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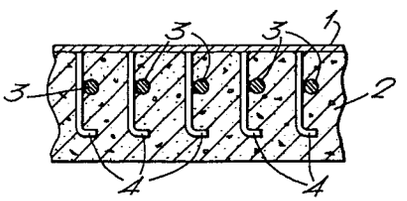
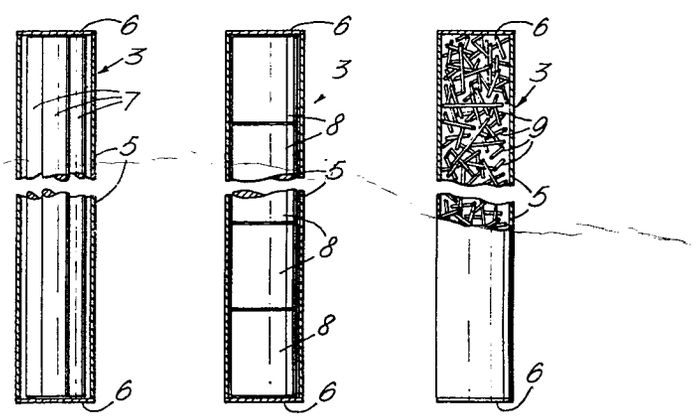
(54) Security barrier structure.

(57) A barrier structure for safes and vaults including reinforcing members 3 designed to provide increased resistance to penetration by diamond drills. A cast concrete layer 2 is held to a backing plate 1 by anchors 4 and the reinforcing members 3 are welded to the anchors 4 so as to be embedded in the layer 2 when the concrete is cast onto the plate 1. The reinforcements 3 comprise tubes 5 which may be filled with a variety of elements which have been found to frustrate the diamond drill, such as tensile steel rods 7 (Fig. 2a) ceramic rollers 8 (Fig. 3a) and small rods or needles 9 of malleable metal (Fig. 4a).





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Security Barrier Structure

The present invention relates to barrier structures for use eg in the walls and/or doors of safes, strongrooms and the like security enclosures. Barrier structures provided for this purpose must have a high degree of resistance to penetration by a variety of mechanical and thermal tools, and as the forms of tool which may be appropriated for attacks on such enclosures are developed so also must the barrier structures for resisting them be improved. In this regard the present invention is particularly concerned to provide a security barrier structure with high resistance to penetration by a certain clss of industrially-useful cutting tool, namely diamond drills, saws and the like.

The diamond drill is a form of core drill (holesaw) which typically comprises a steel tube having welded to one end thereof a series of "teeth", the teeth comprising particles of diamond embedded in a softer matrix material. These drills are intended for cutting hard minerals, concrete and the like materials and depend for their operation on the continual wearing down of the matrix material in the drill tip by the work being cut, so as continually to expose fresh diamond particles. Similar cutting teeth can be provided on the circumference of a circular saw for example.

In one aspect, the invention resides in a security barrier structure comprising a substrate layer onto which is cast a layer of security material; anchor means extending from the substrate layer into the mass of the cast layer; and at least one reinforcing member attached to the anchor means so as to be embedded within the mass of the cast layer; the or each said reinforcing member comprising a tube generally aligned with the plane of the barrier and containing elements which are able to move within the tube in response to contact with a rotary tool.

The invention also resides in the reinforcing members of such a structure per se, and of which details will appear hereafter.

The elements which are contained within the tube of a said reinforcing member may for example comprise rods, rollers or other elements of a relatively hard metal (eg tensile steel), ceramic (eg aluminium oxide) or other material. Such elements may act to resist penetration of the barrier structure by a diamond drill, in the following way. Thus, assuming that the drill has penetrated the part of the surrounding security material between the exterior of the enclosure and the reinforcing member and has also cut through part of the wall of the tube of the reinforcing member, the ensuing contact of the contained elements with the rotating drill tip will in general cause those elements also to rotate, thereby significantly slowing the rate at which individual elements can be cut or preventing them from being cut at all. Moreover if the elements are relatively loosely packed they can also revolve or otherwise move about inside the tube and thereby set up strong vibrations in the drill leading to rapid wear of the drill tip and fracture of its

teeth and other possible damage to the drilling machine. The inclusion of a multiplicity of relatively small hard elements of a size to fit between the teeth of the drill tip is also of advantage, such elements tending to snap off the drill teeth as the tool continues to rotate with the hard elements trapped between its teeth.

However, the inclusion of softer and more malleable elements in the tube of a said reinforcing member, such as mild steel rods or the like, has also been found to frustrate attempts to penetrate the reinforcing member with a diamond drill, although in this case the mechanics are somewhat different. In this case when the wall of the tube is penetrated the soft elements, suitably sized for the purpose, can get between the drill teeth and between the drill and the walls of the core which the drill has prepared in the surrounding security material, and thereby act to jam the rotation of the tool. Furthermore these softer elements tend not to wear the matrix material of the drill teeth rapidly enough to expose sufficient diamond particles to cut the elements; instead the rubbing action of the rotating drill on the elements generates excessive heat and if mild steel elements are used, for example, they may become welded to the tool and thus still further reduce its efficacy. If the tool is withdrawn under these conditions the molten metal may become spread over the walls of the drilled core and thereby prevent reinsertion of the tool to the same depth as it has previously drilled.

In some embodiments a mixture of the harder and softer elements referred to above may also be of advantage.

The layer of security material, so-called herein, within which the aforesaid reinforcing members are embedded may in general be provided by any one of the known castable

penetration-resistant materials customarily used in the construction of security enclosures, thus including selected concrete, metal and elastomer materials, with or without additional penetration-resistant constituents. However it is within concrete security barriers that the inclusion of these reinforcing members is likely to be of the greatest benefit, and a particularly preferred security material which, when used together with such members in a barrier structure according to the invention can provide balanced resistance to a wide variety of forms of mechanical and thermal attack at reasonable cost, is steel fibre-reinforced concrete.

Examples of barrier structures according to the invention will now be described with reference to the accompanying diagrammatic drawings, in which:

Figure 1 is a horizontal section taken through the wall of a safe or the like enclosure and illustrating the general form of barrier structure;

Figures 2a and 2b are respectively vertical and horizontal sections, to an elnarged scale, taken through a first embodiment of reinforcing member for use in the structure of Figure 1;

Figures 3a and 3b are views similar to Figures 2a and 2b of a second embodiment of reinforcing member; and

Figures 4a and 4b are views similar to Figures 2a and 2b of a third embodiment of reinforcing member.

Referring to Figure 1, there is shown a mild steel backing plate 1 (which defines the inside surface of the enclosure) to which is secured a layer of steel fibre-reinforced concrete 2 with embedded therein a series of elongate

reinforcing members 3. Rows of steel anchors 4 are welded to the back plate 1 to extend into the mass of the concrete layer 2, and the reinforcing members 3 are welded to the anchors 4 so as to lie generally in the plane of the barrier structure and transverse to any expected line of attack thereon. The primary purpose of the members 3 is to increase the resistance of the structure to penetration by a diamond core drill, although they may of course similarly act to resist penetration by other types of rotary tool.

Figures 2a and 2b show one form of reinforcing member 3 which can be used in the structure of Figure 1. It comprises a tube 5, typically of mild steel, capped at each end 6 and containing a small number of loosely-packed parallel rods 7, each extending through the full length of the tube. The rods 7 are typically made of tensile steel. Three such rods are shown in the Figures, each having a typical diameter of 7mm, with the inside diameter of the tube 5 being about 20mm. There is thus sufficient space within the tube 5 for the rods 7 not only to rotate around their own respective axes but also to move about independently in the lateral sense. When such a reinforcement is encountered by the tip of a diamond drill cutting through the tube wall 5, the rods will accordingly rotate and vibrate under the action of the drill tip to slow or prevent the drill from cutting the rods, and to spoil the tool.

Figures 3a and 3b show another kind of reinforcement 3, which depends primarily on rotation of its internal elements to frustrate the drill. In ths case the tube 5 contains a series of individual rollers 8 stacked one upon the other, these rollers being made from a hard ceramic material such as aluminium oxide - eg the material sold as METOXIT (Registered Trade Mark) AL998. The rollers have a diameter only

slightly less than the internal diameter of the tube 5, and a typical length of 25mm in a 20mm tube. They have squared-off ends and a combined axial length substantially equal to the length of the tube 5 so that no gaps appear between one roller and the next through which the rim of a diamond core drill could pass.

Turning to Figures 4a and 4b, these show a form of reinforcement 3 in which the tube 5 is packed throughout with a multiplicity of randomly-orientated rods or needles 9 of a relatively soft and malleable metal - eg mild steel of a grade from which ordinary wood-fixing nails are customarily made. These rods typically have a diameter of 1-1.5mm and a length which is slightly less than the internal diameter of the tube 5, eg 15-18mm in a 20mm tube. The rods 9 are therefore of a size such that they can adopt any orientation within the tube 5 and are small enough to be able to pass out of the tube when the latter is penetrated by a diamond drill tip. Elements of this type frustrate the action of the drill in a somewhat different manner to the harder elements 7 and 8 of the Figures 2 and 3 embodiments, as previously described. That is to say they tend to jam the rotation of the tool by getting between the drill teeth and between the drill and the walls of the core which it has prepared in the concrete layer 2, and can even become welded to the drill and core.

In another embodiment of a reinforcing member 3 the tube 5 is filled with elements of a similar form to the mild steel rods 9 of Figure 4, but in this case the rods are of hard steel eg of a grade from which masonry nails are made. These can act to frustrate the drill by snapping off its teeth when the rods are caught between the rotating teeth, in addition to rotation and vibrating within the tube.

A mixture of mild steel and hard steel rods 9 within the same tube 5 is also possible in order to give a combined resistive effect to the drill. In this case a ratio of approximately 2:1 in the numbers of the softer and harder elements has been found to be particularly efficacious.

Returning to Figure 1, to produce a structure of the type shown the rows of anchors 4 are first welded to the back plate 1 and the tubes 5 of the prepared reinforcing members 3 are then welded to the anchors 4. After fabricating this assembly the plate 1 is assembled with a re-usable mould structure (not shown) to define an approprite cavity for the layer 2, and the wet concrete mixture with dispersed steel fibres is poured in. When the concrete 2 has set the plate 1 and mould structure are separated to leave the barrier structure as shown in Figure 1.

The concrete thickness is typically 150mm with the reinforcing members 3 at a typical depth of 105mm from the external concrete surface and pitched at no more than 75mm apart so that any core drill which is adapted to form a "handhole" size aperture will encounter at least one of the members 3 before the barrier structure is penetrated. Advantageously the spacing between adjacent pairs of reinforcing members 3 is irregular (within a maximum specified dimension as typified above) to increase the difficulty of predicting the reinforcement positions from the outside.

In addition to performing the function of resisting the diamond drill or other rotary tools as indicated above, the reinforcing members 3 serve together with the anchors 4 to maintain the integrity of the concrete layer 2 and to offer high resistance to separation of the concrete from the

backing plate 1. Furthermore, the use of steel fibre reinforcement in the concrete of the layer 2 imparts high tensile strength to the concrete, so that if a diamond drill is used to penetrate the concrete up to a reinforcing member 3 it will be difficult to detach the partially-drilled core from the remainder of the concrete layer in order to gain access to the member 3 with different tools to which it may be more vulnerable. This difficulty is compounded by providing the reinforcements 3 at a considerable depth within the layer 2. Moreover, by associating the reinforcements 3 with the anchors 4 (which extend to within, say, 35mm of the outer surface of the layer 2), it is likely that any partially-drilled core which reaches a member 3 will encompass the outer end of an anchor 4 and thus the core will be retained in place by this means also.

CLAIMS

1. A security barrier structure comprising a substrate layer (1) onto which is cast a layer of security material (2); and anchor means (4) extending from the substrate layer (1) into the mass of the cast layer (2); characterised by at least one reinforcing member (3) attached to the anchor means (4) so as to be embedded within the mass of the cast layer (2); the or each said reinforcing member (3) comprising a tube (5) generally aligned with the plane of the barrier and containing elements (7;8;9) which are able to move within the tube (5) in response to contact with a rotary tool.

2. A barrier structure according to claim 1 wherein a said reinforcing member (3) comprises a tube (5) containing a plurality of rods (7) of hard material arranged generally parallel to one another and to the axis of the tube (5) with freedom to rotate and to displace laterally within the tube (5).

3. A barrier structure according to claim 1 or claim 2 wherein a said reinforcing member (3) comprises a tube (5) containing a plurality of rollers (8) of hard material arranged in series along the axis of the tube (5) and with freedom to rotate therein.

4. A barrier structure according to claim 3 wherein said rollers (8) are of ceramic material.

5. A barrier structure according to any preceding claim wherein a said reinforcing member (3) comprises a tube (5) containing a multiplicity of small elements (9) of malleable material.

6. A barrier structure according to any preceding claim wherein a said reinforcing member (3) comprises a tube (5) containing a multiplicity of small elements (9) of hard material.

7. A barrier structure according to any preceding claim wherein a said reinforcing member (3) comprises a tube (5) containing a multiplicity of small elements (9) some of which are of malleable material and others of which are of hard material.

8. A barrier structure according to any one of claims 5 to 7 wherein said small elements are in the form of rods (9) of a length which is less than the characteristic cross-sectional dimension of said tube (5).

9. A barrier structure according to any preceding claim wherein a said reinforcing member (3) is embedded within the mass of said cast layer (2) at such a depth within that layer (2) that it is closer to said substrate layer (1) than to the outer surface of the cast layer (2).

10. A barrier structure according to any preceding claim wherein a said anchor means (4) extends from said substrate layer (1) into the mass of said cast layer (2) to a position beyond its position of attachment to a said reinforcing member (3).

11. A barrier structure according to any preceding claim wherein said security material (2) is steel fibre-reinforced concrete.

12. A reinforcing member for a security barrier structure having the characteristics defined in any one of claims 1 to 8.

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Fig.1.

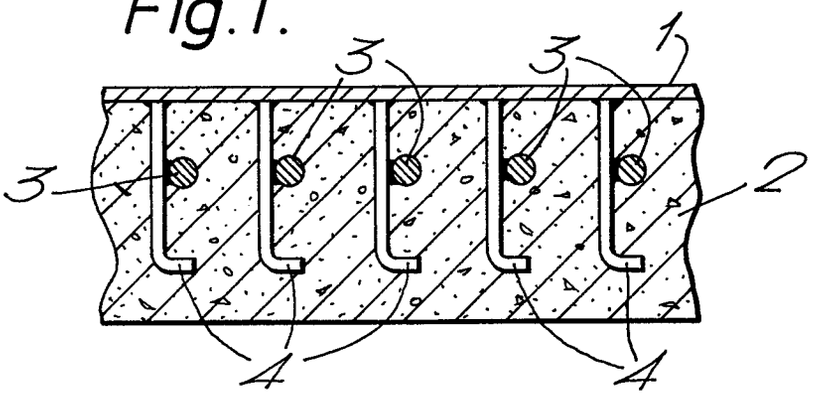


Fig.2a.

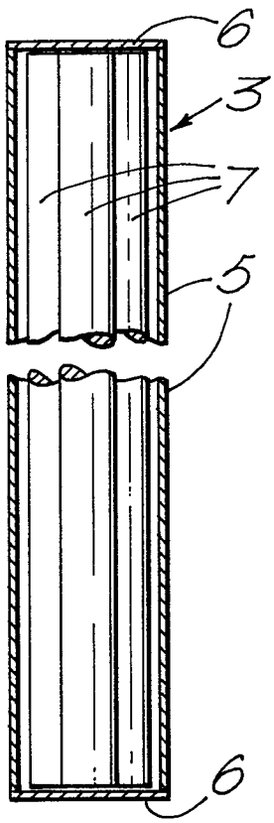


Fig.3a.

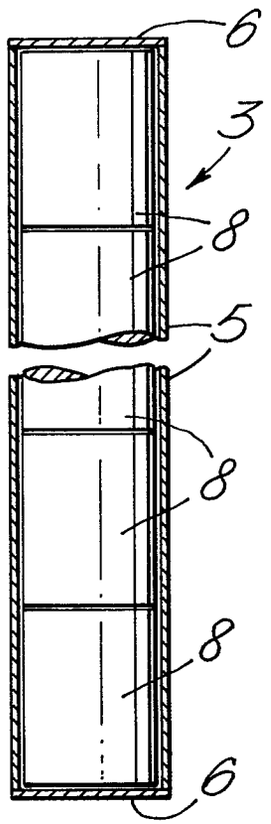


Fig.4a.

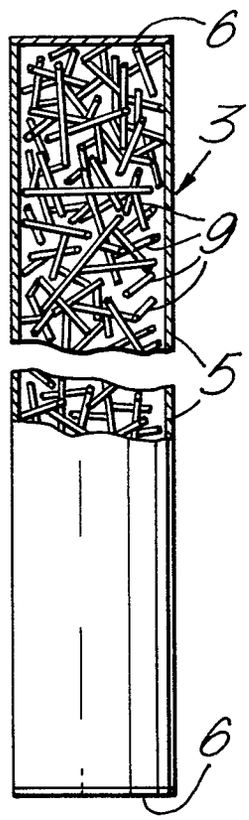


Fig.2b.

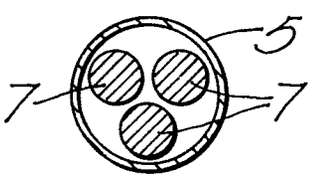


Fig.3b.

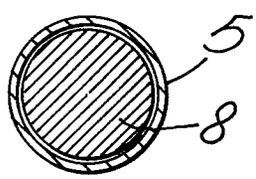
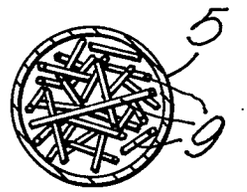


Fig.4b.



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EUROPEAN SEARCH REPORT

0078566
Application number

EP 82 20 1322

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. ³)
Y	US-A-3 123 025 (FUGELSTAD) * Figure 1 *	1,9	E 05 G 1/024
Y	EP-A-0 024 312 (FIPKE) * Abstract; figure 3 *	1,2	
A	DE-A-1 784 644 (KIRSCHBAUM) * Page 1, paragraph 2; figure 3 *	1,2,4	
A	GB-A-1 083 348 (SHWAYDER) * Page 1, lines 80-82; page 2, lines 1-11 *	5-7	
A	DE-A-2 525 738 (DANZER)		

TECHNICAL FIELDS SEARCHED (Int. Cl. ³)

E 05 G
E 06 B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	10-02-1983	NEYS B.G.

CATEGORY OF CITED DOCUMENTS

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