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JP H0823615

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(54) Title of the Invention: **Cable duct plug removal**
Abstract Title: **Removing sealing plug from cable duct**

(57) A plug 18 is removed from a cable duct 1 by piercing the plug using a first tool 3 and extracting the pierced plug using a second tool 4. The first tool comprises a handle connected to a shaft, a combined boring and chiselling extension and an impact surface. A cavity is created in the plug by applying the combined boring and chiselling extension to a location on an outer surface of the plug, striking the impact surface (eg with a hammer 50) and rotating the first tool. The second tool comprises a shaft connected to a handle and to a plug-engaging part arranged to extend in a direction perpendicular to the longitudinal axis of the shaft. The plug is removed by inserting the plug-engaging part of the second tool into a cavity created in the plug by use of the first tool, manipulating the second tool until the plug-engaging part engages with the plug, and applying force to the second tool in order to extract the plug from the duct. The tools may be used with resin duct plugs. The two tools may be integrated into one, or share a detachable handle.

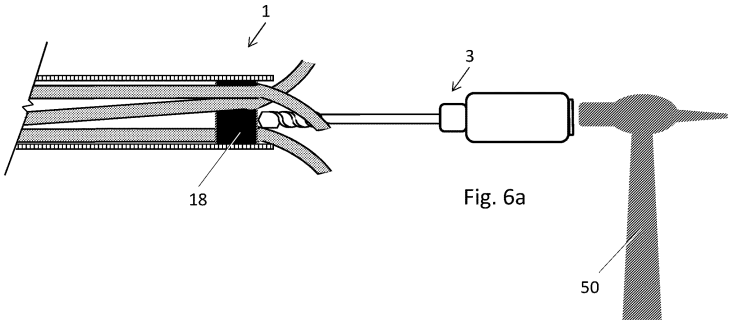

Fig. 6a

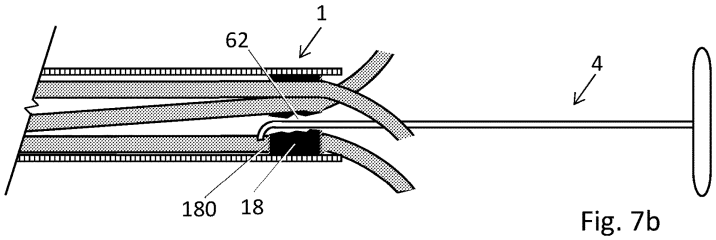

Fig. 7b

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Fig. 1a

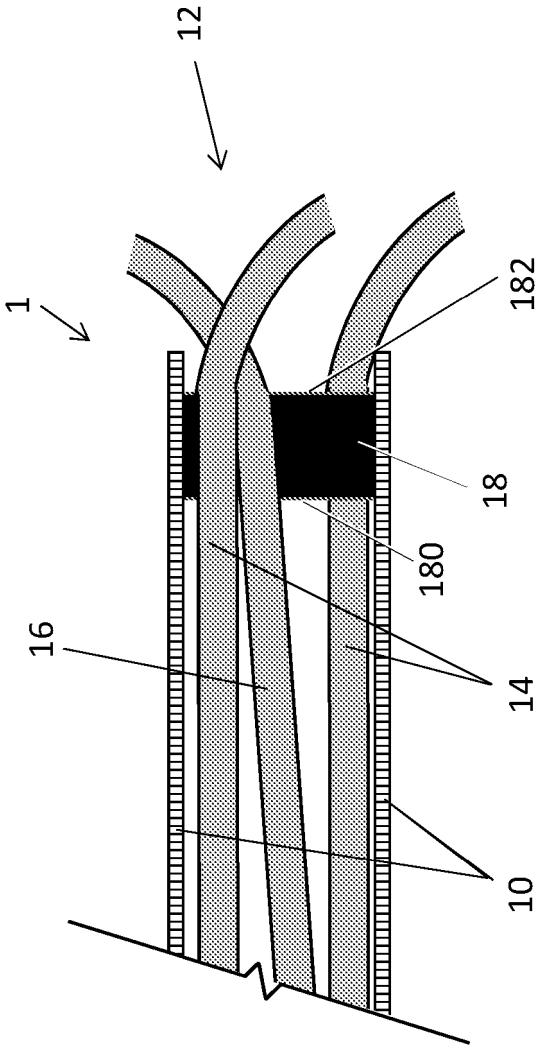
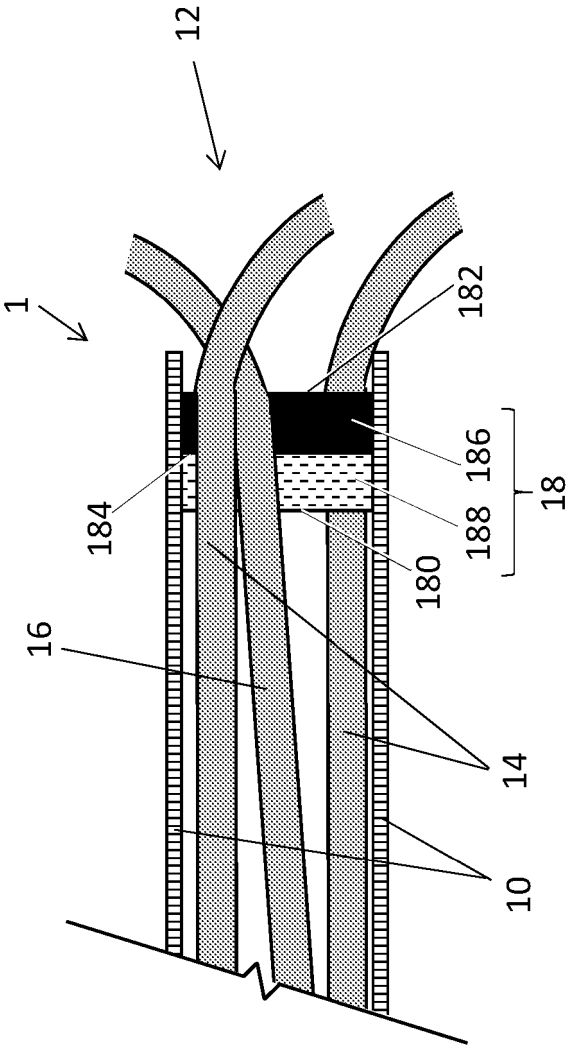


Fig. 1b



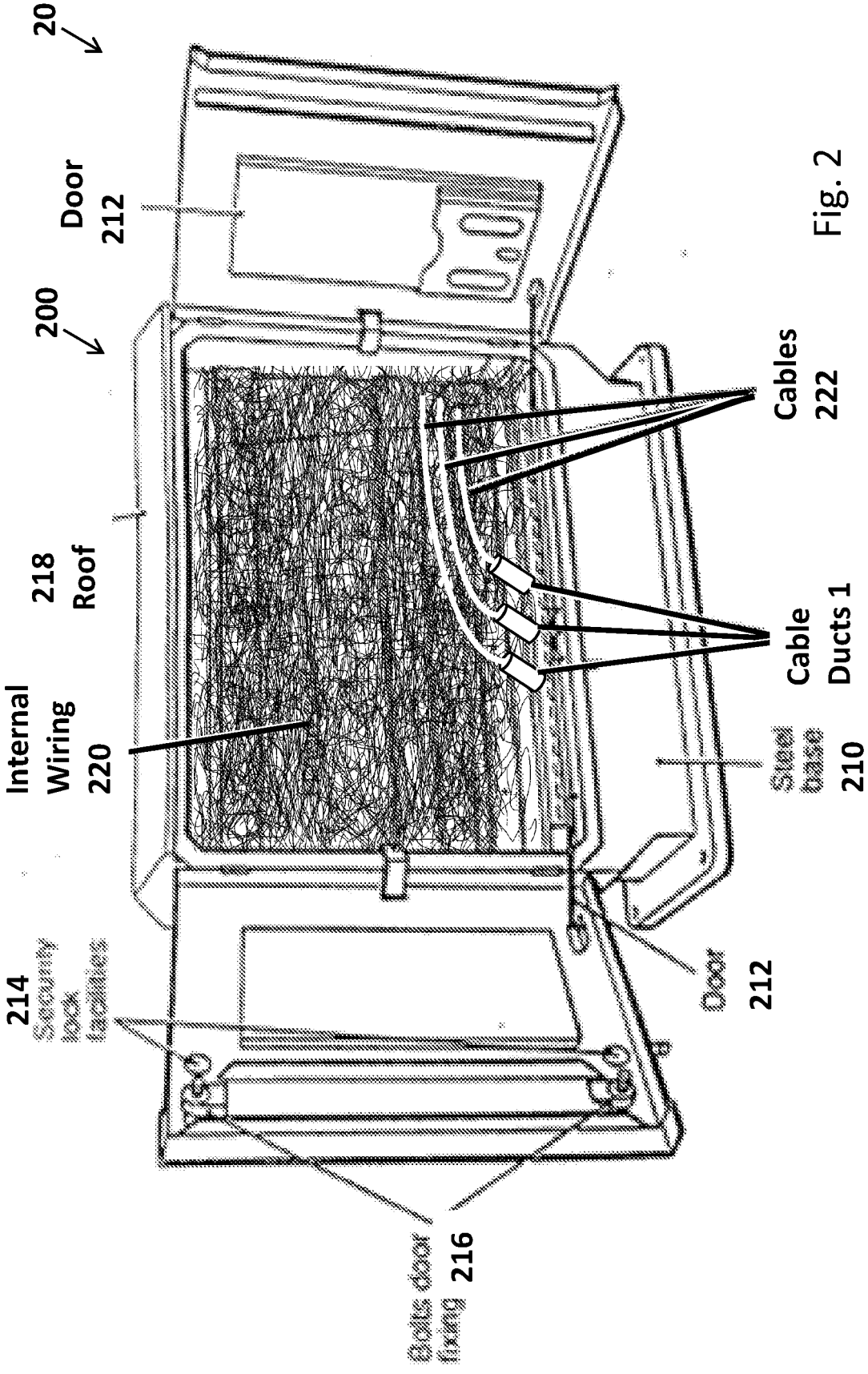

20
Door
212
200
Cables
222
218
Roof
Cable
Ducts 1
Internal
Wiring
220
Steel base
210
214
Security lock cables
Door
212
Bolts door fixing
216

Fig. 2

Fig. 3

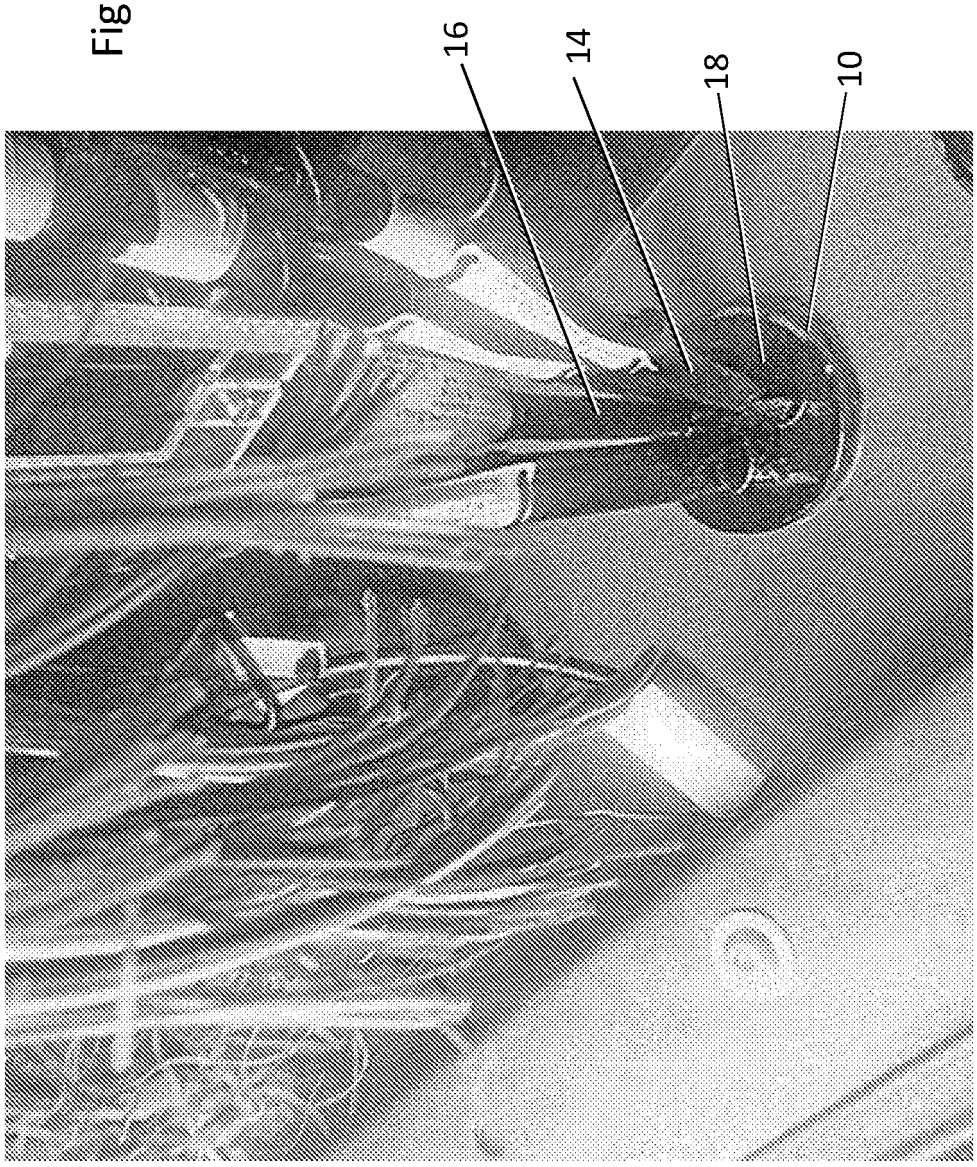


Fig. 4

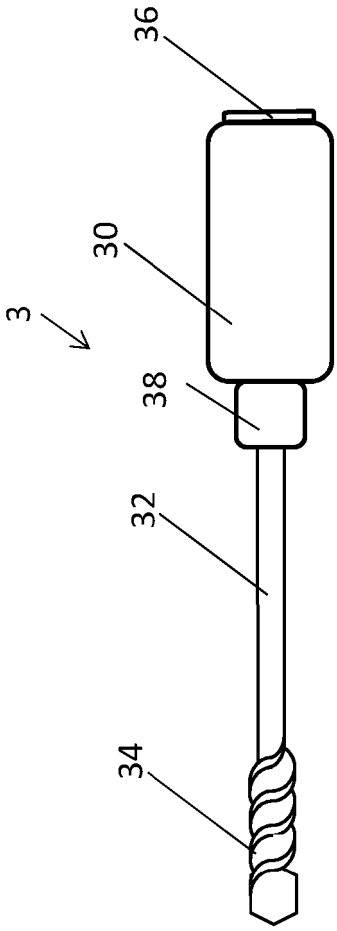


Fig. 5a

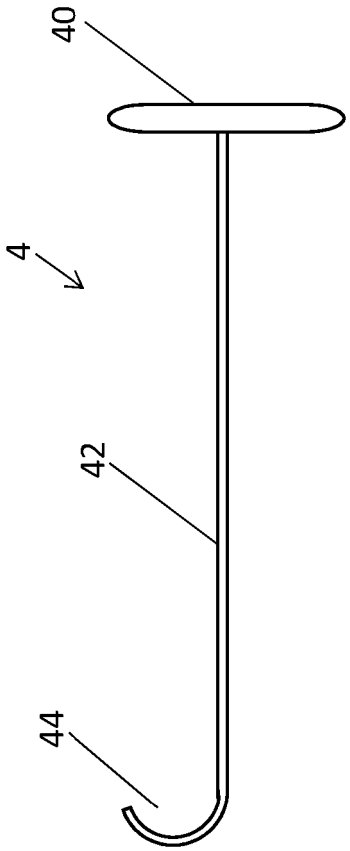
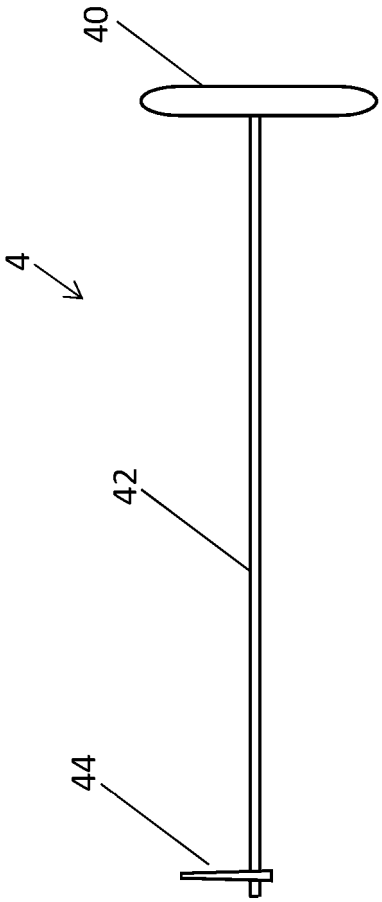


Fig. 5b



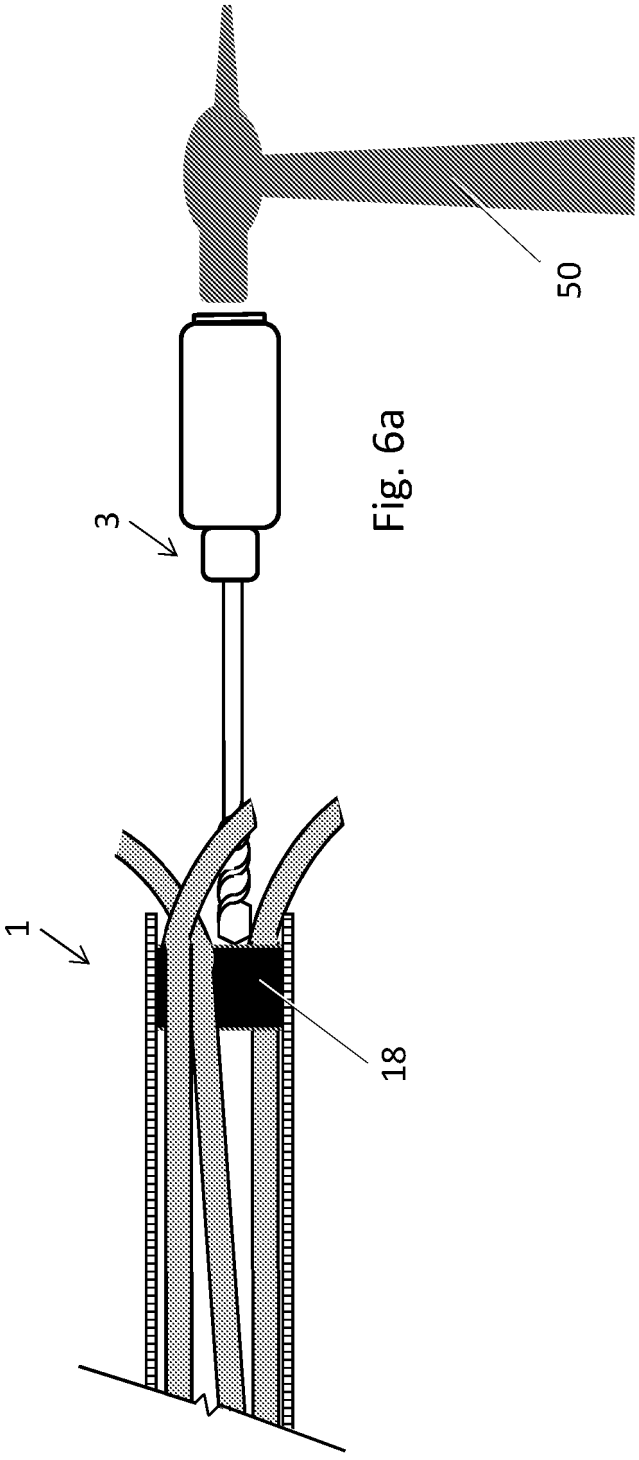


Fig. 6a

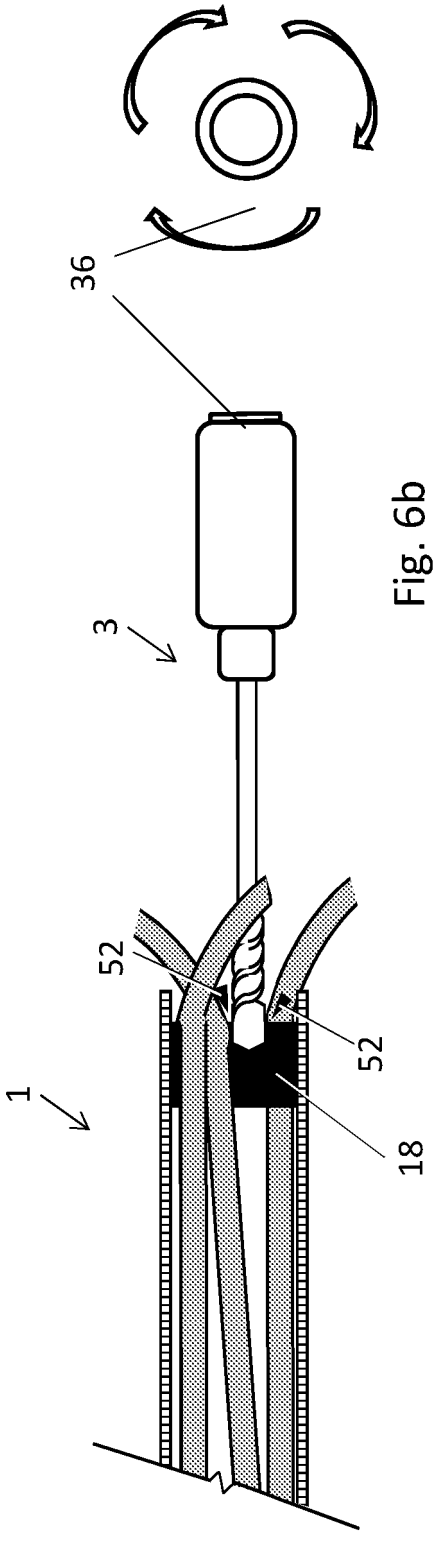


Fig. 6b

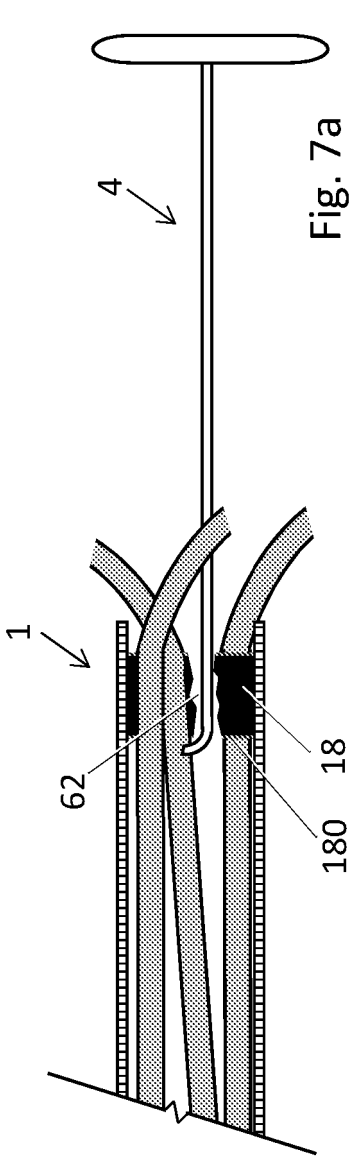


Fig. 7a

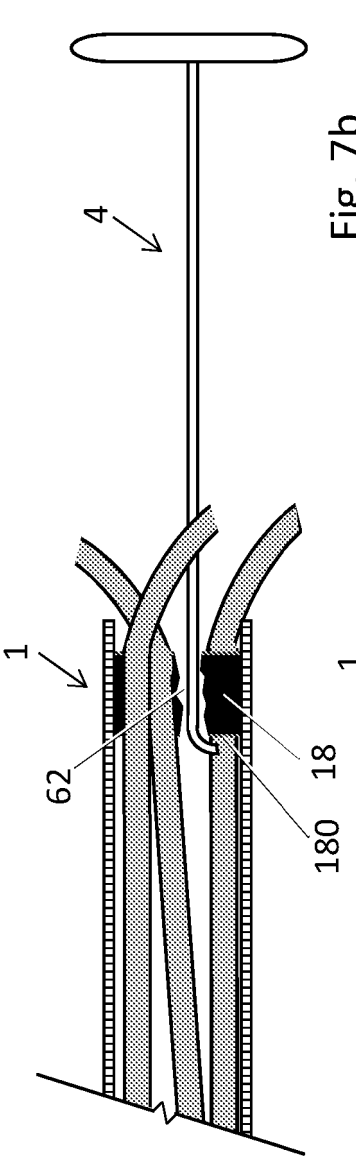


Fig. 7b

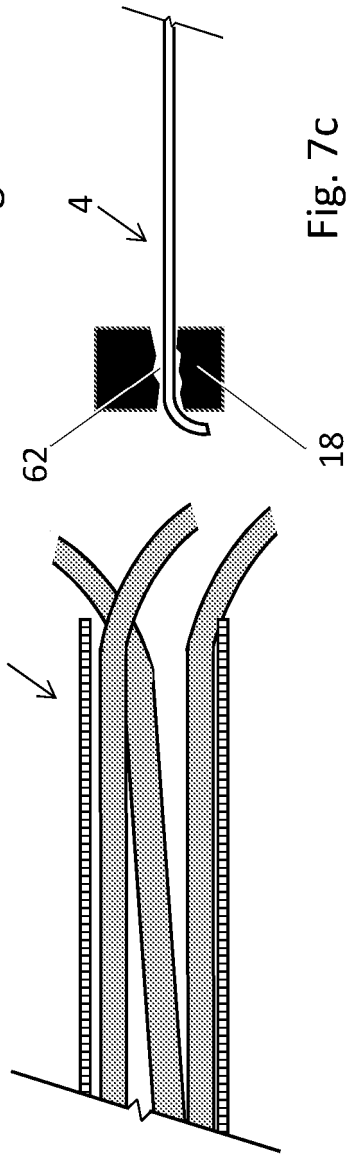


Fig. 7c

Cable Duct Plug Removal

Field of the Invention

The present invention relates to cable ducts and to the removal of cable duct plugs.

Background of the Invention

Modern telecommunications networks connect core communications networks to end users (e.g. subscribers) via communication infrastructures (e.g. access networks) comprising electrical cables and optical fibres carried in cable ducts. These cable ducts may carry electrical cables and conduits (i.e. tubes) for optical fibre from central switching centres such as telephone exchanges to street cabinets located in the vicinity of the end user. For practical reasons, especially in towns and cities, the majority of these ducts are buried in the earth, e.g. under roads and pavements. Cable ducts that originate in a switching centre travel underground to the destination street cabinet where they surface inside the cabinet to allow access to electrical cables and optical fibres carried in tubes by the cable ducts. In the following we shall use the term “cables” to indicate electrical and optical cables and optical fibre tubes. While providing protection for cables, together with flexibility in the provision and recovery of cables, cable ducts inherently, also provide a potential conduit for liquids and gases to enter exchange buildings or cabinets with potentially harmful results. For example explosive gases or flood water may enter a cabinet through an open-ended cable duct.

In order to prevent the unwanted ingress of gases or liquids into a building or cabinet, the ends of cable ducts are sealed, i.e. where they enter the building or cabinet. Cable duct seals are often formed from a compound or resin used to create a cap or plug inside the cable duct and around the cables to create a seal. A current method for sealing cable ducts uses a two-part compound or resin, for example resin 14b supplied by ALH Systems Limited, Westbury, Wiltshire, BA13 4WE, England, which sets in-situ to form a solid plug that fills the space around the cables at the end of the cable duct. According to this method, resin cable duct plugs are created by pouring a two-part cold-cure resin into the cable duct after a temporary dam (e.g. of paper or synthetic sponge) is formed around and between the cables. According to manufacturer’s recommendations, a temporary dam is inserted 25-30mm in from the end of the cable duct and prevents the resin from flowing away into the cable duct before it cures. When the resin cures a gas-tight cable duct plug is created. **Figures 1a and 1b show** a cross-section through a cable duct 1 to illustrate different types

of duct plug. Cable duct 1 carries two electrical cables 14 and an optical fibre tube 16. Cable duct 1 has an open end 12 for egress of the electrical cables 14 and an optical fibre tube 16 and will have a distant end (for example in a central exchange building), for ingress of these same cables and tube. A resin cable duct plug 18 sits inside the duct 1, close to the open end 12 and fixes the cables and tube in place while preventing gas or liquid from leaking through the open end 12 of the duct. As shown in Figure 1a, duct plug 18 comprises a solid plug of resin and has an inner surface 180 and an outer surface 182, where the inner surface is directed away from the open end of the duct and the outer surface is directed towards the open end of the duct.

As shown in Figure 1b, duct plug 18 comprises a solid resin plug 186 and dam 188. Solid resin plug 186 has an outer surface 182 directed towards the open end 12 of the duct and inner surface 184 directed away from the open end 12 of the duct. Dam 188 lies on the inner side of resin plug 186, i.e. adjacent inner surface 184 of the resin plug. Dam 188 has an inner surface 180 directed away from the open end 12 of the duct. Where the method of creating duct plug 18 involves pouring liquid resin onto a dam, duct plug inner surface 184 will abut a second, outer surface of dam 188 (not shown).

The use of duct plugs gives rise to the problem of removing the plugs when it is desired to insert, remove or adjust a cable carried by a cable duct. The resin 14b becomes very hard with age while adhering strongly to the inside of the duct and to the cables in the duct. Particularly in a street cabinet, the end of the cable duct is usually obscured by a mass of hundreds of fine wires which substantially fills the space inside the cabinet. Access to the open end 12 of the cable duct will often be obscured by these wires and also, at least in part, by the cables issuing from the cable duct. Access to the end of the cable duct is therefore restricted and the operative often has very little room to introduce tools into the vicinity of the end of the cable duct. Figure 2 shows, by way of example, a schematic representation of a typical street cabinet, while Figure 3 shows a photograph of a street cabinet interior.

Turning to **Figure 2**, street cabinet 20 comprises standard constructional features, including a steel base 210 secured to a foundation to support the cabinet, doors 212 (normally two) shown open, also of steel and secured, when closed by security locks 214 and bolts 216. Cabinet 20 is topped with roof 218, also of steel. In a typical street cabinet, all these parts are connected by a steel cabinet body 200. In a busy street cabinet, there will be a mass of hundreds of fine wires 220, which connect individual end-users to connections to the central exchange via cables 222 carried in one or more cable ducts 1. Each one of fine wires 200 is connected via one of a large number of connector blocks (not visible in the Figure). For reasons of clarity, the cable ducts 1 and cables 222 are shown in front of the mass of fine

cabinet wires 220, however, in practice, the ducts and cables will be at least partially hidden under the mass of fine cabinet wires 220, obscuring the ends of the ducts.

Figure 3 is a photograph of the interior of a cabinet showing an end of a cable duct 1 with cables 14, 16 emerging from the end of the duct and a plug 18 sealing the end of the duct.

As indicated, above, restricted access to the ends of the cable ducts makes it challenging to safely remove duct plug 18 while avoiding damage to the internal wires, the cables or the duct itself. With the density of fine wires in the vicinity of the cable ducts, there is a constant risk of inadvertently causing damage to the wiring leading to a loss of service for end users. Working in cramped conditions found inside a street cabinet on the inside of a cable duct partially obscured by cables issuing from the duct and by the mass of wires in the cabinet also means there is a risk of inadvertently causing damage to the cables themselves, leading to a loss of service for a large number of end users.

It is therefore desirable to provide a method to facilitate the efficient removal of duct plugs while reducing the risk of damage to the wring within a cabinet, to the cables and to the cable duct.

Summary of the Invention

The present invention accordingly provides, in a first aspect, a method of removing from a cable duct, a plug fixed to the inside of the duct; in which the plug is located at or near an open end of the duct; in which the method comprises:

piercing the plug using a first tool; and extracting the pierced plug using a second tool; in which the tools are applied to the plug through the open end of the duct;

in which the first tool comprises a handle connected to a shaft, a combined boring and chiselling extension and an impact surface;

in which the method further comprises creating a cavity in the plug by:

i) applying the combined boring and chiselling extension to a location on an outer surface of the plug;

ii) striking the impact surface so as to urge the combined boring and chiselling extension into the plug;

iii) rotating the first tool by means of the handle to erode, by means of the combined boring and chiselling extension, the material of the plug;

iv) repeating (ii) and (iii) until a cavity is formed in the material of the plug of an extent sufficient to facilitate removal of the plug;

v) removing the first tool from the plug;

in which the second tool comprises a shaft connected to a handle and to a plug-engaging part arranged to extend in a direction perpendicular to the longitudinal axis of the shaft; in which the method further comprises:

vi) inserting the plug-engaging part of the second tool into a cavity created in the plug by use of the first tool;

vii) manipulating the second tool until the plug-engaging part engages with the material of the plug; and

viii) applying force to the second tool in order to extract the plug from the duct.

In this way a cavity may be carefully created in the plug with reduced use of a hammer and with manual boring so allowing the operator to sense the state of the plug and avoid damage to the cables in the duct and wiring in the cabinet due to the reduction in force required. Also in this way, the plug extraction tool can be engaged reliably with the plug by use of the cavity to allow safe removal of the plug, again avoiding damage to the cables in the duct and wiring in the cabinet.

According to an embodiment, the method further comprises creating at least one further cavity in the plug by:

ix) applying the combined boring and chiselling extension to at least one further location on the outer surface of the plug;

x) repeating (ii) and (iii) until a second cavity is formed in the material of the plug of an extent sufficient to facilitate removal of the plug;

xi) removing the first tool from the plug;

xii) inserting the plug-engaging part of a further second tool into the second cavity;

xiii) manipulating the further second tool until the plug-engaging part engages with the material of the plug; and

xiv) applying force to the second tool and the further second tool in order to extract the plug from the duct.

In this way, the plug may be further weakened combined with the use of a second extraction tool to ease safe removal of the plug.

According to an embodiment, the plug is formed of a resin set in the duct.

According to an embodiment, the or each cavity extends through the plug from the outer surface of the plug to an inner surface of the plug, in which the method further comprises

inserting the plug-engaging part of at least one second tool through the cavity so that the plug-engaging part engages with the inner surface of the plug.

According to an embodiment, the inner surface of the plug comprises a surface of the resin plug.

According to an embodiment, the inner surface of the plug comprises a surface of a dam formed in the duct to restrict the flow of an unset, liquid resin used to form the resin plug.

According to an embodiment, the method further comprises creating a plurality of overlapping cavities in the plug by applying the combined boring and chiselling extension to at least one further location on the outer surface of the plug.

According to an embodiment, each cavity is insufficient on its own to allow insertion of the extraction tool, in which the method comprises inserting the plug-engaging part of at least one second tool into the plurality of overlapping cavities.

In this way, use of a small-diameter chiselling and boring tool eases penetration of the resin (especially when old and hard) while the overlapping of multiple cavities still provides access for the extraction tool to allow for safe extraction of the plug.

According to an embodiment, the method further comprises rotating at least one second tool so that the plug-engaging part engages with the material of the plug.

According to an embodiment, the cable duct houses a plurality of cables, which pass through the plug and issue from the open end of the cable duct.

According to an embodiment, the method further comprises selecting a location on an outer surface of the plug clear of the cables for applying the combined boring and chiselling extension to.

According to an embodiment, the method further comprises cutting the extracted plug to free from the plug at least one of the cables.

In this way, the plug that has been successfully extracted from the duct but is still intact may be safely separated from the cables passing through the duct with minimal use of force, so avoiding damage to the cables.

According to an embodiment, the method further comprises selecting a location on an outer surface of the plug adjacent to the cable duct wall for applying the combined boring and chiselling extension to.

According to an embodiment, the first tool and the second tool are integrated as a single tool.

Brief Description of the Drawings

In order that the present invention may be better understood, embodiments thereof will now be described, by way of example only, with reference to the accompanying drawings in which:

Figures 1a and 1b show, in cross-section, conventional cable ducts provided with duct plugs;

Figure 2 shows a perspective view of a conventional street cabinet;

Figure 3 shows a photograph of the interior of a conventional street cabinet;

Figures 4, 5a and 5b show tools suitable for implementing the invention;

Figures 6a, 6b, 7a, 7b and 7c illustrate aspects of a method according to the present invention.

None of the Figures are to scale.

Detailed Description of the Preferred Embodiments

A method is proposed in which a cable duct plug boring and chiselling tool is used to degrade, weaken or pierce a cable duct plug and in which a cable duct plug extraction tool is used to subsequently extract the degraded, weakened or pierced plug from the cable duct. Hand tools are preferred to power tools. By using hand tools, changes in the density of the material of the duct plug can be detected by the user more accurately. The user is, as a result, able to respond with greater sensitivity to such changes and, for example, to events including a tool breaking through the duct plug. These changes in material density while using the hand tool may, for example, indicate that the tool has made contact with a cable or the duct wall. Hand tools are readily portable and are suitable for use where no mains power supply is available. In addition, hand tools can be designed to be safe to use in explosive atmospheres.

An example duct plug boring and chiselling tool is shown in **Figure 4**. The tool comprises a handle 30 used for holding and rotating the tool in use. The handle is connected on one side to a shaft 32 and a combined boring and chiselling extension 34 and may comprise any suitably shaped part to allow holding and rotating the tool 4. The handle 30 is connected on another side to an impact surface 36, designed to be impacted by a hammer or similar heavy object. The design of the tool means that the impact of the hammer is transmitted though the shaft 32 to the boring and chiselling extension 34, so as to urge the boring and chiselling extension into the material of the duct plug 18 in use. According to an embodiment, handle 30 may be provided with a clamping mechanism 38 to grip a detachable boring and chiselling extension 34.

Exemplary duct plug extraction tools 4 are shown in **Figures 5a and 5b**. The duct plug extraction tool comprises a handle 40 connected to the proximal end of a shaft 42. The distal end of the shaft 42 comprises a projection 44 extending in a direction at right angles to the longitudinal axis of the shaft 42. According to an embodiment, projection 44 may be arranged at an angle of approximately 45 degrees to shaft 42. As shown in Figure 5a, the projection 44 may consist of a part of shaft 42 bent through an angle approximating 45 degrees or another angle suitable for engaging with duct plug 18. As shown in Figure 5b, the projection 44 may consist of a cross-piece secured to shaft 22 by any suitable means, including adhesive, welding and screw thread. According to an embodiment, the duct plug extraction tool 4 is made from 6mm steel bar, approximately 500mm long, with a 20mm lateral projection at the distal end and a "T" handle fitted to the proximal end. Both tools 3 and 4 are applied to the duct plug 18 through the open end 12 of the duct. Handle 40 may comprise a "T" design of handle, as shown, or any suitably shaped part to allow holding and rotating the tool 4.

A method to remove a duct plug 18 will now be described with reference to Figures 6a, 6b, 7a, 7b and 7c. As shown in **Figures 6a and 6b**, the duct plug boring and chiselling tool 3 is used according to a method that employs manual rotation of the boring and chiselling extension to bore carefully into the materiel of the duct plug in combination with minimal use of a hammer, or similar, 50 to impact the tool 3 so as to urge the boring and chiselling extension into the material of the duct plug 18. As shown in Figure 6a, the cable duct plug boring and chiselling tool 3 is initially urged into the material of the duct plug 18 by manual use of a massive object, for example a hammer or mallet to impact the impact surface 36 of the tool 3. As shown in Figure 6b, once slightly embedded into the material of the duct plug 18, the tool 3 may be rotated by manually rotating the handle so that the combined boring and chiselling extension 34 bores into the material of the duct plug 18, producing waste material 52. In order to assist in the boring action, i.e. by further engaging the combined boring and chiselling extension 34 into the material of the duct plug 18, the impact operation of Figure 6a may be repeated intermittently, interspersed by continuation of the boring action of Figure 6b. According to an embodiment, tool 3 is provided with a synthetic, e.g. nylon, handle that reduces the risk of ignition in an explosive atmosphere when struck by a hammer. Figures 6a and 6b illustrate use of tool 3 in the case, shown in Figure 1a, of a resin plug 18 without a dam (or with a dam small enough to be ignored for practical purposes of this description). Where a dam 188 is present, as shown in Figure 1b, tool 3 may, according to an embodiment, be driven completely through resin plug 186 and into or through dam 188.

Figures 7a, 7b and 7c show a cavity 62 has been opened up in duct plug 18 as a result of the use of tool 3 in the boring and impact actions described above. The cavity may or may not extend all the way through the plug. As shown in Figure 7a, tool 3 is now set aside and tool 4 is now inserted into cavity 62. Once inside the cavity, tool 4 is then manipulated (for example including rotation) as shown in Figure 7b, so as to engage with duct plug 18. In the embodiment illustrated in Figure 7b, for example, the projection 44 passes through the duct plug 18 to emerge from the inner surface 180 and engages with the inner surface 180. As shown in Figure 7c, tool 4 may now be pulled away from cable duct 1 (e.g. by pulling on handle 40) to extract duct plug 18 from the cable duct 1. It will be noted that the arrangement shown in the Figures relate to exemplary embodiments of the invention and are, for reasons of clarity, simplified. In practice, two or more cavities may be required in duct plug 18 in order to free it or to weaken it sufficiently to allow extraction without use of excessive force (which could result in damage to the cabinet wiring or elsewhere). In such cases, two or more tools 4 may advantageously be used together to extract the duct plug. Similarly, depending on the circumstances, such as the number and size of cables issuing from the cable duct, it may be necessary to break up the duct plug 18 (i.e. by the creation of further cavities) before it can be safely extracted from the cable duct 1.

Figures 7a, 7b and 7c illustrate use of tool 4 in the case, shown in Figure 1a, of a resin plug 18 without a dam (or with a dam small enough to be ignored for practical purposes). According to an embodiment, where a dam 188 is present, as shown in Figure 1b, tool 4 may be inserted completely through resin plug 186 and into or through dam 188. According to various embodiments, the projection 44 passes through the resin plug 186 into dam 188 and engages with the inner surface 184 of resin plug 186; the projection 44 passes through the resin plug 186 into dam 188 and engages with the material of dam 188 or the projection 44 passes through the resin plug 186 and through dam 188 and engages with inner surface 180 of dam 188.

According to an embodiment, rather than a single cavity, a series of connected or closely-adjacent cavities are created. According to an embodiment, the series of cavities are created close to the juncture where the duct plug 18 meets the inside of the cable duct 1 (i.e. the inner surface of cable duct wall 10). The series of cavities are used to weaken the duct plug, for example, by weakening the bond between duct plug 18 and the inside of the cable duct and to enlarge the entry points for introducing the duct plug extraction tool 4.

According to an embodiment, one or more slots are created in duct plug 18 by closely grouping cavities until a slot is created large enough to allow duct plug extraction tool 4 (and, in particular, projection 44) to pass through the duct plug 18. In use, the projection 44 is passed into the slot, then rotated to engage with the side wall of the slot or passed through

the slot and manipulated to engage with the inner surface 180 of the duct plug 18. Pulling on handle 40 results in projection 44 applying a force to the side wall of the slot or to the inner surfaces 180 or 184 which urges the duct plug 18 towards the open end 12 and out of the duct. According to an embodiment, sufficient cavities are created in duct plug 18 to enable it to be broken up into segments for easy removal using tool 4.

According to an embodiment, the duct plug 18 is inspected to assess whether the cavity or cavities formed by use of tool 3 are judged sufficient to facilitate efficient removal of the duct plug. This assessment may constitute a semi-constant process of creating a cavity, assessing how difficult it was to create the cavity and looking for signs of movement and fragmentation in the duct plug. For example if a duct plug had old resin and was difficult to bore it may be preferable to delay trying to extract the plug until the plug itself showed movement during the process of creating further cavities.

In line with good practice, the removal of a duct plug may be carried out after initial checks. These checks may include a site risk assessment with regard to minimising risk to the user and others. In planning a strategy to employ, various factors may be taken into account including: the number, size and distribution of cables within the cable duct; the type of cable duct e.g. plastic cable duct, clay pot or asbestos cement cable duct; the direction cables take on exiting the cabinet; and the amount of slack available in the cables

According to an embodiment, the best point or points are determined to create one or more cavities in the duct plug 18 for insertion of the tool 4. One or more cavities are then created to weaken the duct plug 18 and the bonds between the plug, the cable duct 1 and cables 14, 16. According to an embodiment, a series of cavities is created, working from as far towards the back of the cabinet as possible and progressing towards the front. According to an embodiment, the method comprises lightly tapping the tool 3 with a jointers hammer and rotating the tool 3 by 90 degrees between taps. Repeating the sequence of tap, twist, tap, twist, acts to loosen and remove the material of duct plug 18 until the required cavity size is created. It may be that cables are still trapped by the duct plug 18 after the plug has been removed from the cable duct 1. According to an embodiment, the cables 14, 16 can then carefully be freed from the duct plug 18 by cutting or sawing through the material of the duct plug 18.

It will be understood by those skilled in the art that, although the present invention has been described in relation to the above described example embodiments, the invention is not limited thereto and that there are many possible variations and modifications which fall within the scope of the invention.

According to an embodiment, the diameter of combined boring and chiselling extension 34 is of the order of 5.5 mm. According to an embodiment, after an initial cavity or a set of initial cavities has been created using the preferred size of combined boring and chiselling extension 34, the cavities may be enlarged by replacing the original combined boring and chiselling extension 34 with a second combined boring and chiselling extension 34 of greater diameter. Here clamping mechanism 38 may be useful in allowing easy interchange of detachable boring and chiselling extensions 34 of different size. Alternatively, a second tool 3 with a second combined boring and chiselling extension 34 of greater diameter may be used. According to an embodiment, the diameter of second combined boring and chiselling extension 34 is 8mm. Use of the second combined boring and chiselling extension 34 may advantageously result in existing, separate cavities being joined up to form slots, which can facilitate insertion of tool 4 and, in addition, further weaken duct plug 18.

According to an embodiment, the first, cable duct plug boring and chiselling tool and the second, cable duct plug extraction tool may be integrated as a single tool. For example, the boring and chiselling extension may share a single handle with shaft 42 and projection 44, where the extension and the proximal end of shaft 42 are joined to a single handle by fixed or jointed (flexible) connections. According to a further example, clamping mechanism 38 may be used to allow interchange of a detachable boring and chiselling extension 34 and a detachable shaft 42 and projection 44.

The scope of the present invention includes any novel features or combination of features disclosed herein. The applicant hereby gives notice that new claims may be formulated to such features or combination of features during prosecution of this application or of any such further applications derived therefrom. In particular, with reference to the appended claims, features from dependent claims may be combined with those of the independent claims and features from respective independent claims may be combined in any appropriate manner and not merely in the specific combinations enumerated in the claims.

Claims

1. A method for removing from a cable duct, a plug fixed to the inside of the duct; in which the plug is located at or near an open end of the duct;

in which the method comprises:

piercing the plug using a first tool; and extracting the pierced plug using a second tool; in which the tools are applied to the plug through the open end of the duct;

in which the first tool comprises a handle connected to a shaft, a combined boring and chiselling extension and an impact surface;

in which the method further comprises creating a cavity in the plug by:

i) applying the combined boring and chiselling extension to a location on an outer surface of the plug;

ii) striking the impact surface so as to urge the combined boring and chiselling extension into the plug;

iii) rotating the first tool by means of the handle to erode, by means of the combined boring and chiselling extension, the material of the plug;

iv) repeating (ii) and (iii) until a cavity is formed in the material of the plug of an extent sufficient to facilitate removal of the plug;

v) removing the first tool from the plug;

in which the second tool comprises a shaft connected to a handle and to a plug-engaging part arranged to extend in a direction perpendicular to the longitudinal axis of the shaft;

in which the method further comprises:

vi) inserting the plug-engaging part of the second tool into a cavity created in the plug by use of the first tool;

vii) manipulating the second tool until the plug-engaging part engages with the material of the plug; and

viii) applying force to the second tool in order to extract the plug from the duct.

2. The method of claim 1, further comprising creating at least one further cavity in the plug by:

ix) applying the combined boring and chiselling extension to at least one further location on the outer surface of the plug;

x) repeating (ii) and (iii) until a second cavity is formed in the material of the plug of an extent sufficient to facilitate removal of the plug;

xi) removing the first tool from the plug;

xii) inserting the plug-engaging part of a further second tool into the second cavity;

xiii) manipulating the further second tool until the plug-engaging part engages with the material of the plug; and

xiv) applying force to the second tool and the further second tool in order to extract the plug from the duct.

3. The method of any above claim, in which the plug is formed of a resin set in the duct.

4. The method of any above claim, in which the or each cavity extends through the plug from the outer surface of the plug to an inner surface of the plug, in which the method further comprises inserting the plug-engaging part of at least one second tool through the cavity so that the plug-engaging part engages with the inner surface of the plug.

5. The method of claim 4, in which the inner surface of the plug comprises a surface of the resin plug.

6. The method of claim 4, in which the inner surface of the plug comprises a surface of a dam formed in the duct to restrict the flow of an unset, liquid resin used to form the resin plug.

7. The method of any above claim, further comprising creating a plurality of overlapping cavities in the plug by applying the combined boring and chiselling extension to at least one further location on the outer surface of the plug.

8. The method of claim 7, in which each cavity is insufficient on its own to allow insertion of the extraction tool, in which the method comprises inserting the plug-engaging part of at least one second tool into the plurality of overlapping cavities.

9. The method of any above claim, comprising rotating at least one second tool so that the plug-engaging part engages with the material of the plug.

10. The method of any above claim, in which the cable duct houses a plurality of cables, which pass through the plug and issue from the open end of the cable duct.

11. The method of claim 10, comprising selecting a location on an outer surface of the plug clear of the cables for applying the combined boring and chiselling extension to.

12. The method of any of claims 10 and 11, comprising cutting the extracted plug to free from the plug at least one of the cables.

13. The method of any above claim, comprising selecting a location on an outer surface of the plug adjacent to the cable duct wall for applying the combined boring and chiselling extension to.

14. The method of any above claim, in which the first tool and the second tool are integrated as a single tool.

Intellectual Property Office

Application No:	GB1614514.6	**Examiner:**	Paul Nicholls
Claims searched:	1 - 14	**Date of search:**	18 January 2017

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
A	-	JP 2001309515 A (DAIMEI) - Holes 3 are drilled in cable duct plug 11 and pliers 14 used to remove it
A	-	JP 2004274955 A (TSUSHIN DOBOKU et al) - Rod 20 is used to remove cable duct plug 32
A	-	JP 2012080687 A (CHUGOKU) - Tool 11 is used to pull cable duct plug 51
A	-	JP H0823615 A (SHOWA) - Cable duct plug is broken up and removed by hitting it with a hammer

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

G02B; H02G

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

WPI, EPODOC

International Classification:

Subclass	Subgroup	Valid From
H02G	0001/00	01/01/2006
G02B	0006/38	01/01/2006