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**US 4976577 A**

(58) Field of Search:  
INT CL **F16B**  
Other: **WPI, EPODOC, TXTE**

(54) Title of the Invention: **Fasteners**  
Abstract Title: **Pin for a blind bolt**

(57) A pin 3 for a blind bolt 1 (see figure 1) has a proximal end 31, a distal end 32 and a shaft 33 between the proximal and distal ends. Extending axially from the distal end is an outwardly tapered surface 34 and an inwardly tapered surface 36. The pin 3 comprises a strike portion 40 at the proximal end 31. The cross sectional area of the strike portion 40 is greater than the cross sectional area of the shaft 33.

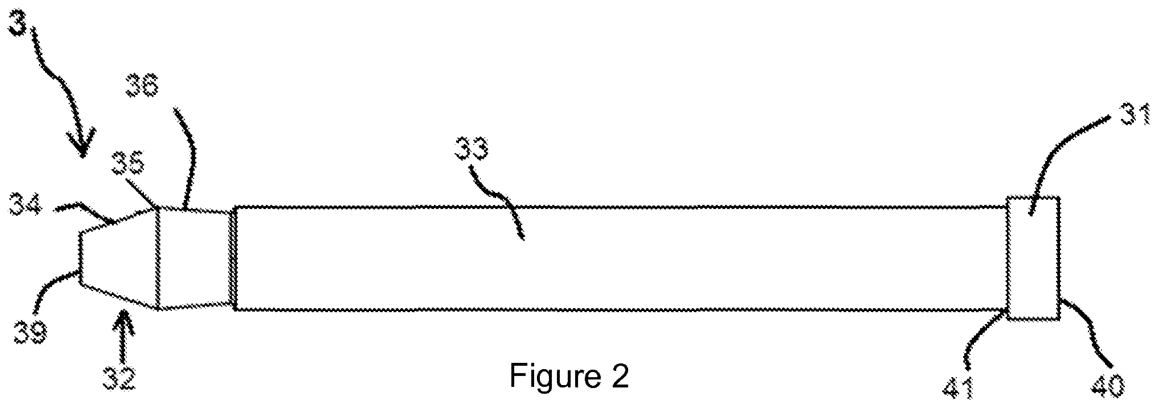


Figure 2

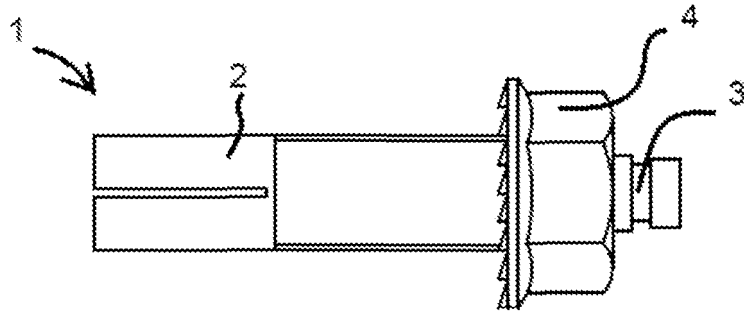


Figure 1

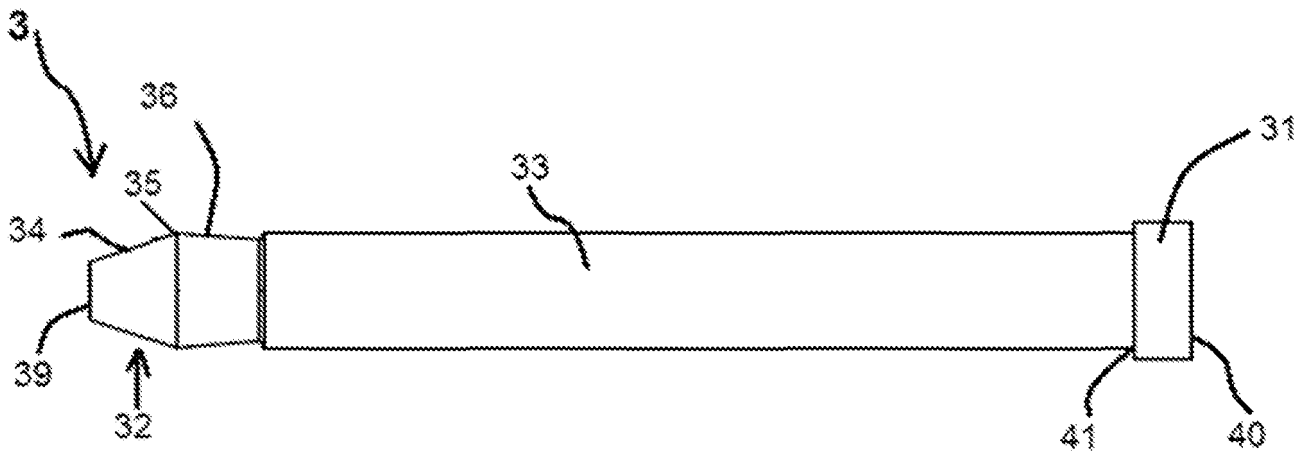


Figure 2

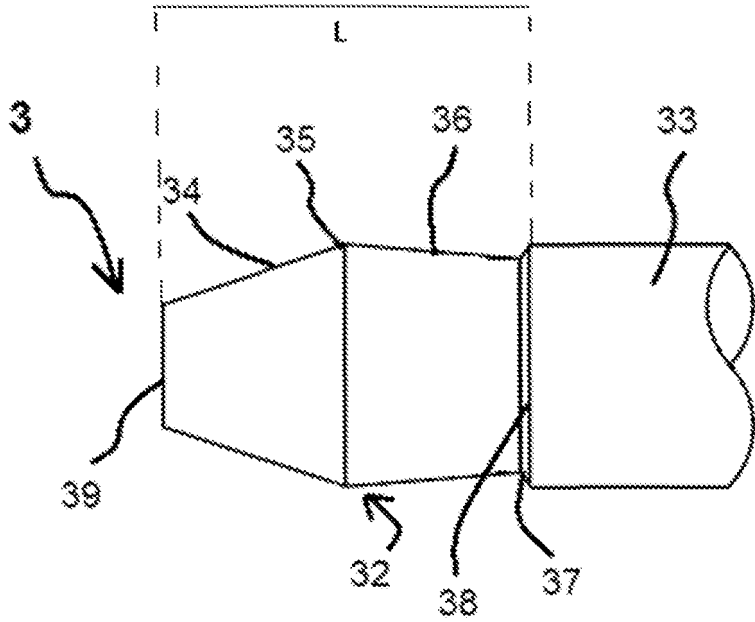


Figure 3

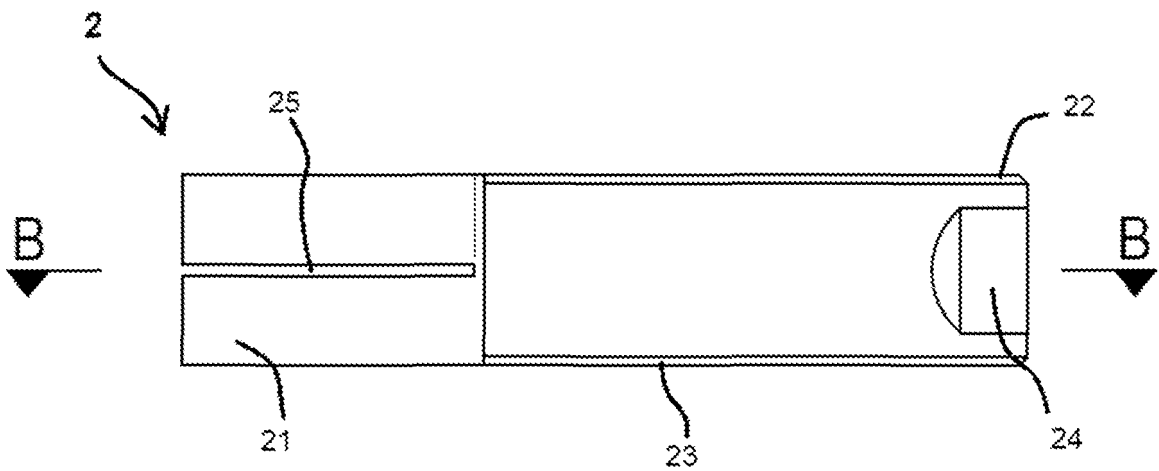


Figure 4

3/4

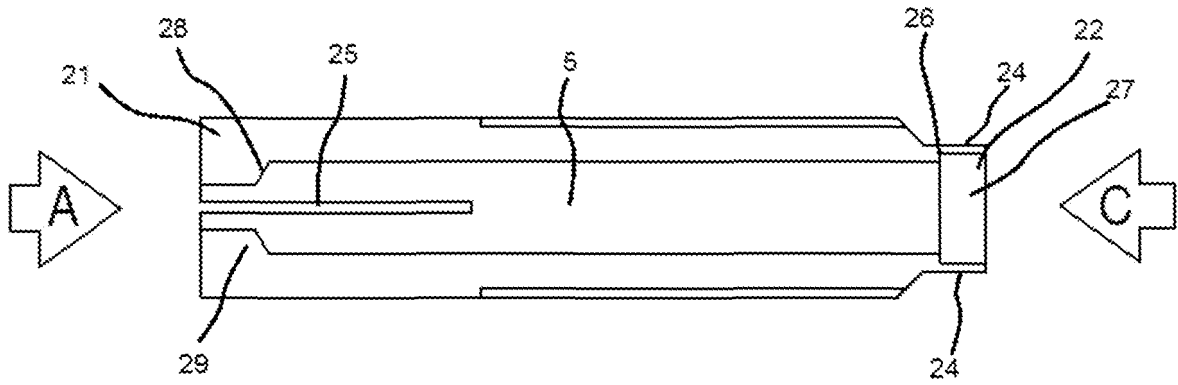


Figure 5

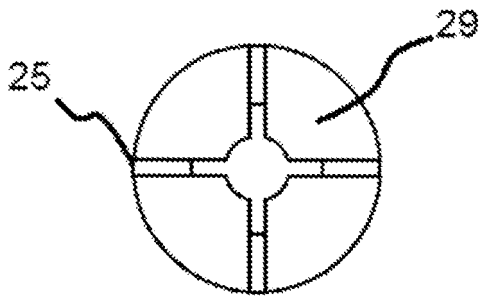


Figure 6

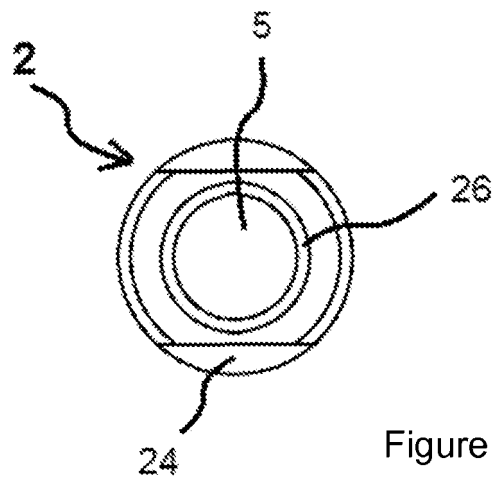


Figure 7

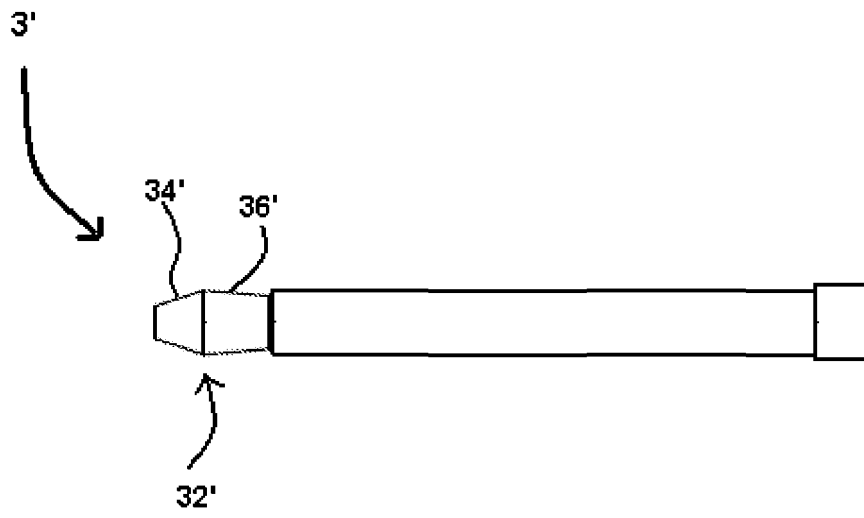


Figure 8

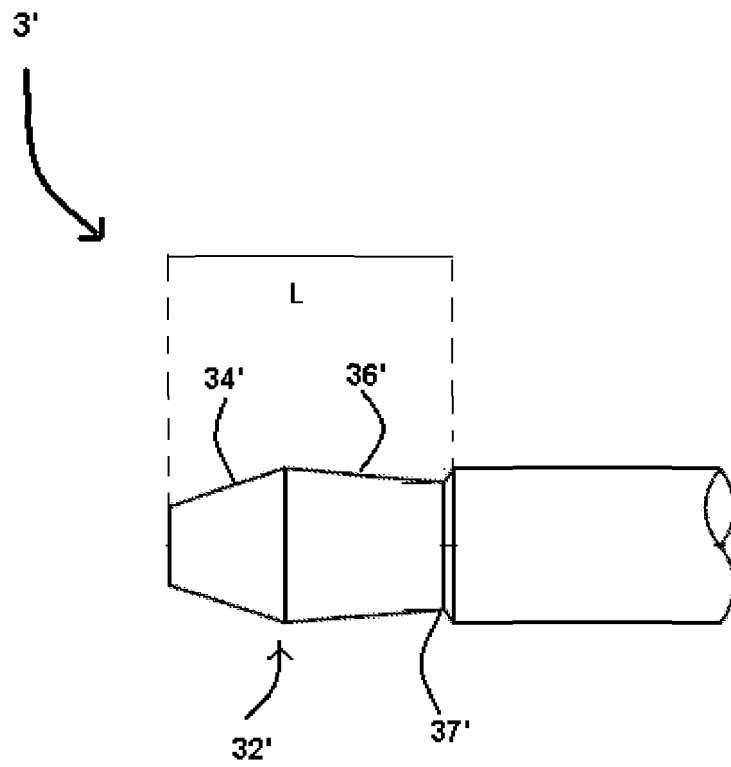


Figure 9

## FASTENERS

5 This invention relates to fasteners and is especially, but not exclusively, related to fasteners for use in securing components to section, e.g. hollow box section, whereby access to the interior of the section is restricted in whole or in part.

A number of fasteners of this kind, which are generally termed blind bolts, are known.

10

It is an object of the present invention to provide an improvement over known types of fasteners. It is a non-exclusive object of the invention to provide a fastener which, once engaged, has a tendency to continue to force the component and section together. It is a further object of the present invention to provide a fastener which can withstand significant environmental factors such as vibrational forces and so on.

15

Accordingly, a first aspect of the invention provides a pin for a blind bolt, the pin having a proximal end, a distal end and a shaft between the proximal and distal ends, extending axially from the distal end an outwardly tapered surface and an inwardly tapered surface, the pin comprising a strike portion at the proximal end, wherein the cross sectional area of the strike portion is greater than the cross sectional area of the shaft.

20

Preferably, the pin comprises an apex at the juncture between the outwardly tapered surface and the inwardly tapered surface.

25

Alternatively, the pin may comprise a region having a substantially constant cross sectional area between the outwardly tapered surface and the inwardly tapered surface.

30

*In some embodiments, the pin may comprise a second outwardly tapered surface extending axially from the distal end and between the inwardly tapered surface and the shaft.*

Preferably, the outwardly tapered surface, the inwardly tapered surface and, if present, the second outwardly tapered surface provide at least part of a tip having a length  $L$ .

Preferably, the inwardly tapered surface has a length of at least approximately  $0.25L$ .

5

Preferably, the inwardly tapered surface has a length of at least approximately  $0.3L$ ,  $0.35L$ ,  $0.4L$ ,  $0.45L$ ,  $0.5L$ ,  $0.55L$  or at least approximately  $0.6L$ .

Preferably, the angle between the second outwardly tapered surface and the shaft is greater than the angle between the outwardly tapered surface and the shaft.

10

Preferably, the distal end of the pin has a narrower cross sectional area than the juncture between the inwardly tapered surface and the shaft or, if present, the second outwardly tapered surface.

15

Preferably, the pin comprises at least one facing surface, the or each facing surface, preferably, defining a juncture between the shaft and the strike portion.

Preferably, the or each facing surface is orthogonal to the principal axis of the shaft.

20

Preferably, the or each facing surface faces the distal end of the pin.

Preferably, the pin comprises a single facing surface which extends about the entire periphery of the pin.

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In other embodiments the facing surface of the pin tapers outwardly towards the proximal end such that the cross sectional area of the strike portion is greater than the cross sectional area of the shaft.

30 Preferably, the pin comprises a unitary body.

Preferably, one or more of the pin, the shaft, the strike portion, the proximal end or the distal end is circular in cross-section. Other cross-sectional shapes such as triangular, rectangular or elliptical may be envisaged without departing from the present invention.

- 5 In a second aspect the invention provides a pin for a blind bolt, the pin comprising a shaft and a tip at one end of the shaft, the tip having a length  $L$ , extending axially in a direction towards the shaft the tip comprises successively an outwardly tapered surface and an inwardly tapered surface, wherein the inwardly tapered surface has a length of at least approximately  $0.25L$ .

10

Preferably, the inwardly tapered surface has a length of at least approximately  $0.3L$ ,  $0.35L$ ,  $0.4L$ ,  $0.45L$ ,  $0.5L$ ,  $0.55L$  or at least approximately  $0.6L$ .

Preferably, the pin further comprises a strike portion at a second end of the shaft.

15

Preferably, the cross sectional area of the strike portion is greater than the cross sectional area of the shaft.

- 20 In a third aspect the invention provides a bolt having a distal end, a proximal end and a longitudinal bore extending therethrough, at the proximal end the bore having a rebate, *e.g.* for receiving the head of a pin.

Preferably, the rebate extends at least partially about the inner surface of the bolt.

- 25 Preferably, the rebate comprises one or more shoulders.

In some embodiments the bolt may comprise a single shoulder extending about the entire inner surface of the bolt.

- 30 Preferably, the bolt comprises at least one slot, *e.g.* an open-ended slot, at or towards the proximal end.



Preferably, the bolt comprises four slots, each slot being spaced from another by approximately 90° about the periphery of the bolt.

Preferably, the bolt comprises an outer thread.

5

Preferably, the outer thread extends axially from the proximal end and terminates at least part-way along the length of the bolt.

10 Preferably, the outer thread terminates at approximately three-quarters along the length of the bolt. More preferably, the outer thread terminates at approximately two-thirds along the length of the bolt.

Preferably, the or each slot extends from the distal end and terminates at or about the region of the outer thread.

15

Preferably, the bolt comprises one or more feet. The or each foot may extend radially from the distal end and, preferably, terminates with a tapered portion.

20 Preferably, the bolt comprises at least one pair of flats, *e.g.* for providing a surface for a spanner to grip the bolt.

Preferably, the bolt comprises a single pair of flats.

25 Preferably, the pin and/or bolt is formed from steel. However, other alloys or metals may be used provided that the pin and/or bolt has sufficient strength.

Preferably, the pin and/or bolt is heat treated and/or finished with a coating.

30 In another aspect the invention provides a fastener comprising a bolt and an insertion pin as described above.

Preferably, the fastener further comprises a nut.

In order that the invention may be more fully understood, a preferred embodiment of a fastener in accordance with the invention will now be described by way of example only and with reference to the accompanying drawings, in which:

5           Figure 1 shows a plan view of a blind bolt;

            Figure 2 shows a plan view of an insertion pin;

            Figure 3 shows a detailed view of a leading end of the insertion pin of Figure 2;

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            Figure 4 shows a plan view of a bolt;

            Figure 5 shows a cross-section of the bolt along the line B-B of Figure 4;

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            Figure 6 shows a side elevation of the bolt as viewed along the direction of arrow A of Figure 5;

            Figure 7 shows a side elevation of the bolt as viewed along the direction of arrow C of Figure 5;

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            Figure 8 shows a plan view of an insertion pin of a second embodiment of the invention; and

            Figure 9 shows a detailed view of a leading end of the insertion pin of Figure 8.

25

Referring firstly to Figure 1 of the accompanying drawings, a blind bolt, indicated generally a 1, comprises a bolt 2, an insertion pin 3 and a nut 4. The bolt 2 has a longitudinal bore 5 extending from one end to the other within which the insertion pin 3 is slidably retained.

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In Figure 2, the insertion pin 3 is shown as comprising a proximal end 31 and a distal end 32. The pin 3 also comprises a shaft 33 between the proximal 31 and distal 32 ends. Each component of the pin 3 is circular in cross-section, although other shapes

may be envisaged without departing from the scope of the invention. For instance, the pin 3 or shaft 33 or another component may comprise a rectangular, triangular or other suitably shaped cross-section.

- 5 Extending axially from the distal end 32, the pin 3 comprises an outwardly tapered surface 34, an apex 35 and an inwardly tapered surface 36.

In the embodiment being described, and as will be appreciated from Figure 3 which shows a detailed view of the distal end 32, the pin 3 comprises a second outwardly tapered surface 37 extending axially from the distal end 32 and between the inwardly tapered surface 36 and the shaft 33. The angle between the second outwardly tapered surface 37 and the shaft 33 is greater than the angle between the first outwardly tapered surface 34 and the shaft 33 which results in the second outwardly tapered surface 37 being significantly shorter in length than the first outwardly tapered surface 34.

15

In some embodiments, the pin 3 need not comprise the second outwardly tapered surface 7. In such embodiments, the inwardly tapered surface 36 is attached directly to shaft 33.

- 20 In all embodiments, the narrowest part of the inwardly tapered surface 36 defines a neck 38.

The distal end 32 of the pin 3 comprises a leading face 39. The leading face 39 has a narrower cross sectional area than that of the neck 38.

25

In the embodiment of Figure 3 the outwardly tapered surface 34, inwardly tapered surface 36 and second outwardly tapered surface 37 together define a tip having a length L. The inwardly tapered surface 36 has a length of approximately 0.47L.

- 30 Referring now back to Figure 2, the proximal end 31 of the pin 3 comprises a strike face 40. The proximal end 31 has a cross sectional area greater than that of the shaft 33. The pin also comprises a surface 41 which extends orthogonally from the principal axis of the

shaft 33. The surface 41 extends about the entire periphery of the pin 3. The surface 41 is thus a juncture between the shaft 33 and proximal end 31.

5 In alternative embodiments (not shown), the pin 3 need not comprise a surface 41 but instead the pin 3 may comprise any raised area or protuberance. Alternatively, the shaft may gradually taper outwardly towards the strike face to provide a proximal end having a greater cross sectional area than that of the shaft.

10 In Figure 4 there is shown a plan view of the bolt 2. The bolt 2 comprises a distal end 21 and a proximal end 22. Extending from the proximal end 22 along approximately two-thirds of the bolt 2, there comprises an outer threaded portion 23, along which the nut 4 can be moved. The proximal end 22 comprises a pair of diametrically opposed flats 24 for enabling a spanner to grip the bolt 2.

15 The distal end 21 of the bolt 2 comprises a substantially flat outer surface. In some embodiments (not shown), the outer surface of the distal end 21 may comprise one or more circumferential ribs or indentations to provide grip.

20 Extending axially from the distal end 21, the bolt 2 comprises a plurality of slots 25 extending towards the threaded portion 23. The slots 25 terminate in close proximity to the threaded portion 23.

25 Figure 5 shows a cross-section along the line B-B of Figure 4. As will be appreciated, the longitudinal bore 5 extends through the bolt 2 from the distal end 21 to the proximal end 22. The bore 5 has a substantially constant cross sectional area therealong. However, towards the proximal end 22, the bolt 2 comprises a shoulder 26 extending about a portion of the inner surface. The bolt 2 therefore comprises a rebate 27 having a cross sectional area which is greater than that of the bore 5. The bolt 2 further comprises a plurality of feet 29 extending axially from the distal end 21 and terminating  
30 with an inner taper 28. The bolt 2 has an opening at the distal end 21 having a cross sectional area which is narrower than that of the bore 5.

In the embodiment being described, and as will be appreciated from Figure 6, the bolt 2 comprises four slits 25 located at 90° intervals about the periphery thereof.

Figure 7 shows the bolt 2 having a pair of diametrically opposed flats 24. Figure 7 also shows the shoulder 26 extending about the entire portion of the inner surface.

Figures 8 and 9 show an alternative embodiment of a pin 3' in accordance with the invention. Extending axially from the distal end 32', the pin 3' comprises an outwardly tapered surface 34', an apex 35' and an inwardly tapered surface 36' which together define a tip having a length L. The inwardly tapered surface 36' has a length of approximately 0.56L.

Operation of the blind bolt 1 will now be described with particular reference to Figures 1 to 4. A user first applies a nut 4 to the proximal end 22 of the bolt 2 and rotates the nut 4 a few turns. The distal end 21 of the bolt 2 is then passed through a component to be fixed to a wall of hollow tubing. The bolt 2 is passed through an opening in the tubing such that the distal end 21 of the bolt 2 stands proud of the inner wall which cannot be easily accessed. The insertion pin 3 is then located partially within the longitudinal bore 5 and the face 40 of the pin 3 is struck, preferably with a hammer. The act of striking the hammer causes pin surface 41 to enter rebate 27 and abut shoulder 26 of the bolt 2. Thus, the strike face 40 of the pin 3 lies flush with the proximal end 22 of the bolt 2. As the pin 3 tunnels through the bore 5, the distal end 32 thereof engages the rear taper 28 of the feet 29 and causes the feet 29 and hence the distal end 21 of the bolt 2 to splay outwardly until the apex 35 of the pin 3 passes the taper 28.

The user then continues to rotate the nut 4 such that the nut engages the outer face of the tubing. Continued rotation of the nut 4 cause the outwardly splayed distal end to abut the restricted inner face and thus locks the component to the tubing. A spanner is used to engage the bolt 2 at the flats 24 and the nut 4 is given a further and final tighten which acts to force the bolt 2 back through the opening. This causes the feet 29 of the bolt 2 to bite the inwardly tapered portion 36 of the pin 3 and thus forces the pin 3 to continue forward. However, since the face 41 of the pin 3 abuts the shoulder 26 of the bolt 2 the pin 3 cannot pass through the bore 5. Instead, the bolt 2 and pin 3 act in

opposite directions and thus continue to force the component and wall together even after the user has stopped tightening the nut 4.

5 Of course, when we say that the tip comprises successively an outwardly tapered surface and an inwardly tapered surface, we mean that there could be one or more elements therebetween, *e.g.* another outwardly tapered surface, another inwardly tapered surface or a surface having a constant cross-sectional area.

**CLAIMS**

1. A pin for a blind bolt, the pin having a proximal end, a distal end and a shaft between  
5 the proximal and distal ends, extending axially from the distal end an outwardly tapered  
surface and an inwardly tapered surface, the pin comprising a strike portion at the  
proximal end, wherein the cross sectional area of the strike portion is greater than the  
cross sectional area of the shaft.
- 10 2. A pin as claimed in Claim 1, wherein the outwardly tapered surface and the inwardly  
tapered surface provide at least part of a tip having a length L.
3. A pin as claimed in Claim 2, wherein the inwardly tapered surface has a length of at  
least approximately 0.2L.
- 15 4. A pin as claimed in any preceding Claim, wherein the pin comprises at least one  
facing surface.
5. A pin as claimed in Claim 4, wherein the or each facing surface is orthogonal to the  
20 principal long axis of the shaft.
6. A pin as claimed in Claim 4 or Claim 5, wherein the or each facing surface faces the  
distal end of the pin.
- 25 7. A pin for a blind bolt, the pin comprising a shaft and a tip at one end of the shaft, the  
tip having a length L, extending axially in a direction towards the shaft the tip comprises  
successively an outwardly tapered surface and an inwardly tapered surface, wherein the  
inwardly tapered surface has a length of at least approximately 0.2L.
- 30 8. A pin as claimed in Claim 7, wherein the pin further comprises a strike portion at a  
second end of the shaft.

9. A pin as claimed in Claim 7 or Claim 8, wherein the cross sectional area of the strike portion is greater than the cross sectional area of the shaft.

5 10. A bolt having a distal end, a proximal end and a longitudinal bore extending therethrough, at the proximal end the longitudinal bore having a rebate, e.g. for receiving the head of a pin.

11. A bolt as claimed in Claim 10, wherein the rebate extends at least partially about an inner surface of the bolt.

10

12. A bolt as claimed in Claim 10 or Claim 11, wherein the rebate comprises one or more shoulders.

13. A bolt as claimed in any one of Claims 10 to 12, wherein the bolt comprises at least one slot, e.g. an open-ended slot, at or towards the proximal end.

15

14. A bolt as claimed in any one of Claims 10 to 13, wherein the bolt comprises an outer thread.

20 15. A bolt as claimed in any one of Claims 10 to 14, wherein the bolt comprises one or more feet.

16. A fastener comprising a pin as claimed in any one of Claims 1 to 9 and a bolt as claimed in any one of Claim 10 to 15.

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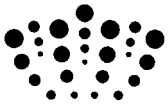
17. A pin, substantially as hereinbefore described with reference to the accompanying drawings.

18. A bolt, substantially as hereinbefore described with reference to the accompanying drawings.

30

19. A fastener, substantially as hereinbefore described with reference to the accompanying drawings.





**Application No:** GB1200187.1

**Examiner:** Peter Macey

**Claims searched:** 1 - 6

**Date of search:** 3 May 2012

**Patents Act 1977: Search Report under Section 17**

**Documents considered to be relevant:**

Category	Relevant to claims	Identity of document and passage or figure of particular relevance
		None

**Categories:**

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.

**Field of Search:**

Search of GB, EP, WO & US patent documents classified in the following areas of the UKC<sup>X</sup>:

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Worldwide search of patent documents classified in the following areas of the IPC

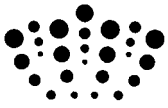
F16B
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The following online and other databases have been used in the preparation of this search report

WPI, EPODOC, TXTE
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**International Classification:**

Subclass	Subgroup	Valid From
F16B	0013/06	01/01/2006



**Application No:** GB1200187.1

**Examiner:** Peter Macey

**Claims searched:** 7 - 9 and 10 - 16

**Date of search:** 20 September 2012

**Patents Act 1977  
Further Search Report under Section 17**

**Documents considered to be relevant:**

Category	Relevant to claims	Identity of document and passage or figure of particular relevance
X	10 - 14	US 4976577 A (BROWN et al) see all figures

**Categories:**

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.

**Field of Search:**

Search of GB, EP, WO & US patent documents classified in the following areas of the UKC<sup>X</sup> :

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Worldwide search of patent documents classified in the following areas of the IPC

F16B
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The following online and other databases have been used in the preparation of this search report

WPI, EPODOC, TXTE
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**International Classification:**

Subclass	Subgroup	Valid From
F16B	0013/06	01/01/2006