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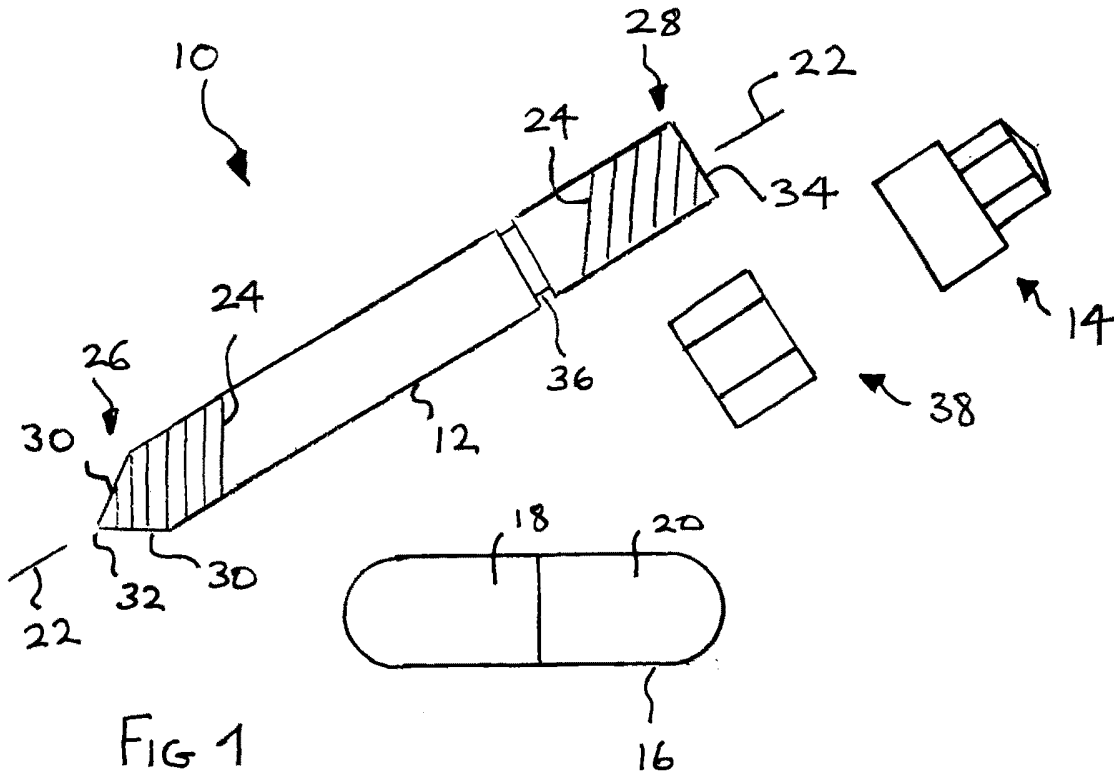
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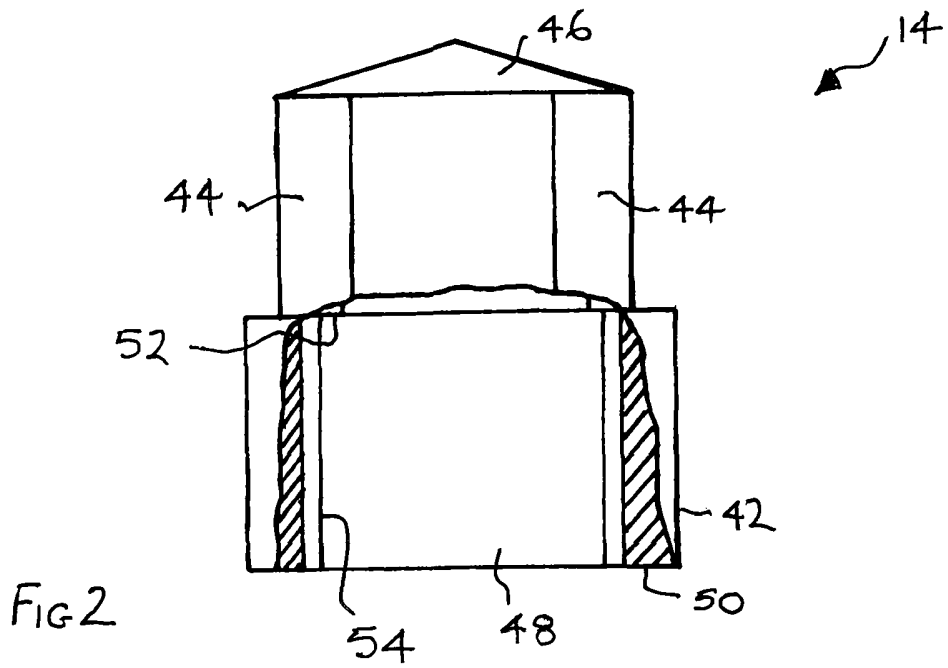
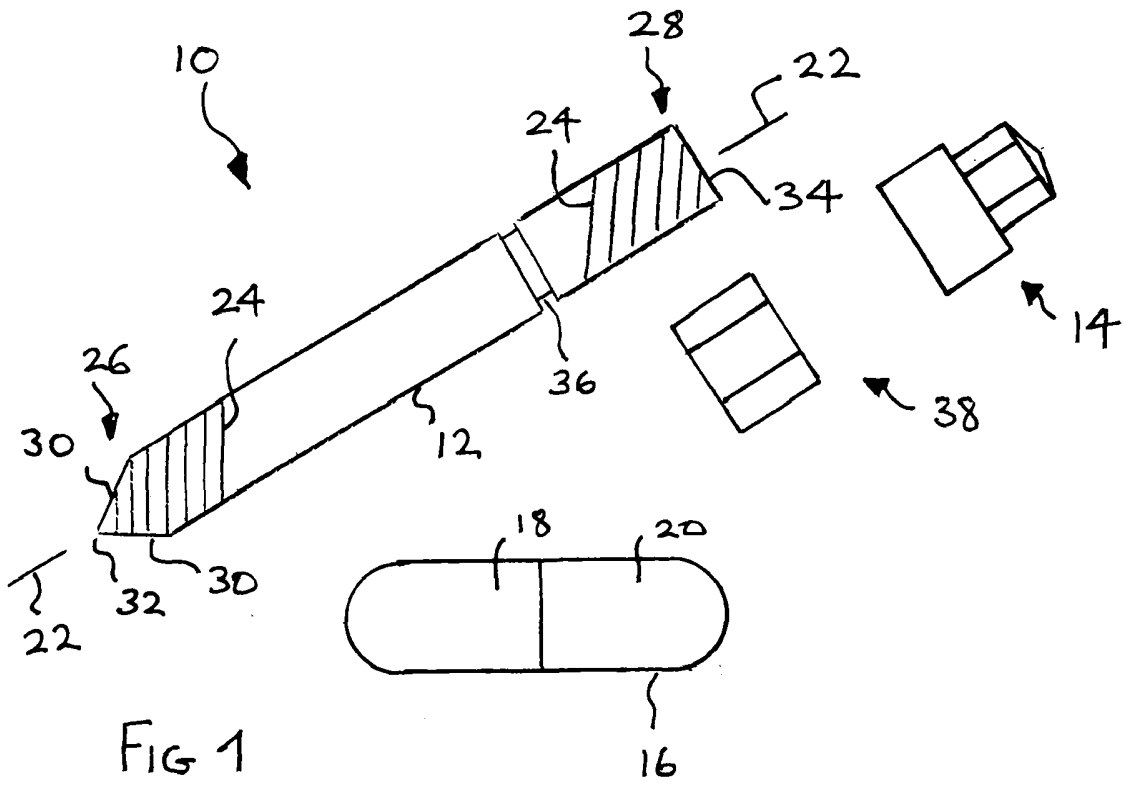
(56) Documents Cited:
GB 2349679 A **GB 1480230 A**

(58) Field of Search:
INT CL **E21D, F16B**
Other: **WPI, EPODOC**

(54) Title of the Invention: **Anchor bolt systems and methods of installing anchor bolts**
Abstract Title: **Anchor bolt system**

(57) An anchor bolt system (10) comprises a threaded rod (12) to be installed in a hole provided in a substrate and a drive receiving device (14) to be gripped by a rotary driving device to rotate the threaded rod (12) during installation in such a hole. The threaded rod (12) has a leading end (26), a trailing end (28), external threading (24) and a transverse surface (34) at the trailing end (28). The drive receiving device (14) is provided with a formation by which the drive receiving device (14) is releasably securable to the trailing end (28) of the threaded rod (12) and a stop surface to engage the transverse surface of the threaded rod (12).





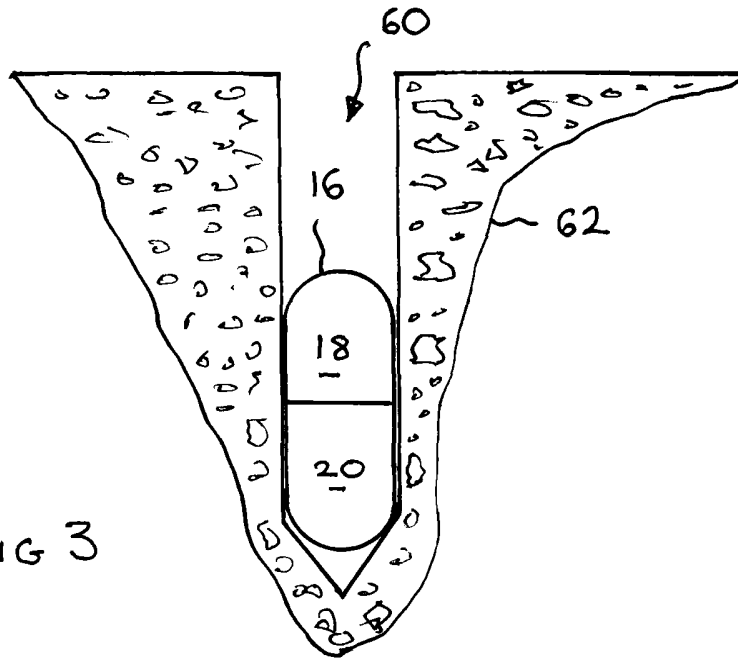


FIG 3

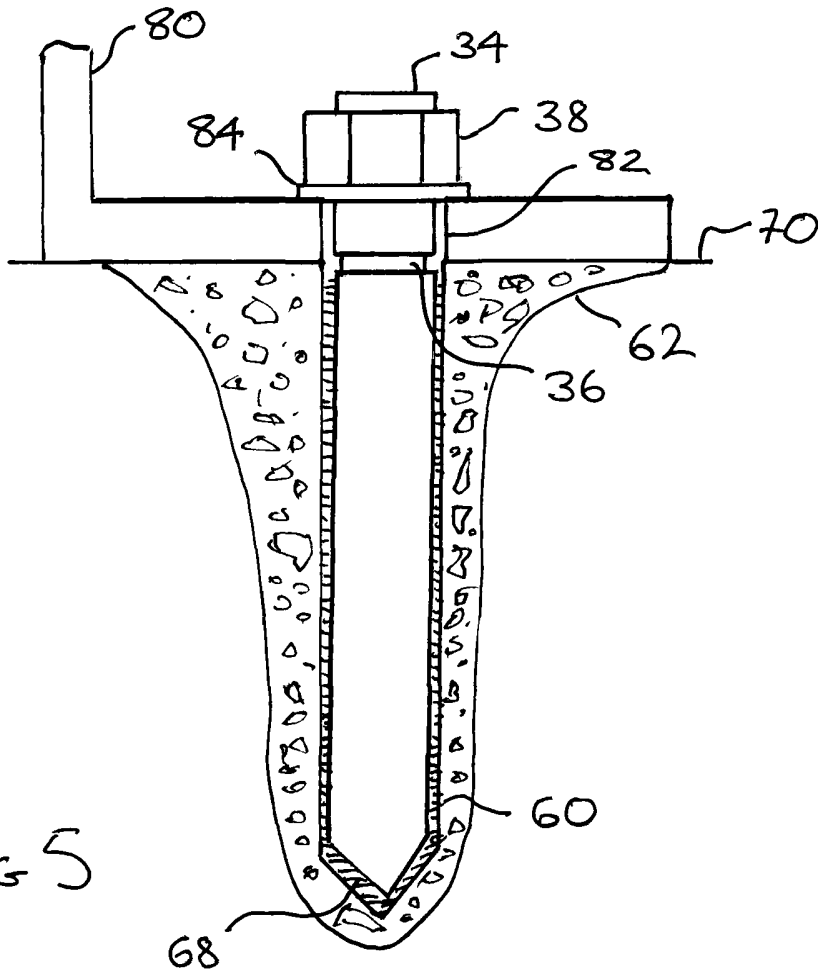


FIG 5

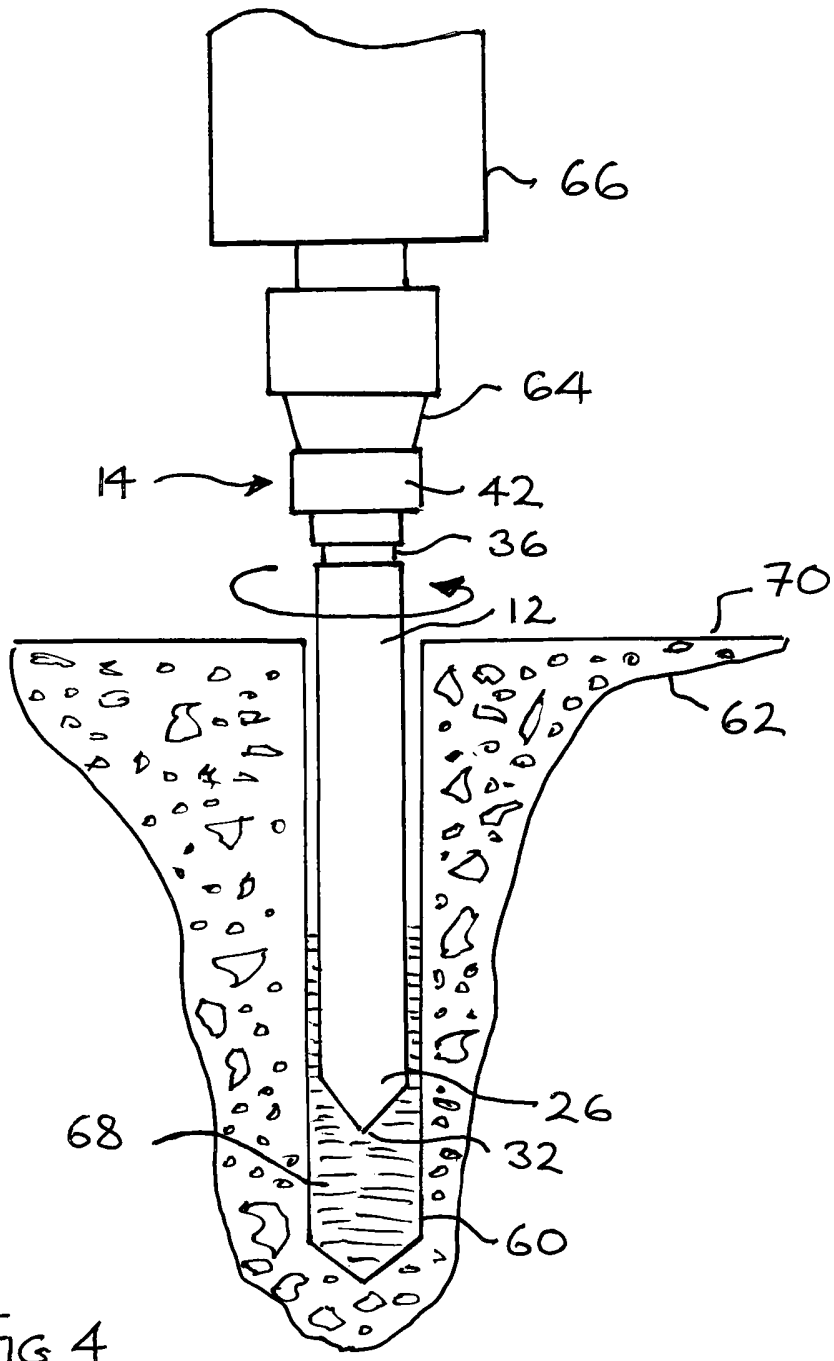
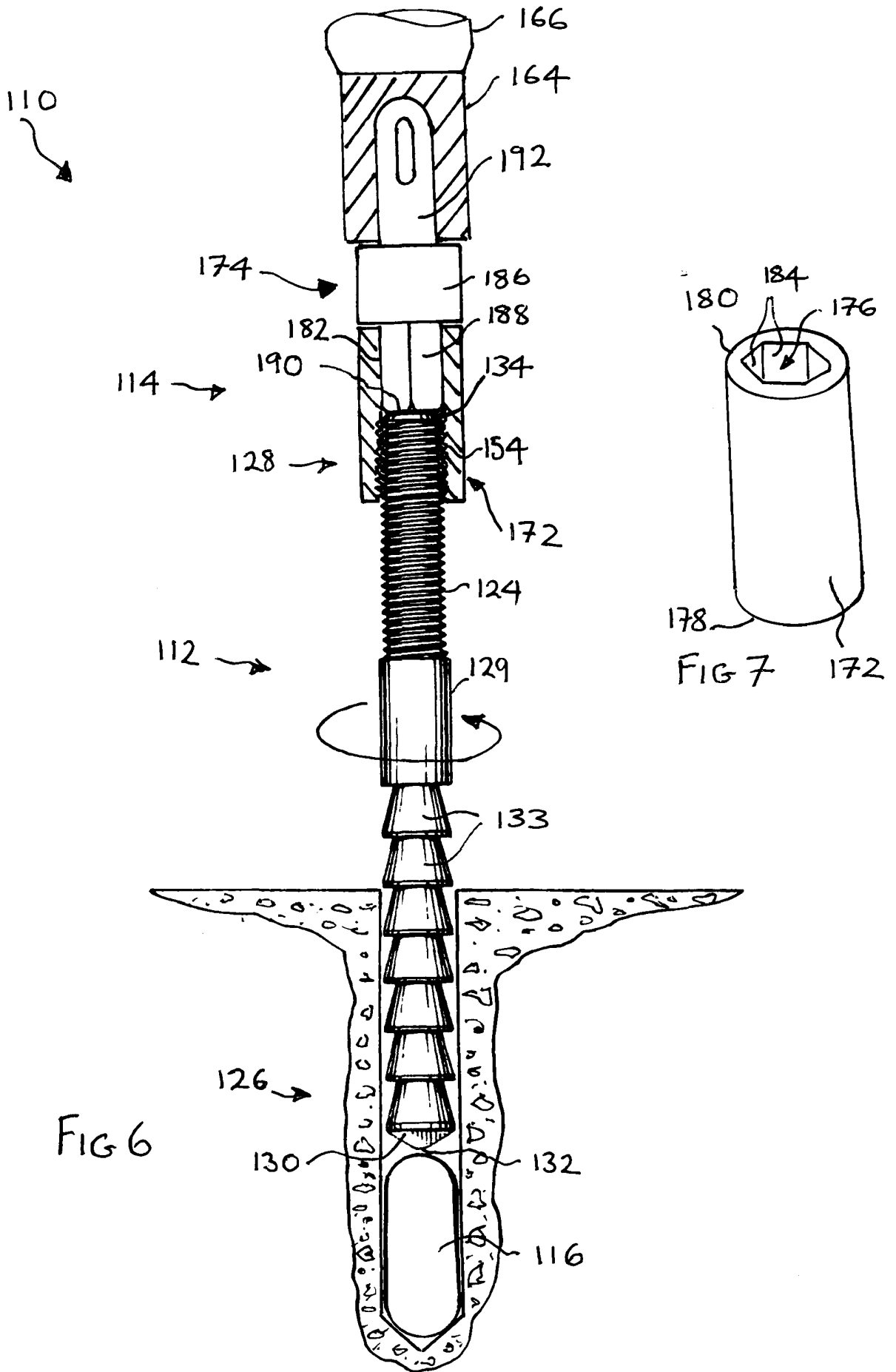


FIG 4



Anchor Bolt Systems and Methods of Installing Anchor Bolts

Field of the Invention

5 The invention relates to anchor bolt systems and methods of installing anchor bolts.

Background to the Invention

Anchor bolts for anchoring in a setting compound are known and may comprise a threaded rod having a leading end that has a tapered point and a trailing end provided with a gripping formation that allows the threaded rod to be gripped by a rotary
10 driving device such as a hammer drill.

The setting compound may be supplied in a container, such as a cartridge or glass capsule, that is to be installed in a suitably sized hole formed in a substrate such as a wall of a building. The contents of the setting compound are released by driving the
15 tapered point of the threaded rod into the container. The high speed rotation of the threaded rod imparted by the driving device breaks up the container and thoroughly mixes the components of the setting compound.

In order to provide a satisfactory grip for the driving device, the gripping formation
20 typically has a hexagonal profile. The gripping formation is integral with the threaded rod and typically is formed by a cold forming technique. Providing such a gripping formation at the trailing end of the threaded rod adds significantly to the cost of producing the anchor bolt. It also determines the length of the anchor bolt making it necessary for installers to carry stores of different length anchor bolts.

25

Summary of the Invention

The invention provides an anchor bolt system comprising:
a threaded rod to be installed in a hole provided in a substrate; and
a drive receiving device to be gripped by a rotary driving device to rotate the threaded
30 rod during installation in such a hole,
said threaded rod having a leading end, a trailing end, external threading and a transverse surface at said trailing end and

said drive receiving device being provided with a formation by which said drive receiving device is releasably securable to said trailing end of the threaded rod and a stop surface to engage said transverse surface.

5 The invention also includes a kit comprising a plurality of threaded rods to be installed in respective holes in a substrate, at least one container containing at least one component of a setting compound and a drive receiving device to be engaged by a rotary driving device to receive a rotary drive force from said rotary drive device, said threaded rods each having a leading end comprising at least one tapering surface, a
10 trailing end, external threading extending from said trailing end and a transverse surface at said trailing end and said drive receiving device comprising a formation to engage and releasably secure said drive receiving device to said external threading and a stop surface engagable with said transverse surface.

15 The invention also includes a method of installing an anchor bolt system, said anchor bolt system comprising a threaded rod having, a leading end, a trailing end, a longitudinal axis extending through said leading and trailing ends, external threading extending from said trailing end towards said leading end and a transverse surface at said trailing end and a drive receiving device having a formation to engage
20 said external threading and a stop surface and said method comprising releasably securing said drive receiving device to said trailing end of said threaded rod by engaging said formation with said external threading, engaging said stop surface with said transverse surface, connecting said drive receiving device with a driving device, operating said driving device to drive said
25 threaded rod into a hole provided in a substrate to install said threaded rod in said substrate with said trailing end projecting from said hole and removing said drive receiving device from said trailing end to permit securing of an object to said substrate using said projecting trailing end of said threaded rod.

30 The invention also includes an anchor bolt system comprising:
a threaded rod to be installed in a hole provided in a substrate; and
a drive receiving device to be engaged by a rotary driving device to rotate the threaded rod during installation in such a hole,

said threaded rod having a leading end, a trailing end, external threading and a transverse end surface at said trailing end and

5 said drive receiving device comprising a through-hole provided with an internal formation by which said drive receiving device is releasably securable to said trailing end and an internal gripping profile, the arrangement being such that an elongate drive member extending from said rotary driving device can engage said internal gripping profile with an end surface of said drive receiving device engaging said transverse end surface.

10 The invention also includes a drive receiving device to transmit drive from a rotary driving device to a trailing end of a threaded rod of an anchor bolt, said drive receiving device a formation to releasably secure the member to said trailing end, a transverse stop surface to engage a transverse surface of said threaded rod disposed at said trailing end and a part to be engaged by said rotary power device to receive a
15 rotary drive force therefrom.

The invention also includes a drive receiving device to transmit drive from a rotary driving device to a trailing end of a threaded rod of an anchor bolt, said drive receiving device a first member having a formation to releasably secure the member
20 to said trailing end, second member releasably engagable with said first member and having a transverse stop surface to engage a transverse surface of said threaded rod disposed at said trailing end and a part to be engaged by said rotary power device to receive a rotary drive force therefrom.

25 Brief Description of the Drawings

In order that the invention may be well understood, some examples thereof, which are given by way of example only, will now be described with reference to the drawings in which:

30 Figure 1 is a schematic illustration of an anchor bolt system;

Figure 2 is a side view of a drive receiving device of the anchor bolt system of Figure 1 with partial sectioning to show internal threading;

Figure 3 is a schematic illustration of first stages of a use of the anchor bolt system of Figure 1;

5 Figure 4 is a schematic illustration of further stages of a use of the anchor bolt system of Figure 1;

Figure 5 is a schematic illustration of final stages of a use of the anchor bolt system of Figure 1;

10 Figure 6 is a schematic illustration, partially in section, of another anchor bolt system; and

Figure 7 is a perspective view of a drive receiving member of the anchor bolt system of Figure 6.

15

Detailed Description

Referring to Figure 1, an anchor bolt system 10 comprises a threaded rod 12, a drive receiving device 14 and a container 16 comprising components 18, 20 of a setting compound. Although not limited to that number, in the illustrated example the setting
20 compound comprises two components 18, 20. The container 16 is an elongate cartridge made of a material that can be readily broken by the threaded rod 12 to release the components of the setting compound and allow them to be mixed. The container 16 may, for example, be made of glass.

25 The threaded rod 12 is a generally cylindrical elongate member having a longitudinal axis 22. The threaded rod 12 has external threading 24 extending from a leading end 26 to a trailing end 28 thereof. The leading end 26 is provided with at least one flat surface 30 that is inclined to the longitudinal axis 22 to define a point 32. In the illustrated example, the leading end 26 has two flat surfaces 30. However, this is not
30 to be taken as limiting as there may be only one or more than two flat surfaces 30.

The trailing end 28 of the threaded rod 12 is defined by an end surface 34 that extends transverse to the longitudinal axis 22. The threading 24 extends at least substantially to the end surface 34. Although not limited to this, in the illustrated example the end

surface 34 is a generally flat surface that extends perpendicular to the longitudinal axis 22. Examples of alternatives are an end surface that is domed or conical.

5 The threaded rod 12 may be provided with a depth indicator 36 such as a suitably positioned circumferentially extending groove. The depth indicator 36 can provide a visual indication to the installer that the threaded rod 12 has been driven to a suitable depth in a hole in which it is being installed. As an alternative to providing a depth indicator as illustrated, the installer may simply mark the installation depth with tape or paint.

10

The threaded rod 12 may be made of a ferrous material including stainless steel or a steel treated to resist corrosion thereof by, for example, galvanising.

15 The anchor bolt system 10 additionally comprises an internally threaded nut 38 that can be screwed onto the threaded rod 12 to secure an object to a substrate in which the threaded rod has been installed.

20 Referring to Figure 2, the drive receiving device 14 is a generally cylindrical body having a first end portion 42 that has a circular profile, an intermediate portion that has a polygonal profile defined by a plurality of generally flat mutually inclined surfaces 44 and a second end portion 46 that is conical. The drive receiving device 14 has a blind bore 48 that extends from an entrance defined at the free end 50 of the first end portion 42 to an inner end (not shown) defined in the second end portion 46.

25 The blind bore 48 has a larger diameter in the first end portion 42 than in the intermediate and second end portions to define an annular shoulder 52, which functions as a stop surface. The portion of the blind bore 48 extending from the end 50 to the shoulder 52 is provided with a formation 54 by means of which the drive receiving device can be releasably secured to the threaded rod 12. In the illustrated example, the formation is an internal thread 54 corresponding to the external
30 threading 24 of the threaded rod.

The polygonal profile defined by the flat surfaces 44 provides a gripping profile that can be gripped by a driving device such as a wrench (spanner) or a power tool such as

an electric drill. Although not limited to this, the illustrated drive receiving device 14 has six surfaces 44 to define a hexagonal gripping profile. As an alternative to the external gripping profile shown, the driving receiving could be provided with an internal drive receiving profile provided, for example, in a blind bore extending in the body towards the blind bore 48. The internal drive receiving profile may, for example, be a hexagonal profile to be engaged by a complementary hexagonal output end of a coupler that is secured to the driving device.

An installation using the anchor bolt system 10 will now be described with reference to Figures 3 to 5. Initially, a suitably sized hole 60 is formed, typically by drilling, in a substrate 62 in which the threaded rod 12 is to be installed. The hole 60 may be cleaned using a suitably sized steel brush. Debris may be removed from the hole 60 by any suitable means, for example by blowing into the hole or applying suction to the hole. A container 16 containing the components of a setting compound is then inserted into the hole. The container 16 has a diameter that is slightly less than that of the hole 60 so that it can be readily push fitted into the hole. The diameter of the container 16 is sufficiently close to that of the hole 60 to ensure that once installed, the container has little freedom for movement transverse to the longitudinal axis of the hole.

Referring to Figures 2 and 4, the drive receiving device 14 is secured to the trailing end 28 of the threaded rod 12 by screwing it onto the rod until the end surface 34 of the rod engages the shoulder 52 of the drive receiving device. The chuck 64 of a rotary driving device 66, such as an electric drill, is then secured onto the flat surfaces 44 of the gripping profile of the drive receiving device 14. The leading end 26 of the threaded rod is then inserted into the hole 60 and the driving device 66 is operated to rotate the threaded rod 12 as the leading end 26 is driven into the container 16. The point 32 penetrates the container 16, which is broken up as the threaded rod is pushed further into the hole. As the threaded rod is driven into the container 16, the rotation of the threaded rod mixes the components of the setting compound to form a generally homogeneous setting compound mix 68. Once the depth indicator 36 is level with the surface 70 of the substrate 62, the driving device 66 can be switched off and the chuck 64 opened to release the drive receiving device 14 from the driving device 66.

Referring to Figure 5, the setting compound mix 68 is left for the time required for it to set. Once the setting compound has set the threaded rod 12 is securely anchored in the hole 60. Either before, or once setting has occurred, the drive receiving device 14 is removed from the threaded rod 12 by unscrewing it. This leaves the portion of the threaded rod 12 between the depth indicator 36 and end surface 34 projecting from the surface 70 of the substrate 62. An object 80, such as a bracket, steel column or post, cable tray, gate, façade or window element, can be anchored to the substrate 62 by placing a hole 82 provided in the object over the projecting portion of the threaded rod, bringing the object into engagement with the surface 70 of the substrate 62 and then screwing a nut 38 (optionally with a washer 84) onto the threaded rod to securely anchor the object to the substrate.

Figures 6 and 7 illustrate another anchor bolt system 110. Parts of the anchor bolt system the same as or similar to parts of the anchor bolt system 10 will be indicated by the same reference numeral incremented by 100 and may not be described in detail again.

The anchor bolt system 110 comprises a threaded rod 112, a drive receiving device 114 and a container 116 comprising components of a setting compound.

The threaded rod 112 is a generally elongate member provided with external threading 124 and having a leading end 126 and a trailing end 128. The threading 124 extends from the trailing end 128 towards the leading end 126 terminating at a central cylindrical body portion 129 of the threaded rod. Although not essential, in the illustrated example the body portion 129 is located approximately halfway between the leading and trailing ends 126, 128 of the threaded rod 112. The leading end 126 of the threaded rod comprises a plurality of flat surfaces 130 (only one of which can be seen in the drawings) that define a point 132 and a wedge section defined by a series of frusto-conical portions 133 disposed end-to-end between the flat surfaces 130 and cylindrical body portion 129. Although the illustrated example has a plurality of frusto-conical portions 133, this is not essential as the wedge section may comprise just one wedge portion.

The trailing end 128 of the threaded rod 112 terminates in a transverse end surface 134 that extends transverse to the longitudinal axis of the threaded rod. The threading 124 extends at least substantially to the end surface 134. Although not limited to this, in the illustrated example the end surface 34 is a generally flat surface that extends perpendicular to the longitudinal axis 22. Examples of alternatives are an end surface that is domed or conical.

The drive receiving device 114 comprises a drive receiving member 172 and a coupler 174. The drive receiving member 172 is a generally cylindrical sleeve having an axially extending through hole 176. The through-hole 176 is provided at one end 178 with a formation that is releasably engagable with the threading 124 of the trailing end 128 of the threaded rod. In the illustrated example, the formation comprises internal threading 154 that complements the threading 124 of the threaded rod 112. At the opposite end 180, the through-hole 176 is provided with an internal drive receiving profile 182. In the illustrated example, the drive receiving profile is defined by a plurality of mutually inclined generally flat surfaces 184 that define a hexagonal drive receiving profile.

The coupler 174 comprises a generally cylindrical body portion 186, an output end that defines a drive profile 188 and a stop surface 190 and a grip end 192 to be gripped by a rotary driving device. The output and grip ends each extend axially outwardly from the cylindrical body portion 186, which in the illustrated example forms the central portion of the coupler 174. The output end is an elongate member having mutually inclined side surfaces that define a hexagonal drive profile 180 that complements the drive receiving profile 182. The grip end 192 may take any form suitable for gripping by a rotary driving device. The grip end 192 may, for example, be a generally circular rod that can be gripped by a chuck 164 of a rotary driving device in the form of a hand held power drill 166.

Installation of the anchor bolt system 110 in a hole 160 in a substrate 162 corresponds essentially to that described with reference to Figures 3 to 5. However, in the case of the anchor bolt system 110, the drive receiving device 114 is a two-piece device. The drive receiving device 114 may be releasably secured to the trailing end of the threaded rod 112 by screwing the drive receiving member 172 onto the threading 124

and then push-fitting the output end of the coupler 174 into the drive receiving member so that the drive profile 188 engages the drive receiving profile 182 and the stop surface 190 engages the end surface 134. A rotary drive force can then be transmitted from the power drill 166 to the threaded rod 112 via the drive receiving device 114.

As an alternative to fitting the drive receiving member 172 onto the threaded rod 112 first, the drive receiving member 172 and coupler 174 may be push-fitted together and then the drive receiving member screwed onto the trailing end 128 of the threaded rod 112 prior to gripping the grip end 192 in the chuck 164..

In the illustrated example, the drive receiving member has a through-hole and the stop surface is defined by the end of the coupler 174. Alternatively, the drive receiving member 172 may be provided with an internally disposed stop surface, for example, in the form of an annular shoulder (not shown) disposed intermediate the internal threading 154 and drive receiving profile 182.

The drive receiving devices 14, 114 provide a removable drive receiving formation, or profile, for the threaded rod 12 that can be connected with the threaded rod when needed for installation and then removed to allow an object to be secured to a substrate using the threaded rod. This avoids the need to provide an integral gripping formation on the trailing end of the threaded rod. This has the benefit of reducing the cost of producing the threaded rod. It also allows the possibility of the installer modifying the length of the threaded rod on site so that it is no longer necessary for the installer to carry so many different lengths of rod.

The drive receiving device can be a reusable device allowing the possibility of supplying a kit with a plurality of threaded rods, respective nuts for the rods and a supply of setting compound with just one drive receiving device, or at least fewer drive receiving devices than there are rods. In the case of a kit provided with a drive receiving device 114, a plurality of drive receiving members 172 may be provided with just one coupler 174.

The drive receiving device may be made of metal or a plastics material. In one example, the drive receiving device comprises at least one plastics moulding.

5 In the illustrated examples the drive receiving device has a hexagonal profile(s). This is not essential. The profile(s) can be selected to suit the type of driving device that is to be used. In principle a wrench could be used to install the threaded rod in which case, just two flat surfaces would be sufficient.

10 In the example in Figure 2, the drive receiving device has an annular shoulder that functions as a stop surface. This is not essential. In examples that have a blind bore, the end of the blind bore may function as a stop surface. Alternatively, a stop surface could be defined other portions of the drive receiving device. For example, the drive receiving device could be provided with one or more transverse projections in the blind bore to define one or more stop surfaces.

15

In the illustrated examples, the drive receiving device is provided with internal threading corresponding to the external threading on the threaded rod so that the drive receiving device can simply be screwed onto the trailing end of the threaded rod. This is not essential. In principle, any formation that allows the drive receiving device to
20 engage with the threaded rod can be used. For example, the drive receiving device could be provided with a plurality of relatively short ribs disposed on a helical pitch that are able to engage the external threading on the rod.

25 In the examples, the setting compound is provided in containers that are inserted into the hole in which the threaded rod is to be installed. This is not essential. The setting compound may be supplied in bulk containers from which a suitable charge is injected into the hole.

30 Although intended mainly for anchor bolts that are to be secured in a hole with a setting compound, in principle, the drive receiving device could be used with anchor bolts that are to be secured in a hole using a threaded wedging element that acts to expand an expansion member coupled to the threaded rod...

Claims

1. An anchor bolt system comprising:
 - 5 a threaded rod to be installed in a hole provided in a substrate; and
a drive receiving device to be gripped by a rotary driving device to rotate the threaded rod during installation in such a hole,
said threaded rod having a leading end, a trailing end, external threading and a transverse surface at said trailing end and
 - 10 said drive receiving device being provided with a formation by which said drive receiving device is releasably securable to said trailing end of the threaded rod and a stop surface to engage said transverse surface.
2. An anchor bolt system as claimed in claim 1, wherein said formation
15 comprises internal threading by which said drive receiving device can be screwed onto said trailing end.
3. An anchor bolt system as claimed in claim 1 or 2, wherein said leading end is tapered.
20
4. An anchor bolt system as claimed in claim 1, 2 or 3, further comprising at least one container containing a component of a setting compound by means of which said threaded rod can be secured in said hole.
- 25 5. An anchor bolt system as claimed in claim 4, wherein said at least one container comprises an elongate cartridge to be installed in said hole, said cartridge containing at least two components of said setting compound.
6. An anchor bolt system as claimed in any one of the preceding claims, wherein
30 said transverse surface is defined by an end surface of said threaded rod and said external threading extends at least substantially to said end surface.

7. An anchor bolt system as claimed in any one of the preceding claims, wherein said drive receiving device has an external gripping profile comprising a plurality of flat surfaces to be gripped by said rotary driving device.
- 5 8. An anchor bolt system as claimed in any one of the preceding claims, wherein said drive receiving device comprises a blind bore and said stop surface and formation are provided in said blind bore.
9. An anchor bolt system as claimed in any one of the preceding claims, wherein
10 said stop surface is a generally annular shoulder.
10. An anchor bolt system as claimed in any one of the preceding claims, wherein said drive receiving device is a one-piece device.
- 15 11. An anchor bolt system as claimed in any one of claims 1 to 6, wherein said drive receiving device comprises a drive receiving member provided with said formation and an internal drive receiving profile.
12. An anchor bolt system as claimed in claim 11, wherein said drive receiving
20 member comprises a sleeve.
13. An anchor bolt system as claimed in claim 11 or 12, wherein said drive receiving device comprises a coupler having an output end that defines said stop surface and a drive profile to releasably engage said drive receiving profile.
- 25 14. An anchor bolt system as claimed in 13, wherein said coupler is releasably engagable with said drive receiving member by push-fitting.
15. An anchor bolt system as claimed in 13 or 14, wherein said coupler comprises
30 a grip end to be gripped by a said rotary driving device.
16. An anchor bolt system as claimed in any one of the preceding claims, further comprising a nut to be screwed onto said trailing end to secure an object to said substrate.

17. An anchor bolt system as claimed in any one of the preceding claims, wherein said drive receiving device comprises at least one plastics moulding.
- 5 18. A kit comprising a plurality of threaded rods to be installed in respective holes in a substrate, at least one container containing at least one component of a setting compound and a drive receiving device to be engaged by a rotary driving device to receive a rotary drive force from said rotary drive device, said threaded rods each having a leading end comprising at least one tapering surface, a trailing end, external
10 threading extending from said trailing end and a transverse surface at said trailing end and said drive receiving device comprising a formation to engage and releasably secure said drive receiving device to said external threading and a stop surface engagable with said transverse surface.
- 15 19. A kit as claimed in claim 18, comprising a number x of said rods, a number y of said containers and a number z of said drive receiving devices, wherein said number z is less than said number x and said number z is less than said number y .
20. A kit as claimed in claim 19, wherein said number z is 1.
- 20 21. A kit as claimed in claim 18, 19 or 20, wherein said at least one container comprises a plurality of elongate cartridges to be in a respective said hole with a said threaded rod and each containing a plurality of said components.
- 25 22. A kit as claimed in any one of claims 18 to 21, further comprising a plurality of nuts having internal threading corresponding to said external threading.
23. A kit as claimed in any one of claims 18 to 22, wherein said drive receiving device is a one-piece device.
- 30 24. A kit as claimed in any one of claims 18 to 22, wherein said drive receiving device comprises a drive receiving member provided with said formation and a coupler that is engagable with said drive receiving member and defines said stop surface.

25. A method of installing an anchor bolt system,
said anchor bolt system comprising a threaded rod having, a leading end, a trailing
end, a longitudinal axis extending through said leading and trailing ends, external
5 threading extending from said trailing end towards said leading end and a transverse
surface at said trailing end and a drive receiving device having a formation to engage
said external threading and a stop surface and
said method comprising releasably securing said drive receiving device to said trailing
end of said threaded rod by engaging said formation with said external threading,
10 engaging said stop surface with said transverse surface, connecting said drive
receiving device with a driving device, operating said driving device to drive said
threaded rod into a hole provided in a substrate to install said threaded rod in said
substrate with said trailing end projecting from said hole and removing said drive
receiving device from said trailing end to permit securing of an object to said
15 substrate using said projecting trailing end of said threaded rod.

26. A method as claimed in claim 25, wherein said driving device is a rotary
power tool.

20 27. A method as claimed in claim 25 or 26, comprising providing components of a
setting compound in said hole prior to installing said threaded rod.

28. A method as claimed in claim 27, comprising mixing said components of said
setting compound by rotation of said threaded rod by means of said driving device.

25 29. A method as claimed in claim 27 or 28, comprising providing said components
in said hole by inserting a container containing said components in said hole, said
components being released from said container by opening of said container when
said threaded rod is driven into said hole.

30 30. A method as claimed in any one of claims 25 to 29, comprising passing a
through hole of an object to be secured to said substrate along said projecting trailing
end of said threaded rod after removal of said drive receiving device and fitting a
securing device onto said threaded rod to secure said object to said substrate.

31. A method as claimed in any one of claims 25 to 30, wherein said drive receiving device is a one-piece device having an external gripping profile and engaging said drive device with said driving device comprises gripping said external profile with said drive device.

32. A method as claimed in claim 31, wherein releasably securing said drive receiving device with said trailing end comprises screwing said drive receiving device to said trailing end.

33. A method as claimed in any one of claims 25 to 30, wherein said drive receiving device comprises a drive receiving member provided with said formation and a coupler that defines said stop surface and is engagable with said drive receiving member and connecting said drive receiving device with said driving device comprises engaging said coupler with said driving device and engaging said coupler with said drive receiving member.

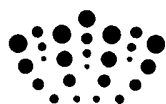
34. A method as claimed in claim 33, wherein engaging said coupler with said drive receiving member comprises push-fitting an output end of said coupler into a through-hole defined by said drive receiving member.

35. An anchor bolt system comprising:
a threaded rod to be installed in a hole provided in a substrate; and
a drive receiving device to be engaged by a rotary driving device to rotate the threaded rod during installation in such a hole,
said threaded rod having a leading end, a trailing end, external threading and a transverse end surface at said trailing end and
said drive receiving device comprising a through-hole provided with an internal formation by which said drive receiving device is releasably securable to said trailing end and an internal gripping profile, the arrangement being such that an elongate drive member extending from said rotary driving device can engage said internal gripping profile with an end surface of said drive receiving device engaging said transverse end surface.

36. An anchor bolt system substantially as herein described with reference to the drawings.

37. A method of installing an anchor bolt system substantially as herein described
5 with reference to the drawings.

10



Application No: GB1103535.9

Examiner: Peter Macey

Claims searched: 1 - 37

Date of search: 1 July 2011

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
X	1, 2, 4 - 7, 9 - 13	GB 1480230 A (TITAN) see especially figures 3 to 5
X	1, 2, 4 - 7, 11 - 14	GB 2349679 A (MAI) 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^X :

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

E21D; F16B

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

WPI, EPODOC

International Classification:

Subclass	Subgroup	Valid From
F16B	0013/14	01/01/2006
E21D	0021/00	01/01/2006