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(71) Applicant: SIMPSON STRONG-TIE COMPANY, INC. [US/US]; 5956 W. Las Positas Boulevard, Pleasanton, CA 94588 (US).

(72) Inventor; and

(71) Applicant (for US only): PARK, Jeremy, Scott [US/US]; 5956 W. Las Positas Boulevard, Pleasanton, CA 94588 (US).

(74) Agent: VIERRA, Larry, E.; Vierra Magen Marcus LLP, 575 Market Street, Suite 3750, San Francisco, CA 94105 (US).

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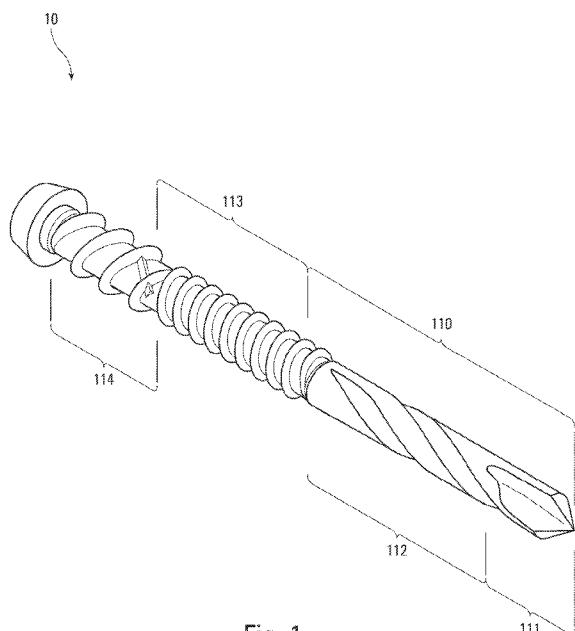


Fig. 1

(57) Abstract: A fastener includes a shank (100) having a pilot section (110) and a threaded section (113). The pilot section includes a cutting tip (111) and a drill section (112); the threaded section includes a first thread region (113) having the same twist as the drill section and a reverse thread region (114). A helical ridge (115) may be provided in the reverse thread region. A head (104) at the second end includes a top portion such as a disk and an undercut region.

## **FASTENER WITH DRILL PILOT AND REVERSED THREADED REGIONS**

### **BACKGROUND**

**[0001]** Variations in fastener design have been used to improve different characteristics and performance of fasteners depending on the intended use of the fastener. In general, a screw-type fastener includes a threaded shank with a pointed tip at one end thereof and a head at the other end. The head has a recess for accepting a driver tip.

**[0002]** Fastener design can vary based on whether the design is used as a self-drilling fastener, or used with a pre-drilled bore, and based on the type of material for which the fastener is to be used.

### **SUMMARY**

**[0003]** Technology is described herein which comprises a fastener having features allowing securing elements in wood, composite or other material and providing an improved counter-sunk head. The fastener includes a shank having a pilot section and a threaded section. The pilot section includes a cutting tip and a drill section; the threaded section includes a first thread region having the same twist as the drill section and a reverse thread region. A head at the second end includes a top portion such as a disk and an undercut region.

**[0004]** This Summary is provided to introduce a selection of concepts in a simplified form that are further described below in the Detailed

Description. This Summary is not intended to identify key features or essential features of the claimed subject matter, nor is it intended to be used as an aid in determining the scope of the claimed subject matter.

### **BRIEF DESCRIPTION OF THE DRAWINGS**

**[0005]** Figure 1 depicts a perspective view of a first embodiment of a fastener in accordance with the present technology.

**[0006]** Figure 2 depicts a plan view of a first embodiment of a fastener in accordance with the present technology.

**[0007]** Figure 3 depicts an end view of a first embodiment of a fastener in accordance with the present technology.

**[0008]** Figure 4 depicts a partial cross sectional view along line b-b in Figure 3.

**[0009]** Figure 5 is a cross sectional view along line c-c in Figure 2.

**[0010]** Figure 6 is a plan view of the fastener in accordance with the present technology.

### **DETAILED DESCRIPTION**

**[0011]** The technology described herein is a fastener having features allowing for securing elements in wood, composite or other material and providing an improved counter-sunk head. The fastener is advantageously used in composite materials and in applications using the composite materials mounted to a steel frame. One example of this type of application is construction of a composite deck using a steel frame.

**[0012]** A first embodiment of the fastener technology will be described with respect to Figures 1 – 6.

**[0013]** The fastener 10 includes a pilot section 110 having a cutting tip 111 and a drill section 112, followed by a first threaded section having a twist matching the twist or spiral of the drill section, and a reverse thread section. The design of the fastener allows the fastener to bore into a material, such as a composite decking material, and bore through and engage a metal frame supporting the material, to secure the material to the frame. The pilot section ensures the fastener passes through both the composite and the metal material, and the threaded section engages the metal frame to secure the material to the frame. The threaded section pulls the fastener down by rotation of the fastener so that a head of the fastener engages and sinks into the material and secures the material to the frame. The reverse thread section evacuates debris generated by the boring of the fastener into the material as the fastener rotates into the material.

**[0014]** The fastener 10 of Figures 1 – 6 includes a shank 100 having a first end with a pointed tip 102 at and a second end having a head 104. The shank may be formed of galvanized steel. The body of the shank has a minor diameter  $D_m$ . A pilot region 110 of the shank includes a cutting tip 111 and a drill section 112 formed on the shank 100 and has a pilot length  $PL$ . The pilot region extends from pointed tip 102 to a threaded region 113. The shank in the first region has major diameter  $M_d$ .

**[0015]** The cutting tip 111 is commonly known in the industry as a drill point tip, also referred to by a common manufacturer name as a TEK® point. A cutting tip has two cutting edges extending from the point 102 and formed from a cylindrical cross-section of a shank, ending in

drill section 112. The cutting edges are symmetrical relative to the cross section and allow material borne out by the rotation of the screw to be evacuated as the fastener is rotated into the material. The cutting tip 111 has a point diameter 111a and a length 112a. The point is formed by an angle ALPHA of the cutting edges. The drill section 112 has a drill length 112b. As indicated in the Figures, the diameter 112c of the drill section 112 may be smaller than the diameter 111a of the drill point 102.

**[0016]** The drill section 112 has an effective diameter 112c with a drill spiral or flute having approximately one and a half turns in the drill section 112. More or fewer turns can be provided within the context of the technology. As illustrated in Figure 5, a cross section along line c –c in Figure 2, the spiral may be a double sided spiral (with two flutes effectively 180 degrees apart in section 112 (relative to the cross sectional diameter shown in Figure 5)).

**[0017]** The drill section 112 abuts a first threaded region 113 having a thread with a twist direction matching the twist direction of the spiral in the drill section 112. A reverse thread section 114 abuts the first thread region between the region 113 and the head 104. The reverse thread region 114 includes a helical ridge 115 formed on the shank having an thread height lower than a thread height of the thread 116 in the reverse thread region 114, and of a shorter thread length (smaller number of turns) interspersed with the reverse thread 116 in reverse thread region 114.

**[0018]** The fastener has a total length  $T_1$  from the top of the head to the point 102. The head height is  $H_h$  and the helical ridge begins a distance  $R_s$  from the top of the head 104 and ends a distance  $R_e$  from the top of the head. The first thread region has a length  $T_{h1}$ .

**[0019]** The shank in the first thread region has a minor diameter  $D_m$

and a major diameter  $M_d$ , the difference between which is the thread height of the threads in thread region 113. The threads in region 113 have a pitch  $P_1$ , while those in the reverse thread region have a pitch  $P_2$ . The reverse thread major diameter  $RTM_d$  is greater than the major diameter  $M_d$  and the difference between  $RTM_d$  and minor diameter  $D_m$  is the height of the threads in region 114. The helical ridge has a height lower than the height of the threads in region 114.

**[0020]** In one embodiment, a reverse thread region need not be utilized.

**[0021]** The fastener has a total length  $T_l$ . Region 113 has a length  $Th_l$ . The head has a height  $H_h$ .

**[0022]** In one embodiment, the relationship between the aforementioned dimensions includes one or more of the following:

- a.  $P_2$  is greater than  $P_1$  such that  $P_2:P_1$  is in a range of about 1.7:1 to 2:1;
- b.  $P_3$  is greater than  $P_1$  such that  $P_3:P_1$  is in a range of about 20:1 – 30:1. In a fastener having a total overall length of about 2.375 inch,  $P_3$  will be approximately 0.75 turns per inch, with  $P_1$  being slightly less than half the length of the  $T_l$ ;
- c.  $M_d$  is greater than the diameter of the point 111a in a range of about 1.5:1 – 1.2:1;
- d.  $RTM_d$  is greater than  $M_d$  in a range of about 1.15:1 – 1.02:1;
- e.  $RTM_d$  is greater than  $D_m$  in a range of about 1.55:1 –

1.3:1;

- f. The diameter 111a of the cutting tip is greater than or equal to the diameter 112c of the drill section in a ratio of about 1:1 to 1.2:1; and
- g. Alpha is about 105 – 115 degrees, but could be greater or smaller.
- h. The relative length of section 110 (PL) to the length of 114 is about 2.5:1, and the relative length of section 113 (THI) to 114 is about 1.8:1. Length 112a of tip 111 is about 20 – 30% of the length PL of section 110.

**[0023]** A head 140 having a head diameter HD is provided at the other end of the shank 100. The head comprises a top portion which may include a disk 142 having a top surface and a bottom surface. The bottom surface is formed with a recess having a depth Rc. In another embodiment (not shown), the top portion of the head includes no disk but terminates in a top surface. The top surface of the head is formed to have a recess forming a Phillips socket. Note that instead of the Phillips recess, a square or other shaped recess may be formed in the top of the head 142 to receive a driver.

**[0024]** The head diameter Hd is greater than the minor diameter Dm in a range of about 2.1:1 to 1.8:1.

**[0025]** The screw is designed to be a self-boring screw into the material to be fastened. However, a pilot hole may be utilized.

**[0026]** When the screw is driven into a material, the cutting tip and drill section bore out material as the screw is pressed and rotated (using for example a power drilling tool) into a material. Because the cutting tip

has a slightly larger effective diameter, it is responsible for more of the torque and evacuation of material. Where the fastener is used in an application for fastening a first material (such as a composite) to a second, harder material (such as metal), the first threaded region does not generally contribute to pull down in the first material. Rather, when the first threaded region reaches the harder material, the first threaded region engages the harder material and provides pull down as the screw rotates. The reverse thread region evacuates material as the screw rotates in the first material.

**[0027]** Although the subject matter has been described in language specific to structural features and/or methodological acts, it is to be understood that the subject matter defined in the appended claims is not necessarily limited to the specific features or acts described above. Rather, the specific features and acts described above are disclosed as example forms of implementing the claims.

**CLAIMS**

What is claimed is:

1. A fastener, comprising:
  - a shank having a first end and a second end, and having a diameter, the shank including
    - a pilot region beginning at the first end and including a drill section;
    - a first thread region adjacent the pilot region having a thread with a twist direction matching a twist direction of the drill section;
    - a reverse thread region adjacent the first thread region, the reverse thread region having a thread having a twist opposite to the thread in the first thread region; and
    - a head at the second end.
2. The fastener of claim 1 wherein the pilot region includes a cutting tip and the drill section.
3. The fastener of claim 2 wherein the cutting tip comprises a TEK tip.
4. The fastener of claim 3 wherein the cutting tip includes a pointed end, the pointed end formed by two cutting edges joined at an angle between 100 and 120 degrees.
5. The fastener of claim 2 wherein the cutting tip has a diameter and the drill section has a diameter smaller than the diameter of the cutting tip.

6. The fastener of claim 2 wherein the pilot region drill section has a helical twist having a pitch greater than a pitch the thread in the first thread region.
7. The fastener of claim 5 wherein the thread in the first thread region includes is a helical thread having a height greater than a diameter of the cutting tip in a range of about 1.5:1 – 1.2:1.
8. The fastener of claim 1 further including a helical ridge in the reverse thread region having a twist direction matching the thread in the first thread region.
9. The fastener of claim 8 wherein the helical ridge has a height which is less than a height of the thread in the reverse thread region.
10. The fastener of claim 1 wherein the thread in the reverse thread region includes a height which is greater than a minor diameter of the shank in the first thread region in a range of about 1.55:1 - 1.3:1.
11. The fastener of claim 1 wherein the pilot region has a length which is greater than a length of the reverse thread region by about 2.5:1
12. The fastener of claim 1 wherein the first thread region has a length which is greater than a length of the reverse thread region, by about 1.8:1.
13. The fastener of claim 2 wherein the cutting tip has a length which is about 20 – 30% of a length of the pilot region
14. The fastener of claim 1 wherein a pitch of the thread in the reverse thread region is greater than a pitch of the thread in the first

thread region in a range of about 1.7: 1 to 2:1.

15. A fastener, comprising:

a shaft having a first end and a head at a second end, the shaft including

a pilot region including a cutting tip adjacent to the first end and a drill section positioned adjacent to the, the cutting tip having a diameter larger than a diameter of the drill section, the drill section including a flute spiraled in the drill section;

a first thread region adjacent to the pilot region having a helical thread with a twist direction matching a twist direction of the flute, the helical thread having a diameter greater than the diameter of the drill section;

a reverse thread region adjacent the pilot region, the reverse thread region having a thread with a twist direction opposite the thread in the first thread region, the thread in the reverse thread region having a diameter greater than the diameter of the helical thread; and

the head having a top portion and a bottom portion the bottom portion having a recess.

16. The fastener of claim 15 wherein the flute has a helical twist having a pitch greater than a pitch the thread in the first thread region.

17. The fastener of claim 16 wherein the helical thread in the first thread region has a height greater than the diameter of the cutting tip in a range of about 1.5:1 – 1.2:1.

18. The fastener of claim 17 further including a helical ridge in the reverse thread region having a twist direction matching the thread in the first thread region, the helical ridge has a height which is less than a height of the thread in the reverse thread region.

19. A fastener having a first end and a second end, comprising:

    a pilot region including a cutting tip adjacent to the first end and a drill section positioned adjacent to the, the cutting tip having a diameter larger than a diameter of the drill section, the drill section including a flute spiraled in the drill section;

    a first thread region adjacent to the pilot region having a helical thread with a twist direction matching a twist direction of the flute, the helical thread having a diameter greater than the diameter of the drill section.

20. The fastener of claim 19 further including a reverse thread region adjacent the pilot region, the reverse thread region having a thread with a twist direction opposite the thread in the first thread region, the thread in the reverse thread region having a diameter greater than the diameter of the helical thread.

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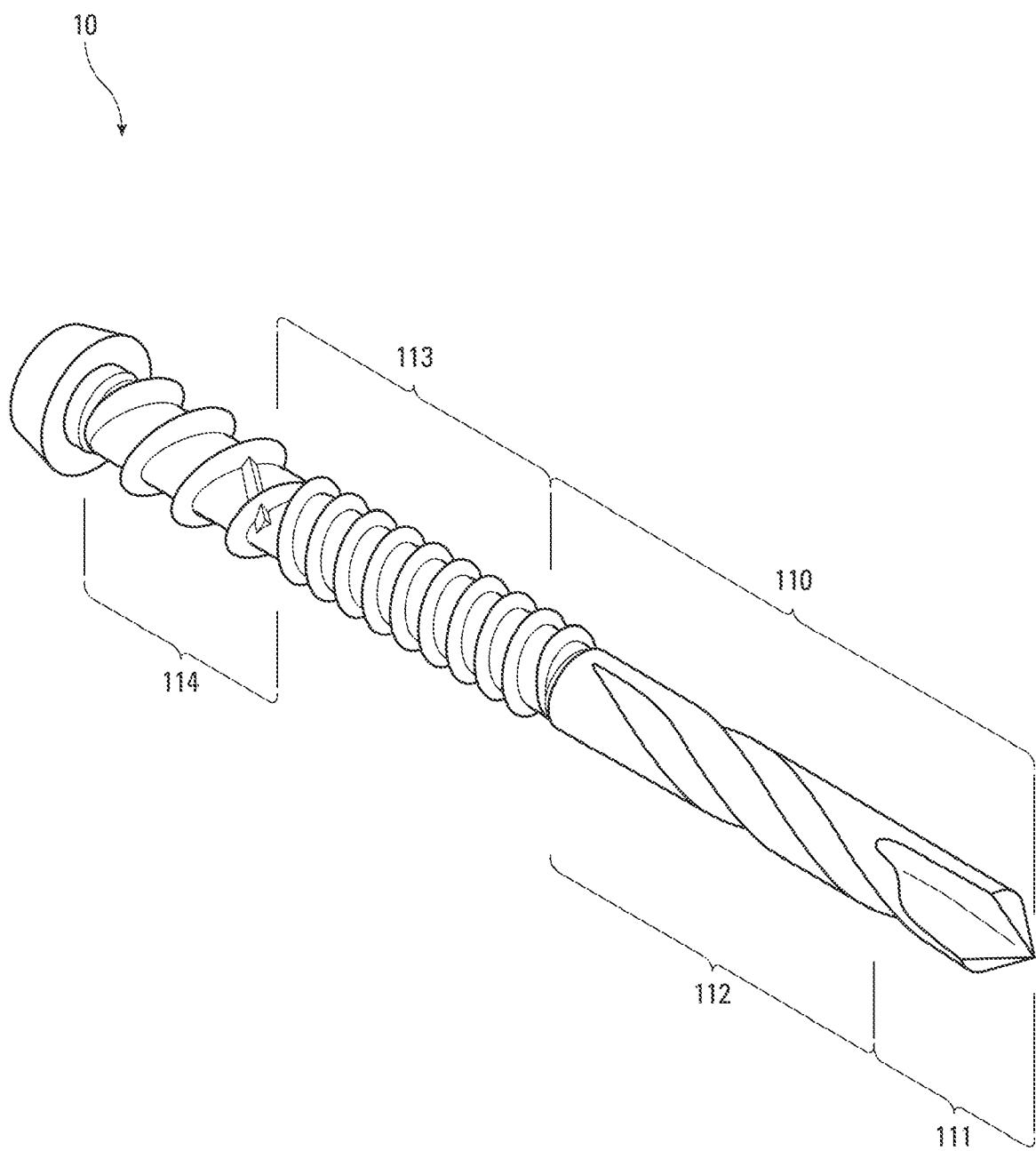


Fig. 1

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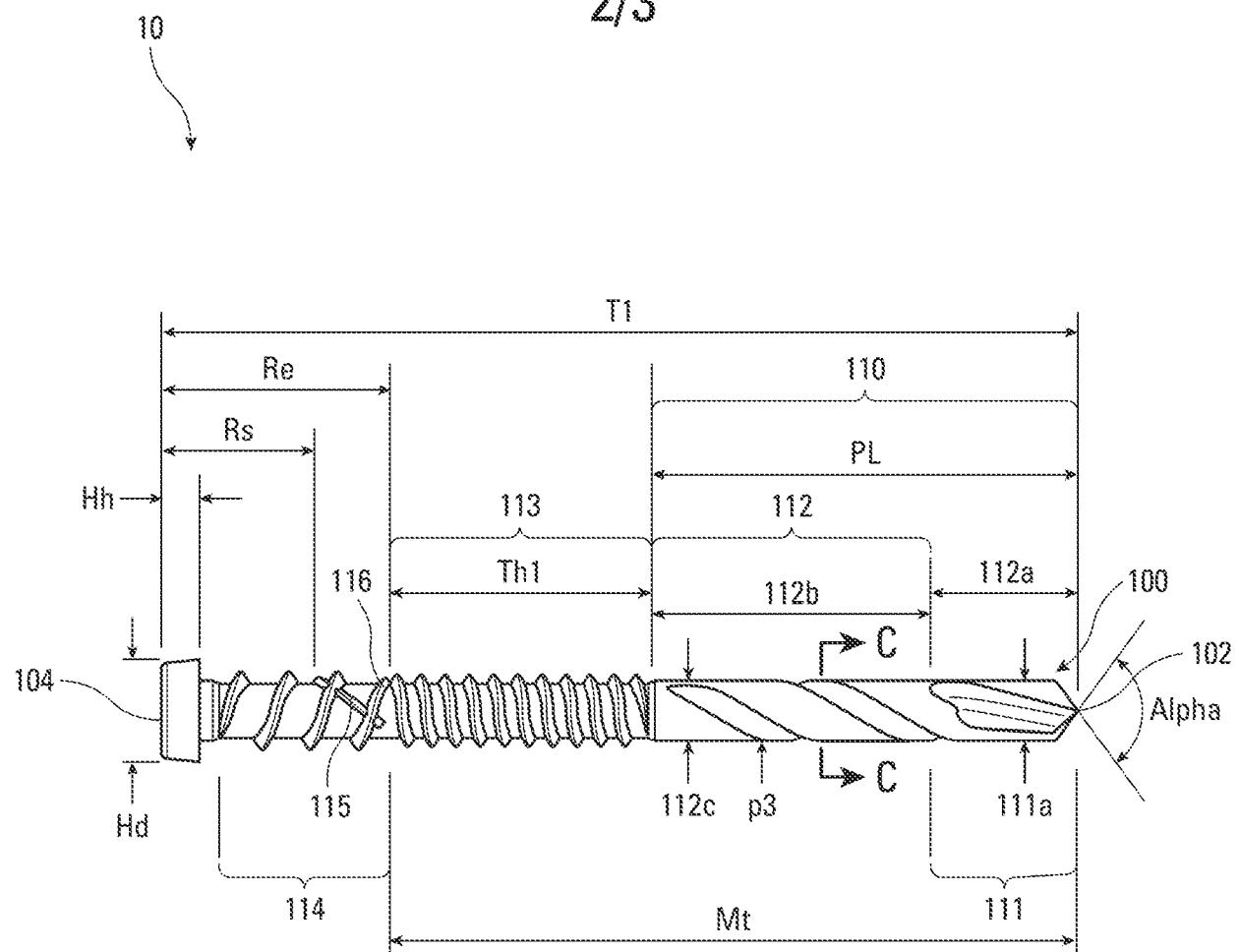


Fig. 2

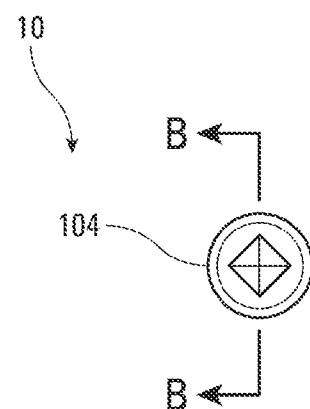


Fig. 3

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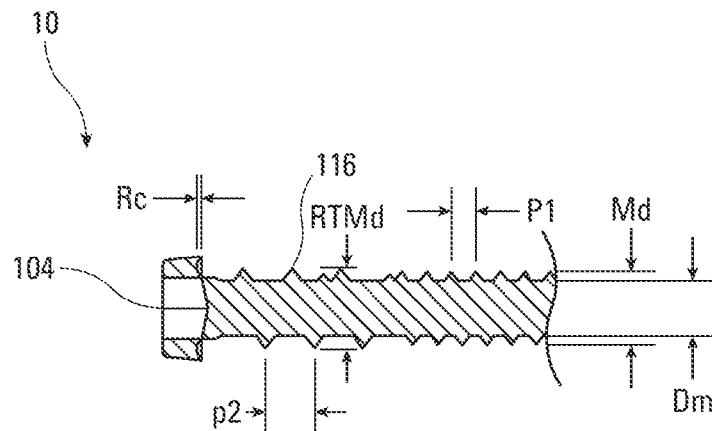
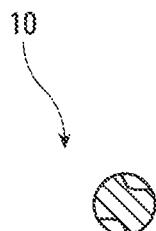


Fig. 4



C - C

Fig. 5

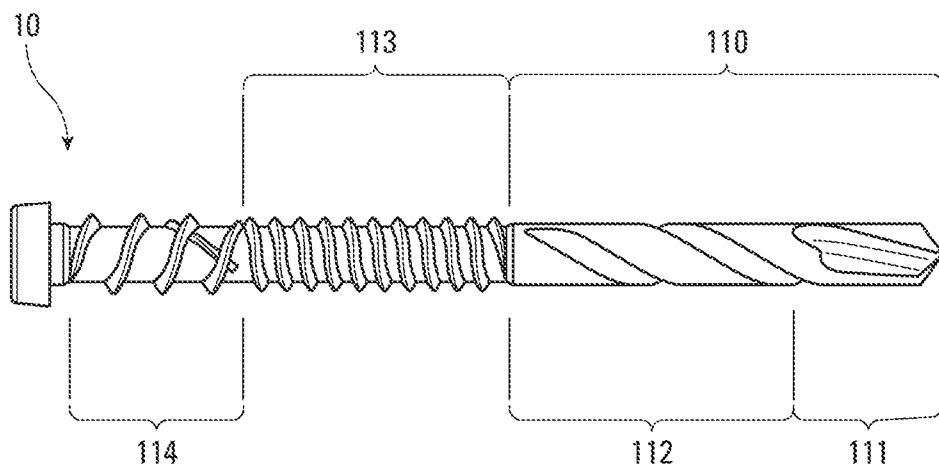


Fig. 6

# INTERNATIONAL SEARCH REPORT

International application No  
PCT/US2013/051704

**A. CLASSIFICATION OF SUBJECT MATTER**  
INV. F16B25/00  
ADD. F16B25/10

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)  
F16B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, WPI Data

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

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Y	figures 1-2 -----	8,9,18
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X	JP 2002 349528 A (FUKASAWA KK) 4 December 2002 (2002-12-04) abstract; figures ----- -/-	1

Further documents are listed in the continuation of Box C.

See patent family annex.

\* Special categories of cited documents :

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Date of the actual completion of the international search  25 September 2013	Date of mailing of the international search report  02/10/2013
Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Authorized officer  Pöll, Andreas

**INTERNATIONAL SEARCH REPORT**

International application No PCT/US2013/051704
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