rail framing. Specifically, plastic tab fasteners 48a, 48b secure
10 top foam deck 46 by insertion of plastic tab fasteners 48a, 48b into side rail 44a. Similarly, plastic tab fasteners 48c, 48d secure top foam deck 46 by insertion of plastic tab fasteners 48c, 48d into side rail 44c.

[0046] As shown in Figure 5, to manufacture the mattress assembly in accordance with Figure 3 and Figure 4, the top or bottom foam decking can be affixed to the planar
15 face of the innerspring unit (not shown) using plastic tab fastener dispenser 56. The plastic tab fastener dispenser 56 has an insertion tip 58. In one or more embodiments, the insertion tip 58 does not penetrate entirely through the foam components. In practice, it has been discovered that this method of attachment is an effective means for adhering components, especially in closed cell type materials. For example, as depicted in Figure
20 5, top or bottom foam decking 52 is affixed to side rail 54 by piercing through top or bottom foam decking 52 and penetrating into, but not through, side rail 54.

[0047] Alternatively, the side rail frame (partially comprised by side rail 54) surrounding the innerspring unit may be made of a single piece made, for example, by an extrusion process. Accordingly, top or bottom foam decking can be affixed to an
25 extruded rail frame (not shown) by piercing through top or bottom foam decking and penetrating into, but not through, the extruded rail frame.

[0048] Figure 6 shows an embodiment of a mattress assembly 64 with side panels 68a, 68b installed over the side rails 62a, 62b for permanently installing a quilted top panel. Quilted top panel 60 is attached to the foam encasement unit, which surrounds the innerspring unit, using plastic tab fasteners. Specifically, side panel 68a of the quilted top panel 60 is pulled down and is affixed to side rail 62a by piercing through side panel 68a and penetrating into, but not through, side rail 62a. Side panel 68b of the quilted top panel 60 is similarly pulled down and affixed to side rail 62b by piercing through side panel 68b and penetrating into, but not through, side rail 62b.

[0049] Referring now to Figures 7 and 8, there are shown various views of an embodiment of a tool for use in dispensing one or more plastic fasteners. As will be described further below, tool 70 is designed principally for use in installing heavy-duty plastic fasteners, such as fastener 31, through various mattress components, such as those used to construct a foam encasement.

[0050] Compressed air powers tool 70 to dispense plastic fasteners. Tool 70 can be derived from EHD T-end system, such as, an extra heavy duty T-end fastener dispensing tool of the type manufactured and sold by Avery Dennison Corporation of Pasadena, California.

[0051] Tool 70 comprises a protective housing 75 which is constructed of a rigid and durable material. Housing 75 comprises a right side casing 77 and a left side casing 79 which are secured together by screws. Housing 75 additionally includes a nose 72 which is secured onto the leading end of casings 77 and 79 by screws. Nose 72 is adapted to receive an elongated, extra heavy-duty T-end, hollow, slotted needle 71.

[0052] Needle 71 is manufactured to have a length which is considerably longer than other types of conventional extra heavy-duty T-end, hollow, slotted needles. Specifically, needle 71 is preferably approximately 8 cm in length, thereby enabling it to penetrate

through two side rails of the foam encasement unit. However, it is to be understood that tool 70 can have needles of any length.

[0053] Tool 70 includes a pneumatically-driven ejection mechanism. Specifically, tool 70 has a pneumatically driven cylinder 73. Pneumatically driven cylinder 73 includes an air chamber and a telescopingly mounted push rod (not shown) which actuates in the axial direction. In practice, the activation and deactivation of drive cylinder 73 serves to longitudinally displace a slide which advances an ejector rod through tool 70. In particular, ejector rod (not shown) is aligned to selectively protrude axially through needle 71 so as to expel the cross-bar 85 of a fastener 81 out through the open tip of needle 71.

[0054] Activation and deactivation of drive cylinder 73 is controlled through a finger switch assembly 80. Finger switch assembly 80 allows tool 70 to be operated by hand, which is highly desirable.

[0055] Plastic tab fastener 81 is preferably in the form of a heavy duty plastic fastener. In particular, plastic tab fastener 81 can be in the form of an H-shaped heavy duty fastener of the type sold by Avery Dennison Corporation as part of the Extra Heavy Duty T-end® system. Specifically, plastic tab fastener 81 is a 3 inch plastic member which includes a first end shaped to define a cross-bar 83 (also commonly referred to as a "T-bar") a second end similarly shaped to define a cross-bar 85, (also commonly referred to as a "T-bar"), and a thin filament 87 interconnecting cross-bars 83 and 85.

[0056] Plastic tab fasteners can be mass-produced in a unitary form known commonly as fastener stock (as shown as plastic tab fastener clip 28 in Figure 2). The fastener stock is constructed in a clip-type assembly in which individual plastic fasteners are arranged in a spaced, side-by-side orientation, with the respective cross-bars 83 and 85 and parallel to one another, each of cross-bars being joined to a common, orthogonally-disposed runner bar 89 by a severable connector 87. Plastic tab fastener

clip is typically manufactured through the process of injection molding. In practice, plastic tab fastener clip, at least in part, is disposed in fastener guide assembly 90 which will now be described in greater detail.

5 [0057] Turning to Figure 9, fastener guide assembly 90 comprises a fastener guide 93 and a pair of guide covers 95a and 95b which together define a partially enclosed channel 96 for receiving runner bar 89, severable connectors 87, and cross-members 85 of the fastener clip. It can be appreciated that fastener guide assembly 90 is provided with a curved construction in order to maintain the clip of fasteners 81 away from the item to be fastened (i.e., the mattress assembly).

10 [0058] In other embodiments, the systems and methods described herein maybe used with two sided mattresses as well as mattresses that are capable of being used with adjustable beds. For example, a mattress for an adjustable bed may have a foam edge that has a break or a flexible component that is disposed somewhat midway along both long edges of the mattress. In this way, the adjustable bed will be more capable of pivoting
15 around a central axis as the flexible portion built in the foam edge readily allows the mattress to pivot and bend.

[0059] It will be understood that any innerspring unit may be employed with the systems and methods described herein. Thus, open coils, pocketed coils, coils in foam, and even all foam units, which may include sections of different firmness, maybe used
20 with the methods described herein.

[0060] The embodiments shown of the present invention are intended to be merely exemplary and those skilled in the art shall be able to make numerous variations and modifications to them without departing from the spirit of the present invention. All such variations and modifications are intended to be within the scope of the present invention
25 as defined in the appended claims.

[0061] For example, the disclosed invention may be used to assembled foam encasements using other types of fasteners. According to other implementations, the invention may be employed assembled using alternative types of dispensers, other than explicitly disclosed.

- 5 [0062] The order in which the steps of the present method are performed is purely illustrative in nature. In fact, the steps can be performed in any order or in parallel, unless otherwise indicated by the present disclosure.

[0063] What is claimed is:

1. A mattress comprising:

an innerspring unit;

a foam encasement for enclosing the innerspring unit having:

a plurality of foam encasement elements, including at least one mitered side rail;

one or more fasteners fastening the plurality of foam encasement elements together, the fasteners having at least one end terminating in a substantially perpendicular end; and

an outer cover covering at least a portion of the foam encasement.

2. The mattress according to claim 1 wherein, one or more of foam encasement elements comprise a substantially planar piece of foam.

3. The mattress according to claim 1 wherein, one of the at least one side rail is abutted up against another of the at least one side rail to form an interface.

4. The mattress according to claim 1 wherein, the at least one side rail is composed of, at least in part, polyurethane foam.

5. The mattress according to claim 1 wherein, the fasteners comprise a polymer.

6. The mattress according to claim 5 wherein, the fasteners are plastic tab fasteners.

7. The mattress according to claim 6 wherein, the plastic tab fasteners have ends terminating in a substantially perpendicular direction relative to the main body of the plastic tab fastener.

8. The mattress according to claim 1 wherein, the fasteners are T-End fasteners.

9. The mattress according to claim 2 wherein, the substantially planar piece of foam is in the form of a sheet.
10. The mattress according to claim 1 wherein, the at least one side rail forms, at least in part, a perimeter.
11. The mattress according to claim 9 wherein, the substantially planar piece of foam is substantially the size of an outer perimeter and disposed adjacent to a perimeter formed, at least in part, by one or more foam encasement elements.
12. The mattress according to claim 11 further comprising a second substantially planar piece of foam, being substantially the size of the outer perimeter and disposed adjacent and opposite to the foam encasement relative to the substantially planar piece of foam.
13. The mattress according to claim 1 wherein, the fasteners comprise a polymer.
14. The mattress according to claim 1 wherein, the innerspring unit is an open coil configuration, or an Marshall coil configuration.
15. The mattress according to claim 1 wherein, the outer covering is substantially flame retardant.
16. The mattress of claim 1, wherein the one or more fasteners penetrate into the plurality of foam encasement elements.
17. A method for assembling a foam encasement for enclosing pocketed coils contained in a mattress comprising:
 - providing a fastening tool having a needle for inserting and disposing fasteners through foam or fabric, the fasteners having a least one end terminating in a substantially perpendicular end;
 - providing a first and second foam encasement element, wherein at least one of the first and second foam encasement elements is mitered; and

assembling the first and second foam encasement elements by:

inserting the needle into the first foam encasement element;

continuing to insert the needle into the second foam encasement element; and

actuating the fastening tool for disposing the fastener in a predetermined location.

18. The method according to claim 17 wherein, the first and second foam encasement elements are side rails.

19. The method according to claim 18 wherein, the at least one mitered side rail forms a corner joint.

20. The method according to claim 19 wherein, the needle is inserted through the mitered face of the side rail at the corner joint.

21. The method according to claim 17 wherein, the first foam encasement element is a bottom foam base.

22. The method according to claim 21 wherein, the fastening tool is inserted through the bottom foam base and partially through the second foam encasement element.

23. The method according to claim 22 wherein, the second foam encasement element is a side rail.

24. The method according to claim 17 wherein, the fasteners comprise a polymer.

25. The method according to claim 24 wherein, the fasteners are plastic tab fasteners having longitudinal axes.

26. The method according to claim 25 wherein, the plastic tab fasteners have two ends and at least one of the two end terminating in a substantially perpendicularly relative to the longitudinal axis of the plastic tab fastener.

27. The method according to claim 17 wherein, the fasteners are T-End fasteners.