(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 0 811 736 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
10.12.1997 Bulletin 1997/50

(51) Int Cl.[6]: **E04G 23/02**

(21) Application number: **97303835.9**

(22) Date of filing: **04.06.1997**

(84) Designated Contracting States:
AT BE CH DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE
Designated Extension States:
AL LT LV SI

(30) Priority: **04.06.1996 GB 9611641**

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(54) Reinforcement of masonry structures

(57) A reinforcement 1 for a masonry structure includes a central core 2 and a plurality of spacers for holding the central core 2 away from the edges of a groove 7 in the masonry structure. This ensures that bonding material can surround the central core 2 of the reinforcement 1.

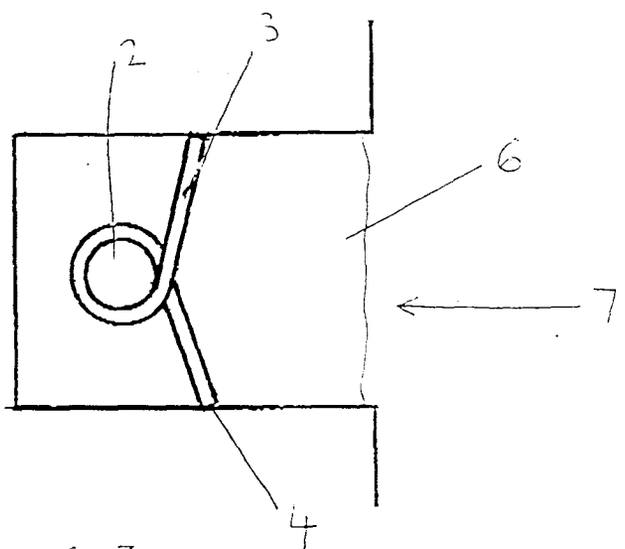

FIG 3

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Description

Field of the Invention

The invention relates to a method of reinforcing a masonry structure such as a solid wall, cavity wall, arch, bridge, chimney or viaduct, and to a reinforcement for use in such a method.

Background Art

Masonry and like materials are generally strong in compression but weak in tension and are therefore used in structures where there is substantially no tensile loading. For example, masonry is appropriate for the construction of buildings where the forces are essentially vertical and compressive. It is necessary however to provide beams in the form of lintels over doors, windows and other openings.

Buildings and other masonry structures may suffer damage from a variety of structural failures, both above and below ground level, for example lintel failure, subsidence, thermal movement, differential movement, physical damage and design faults. This can cause a loss of support in some areas and result in tensile forces within the masonry. As the masonry is unable to withstand the tensile forces, cracks will form above the unsupported areas.

There have been a number of proposals for repairing and supporting masonry structures and most of these methods involve cutting into the external face of a wall to form a groove into which a reinforcement is inserted. The reinforcement usually consists of a bar or reinforcement of steel or similar material strong in tension. The rod or bar may be circular or rectangular in cross section and may include ridges or have a roughened surface to help retain it in a bonding material.

The reinforcement is glued or bonded into position with resin cementitious mortars, wedges, plastic bonding agents or similar substances. This allows the tensile qualities of the reinforcement to be transferred to the masonry. This provides tensile restraint of the masonry, and may be used to provide a composite masonry/reinforcement beam which acts to support or transfer loads imposed upon it.

When reinforcing existing masonry structures, a hole or groove is cut to accommodate the reinforcement. Particularly in older masonry structures, the width of the groove may deviate from the desired dimensions, or may not be uniform.

The Invention

According to a first aspect of the invention there is provided a reinforcement for insertion into a slot, groove or hole in a masonry structure, the reinforcement including a central elongate core and a plurality of spacers on the central core for holding the central core away from the edges of the slot, groove or hole.

Preferably each spacer includes one or more projections extending radially outwards away from the central core. The projections may be relatively sharp such that they tend to snag against the edges of the slot, groove or hole, thus keeping the reinforcement firmly in place.

The spacers may consist of pieces of wire, which may be stainless steel, twisted around the central core such that the ends of the wire form projecting tails.

The spacers may include projections located such that when the reinforcement is positioned in a horizontal slot, groove or hole its maximum vertical height varies as it is twisted about its axis. In this embodiment, the reinforcement may be twisted until it is tightly positioned in any of a number of grooves of varying thicknesses. For example, each spacer may include two projections approximately diametrically opposed to one another. When the reinforcement is to be inserted into a relatively narrow horizontal groove, it is positioned such that the projections extend horizontally away from the central core. When the reinforcement is to be inserted in a relatively wide horizontal groove, it is positioned such that the projections extend vertically. The reinforcement can be twisted by a varying amount depending on the thickness of the groove, such that the reinforcement is always held firmly within the groove. Although the above explanation refers to horizontal reinforcements, the principle is of course equally applicable to reinforcements located at any angle.

Alternatively, the reinforcement may include spacers having three, four or more projections located around the perimeter of the central core, to ensure that the core always lies away from the edge of a slot, groove or hole.

The central core may be solid or hollow, of straight or twisted shape, and may have a roughened or ridged surface to increase adhesion between the central core and a bonding material.

Because the reinforcement is held firmly in place, parts of the reinforcement are prevented from springing out of the groove as other parts are inserted into the groove. This has been found by the inventor to be a problem, particularly on corners or curved surfaces such as the intrados of an arched bridge or a round chimney or tank.

Further tests carried out by the inventor to establish the degree of bond between steel and masonry show that bonding material must be distributed evenly around the reinforcement and that bars lying on the bottom of the groove and not surrounded by bonding mortar will fail at relatively low tension levels. Bars according to the invention can be held by the spacers away from the bottom of the groove thus overcoming this problem.

If the groove is too tight, the reinforcement may also be damaged as it is forced into the groove. The invention overcomes this problem as it is only the spacers which contact the edges of the groove.

When cutting grooves in masonry structures, a weakness is created in the wall, undermining its stability. The spacers of a reinforcement according to the invention mitigate this effect.

A further advantage of the spacers is that they increase the bonding force in a direction along the length of the reinforcement. They engage the bonding material and make it much more difficult to pull the reinforcement longitudinally out of the bonding material.

According to a further aspect of the invention, there is provided a method of reinforcing a masonry structure by positioning a reinforcement in a slot, groove or hole in the masonry structure, wherein the reinforcement is as previously defined.

The spacers may be attached to the central core before or after the central core is inserted into the masonry structure.

More than one reinforcement may be inserted in a single groove. The spacers then prevent the central cores touching and allow the bonding material to surround the reinforcement.

The reinforcement may be surrounded by a flexible sheathing material.

Where long runs of reinforcement are used, the reinforcements may be lapped, and in this case the reinforcing bars must be kept apart in order to allow the bonding material to surround the reinforcement.

The reinforcements may be tensioned after insertion into the slot, groove or hole.

The Drawings

Figure 1 is a side view of a reinforcement according to the invention;

Figure 2 is a cross section of a structure reinforced with a reinforcement according to the invention;

Figure 3 is a cross section of a different structure reinforced according to the invention;

Figure 4 shows a double reinforcement according to the invention for use in a cavity wall;

Figure 5 shows a double reinforcement according to the invention for use in a join between a horizontal and vertical reinforcement;

Figures 6 and 7 show two ways in which a spacer may be extended to accommodate a bracket; and

Figure 8 shows a four tailed reinforcement according to the invention.

Referring to Figure 1 a reinforcement 1 according to the invention includes a central core 2, the diameter of which varies according to the intended use. Diameters of between 2mm and 6mm are typical. Around the central core 2 is twisted a piece of stainless steel wire 3. The ends of the wire protrude radially from the reinforcement to form tails 4.

Figure 2 shows the reinforcement 1 inserted into a relatively narrow groove 5. The reinforcement 1 is inserted with the tails 4 in a horizontal direction. The groove is filled with bonding material 6 which is preferably thixotropic and hardens irreversibly thus bonding the reinforcement 1 within the structure. The width of the stainless steel wire 3 is sufficient to support the central core in the groove such that it does not rest on the bottom or touch the top of the groove 5 even if there are irregularities in the shape or height of the groove. Because the central core is held away from the edges of the groove by the wire 3, the bonding material flows all around the central core and forms a strong bond.

Figure 3 shows a bar 1 according to the invention in a somewhat wider groove 7. In this case the bar 1 is twisted so that the tails 4 are no longer horizontal, but protrude almost vertically to jam against the upper and lower faces of the groove as the reinforcement is pushed into the groove. The reinforcement 1 is thus secured in the correct position and is suspended away from the upper and lower faces of the groove allowing the bonding material to flow around and to surround the reinforcement.

Even if the reinforcement 1 is inserted into a curved groove, the tails 4 hold the reinforcement firmly in place and prevent it from springing out of the groove as other parts of the reinforcement are being inserted.

Referring to Figure 4, a tail 4 of the wire 3 may be extended to form a tie between two reinforcements for use in the two leaves of a cavity wall. It is often necessary to tie together the two leaves in this way to increase stability.

Figure 5 shows the extension of the wire 3 to wrap around a further central core, forming a join between a horizontal and vertical reinforcement.

Figures 6 and 7 show a reinforcement having a spacer with an extended tail used as a bracket 8. The fixing of brackets to masonry structures can be difficult and this method is advantageous because it fixes the bracket securely to the reinforcement, which is held firmly within the masonry structure.

Figure 8 shows a reinforcement including a spacer having four tails 4. Such spacers are particularly advantageous when the reinforcement is to be inserted in a hole 9 rather than a groove or slot.

The reinforcements 1 are preferably inserted into a groove by fitting an insertion tool to a protruding tail 4, moving the reinforcement into position at the edge of a groove and tapping lightly with a hammer or similar instrument, moving along the length of the reinforcement.

The reinforcement may be inserted into the inner leaf of a cavity wall by cutting through the outer leaf and making a groove in the inner leaf. An insertion tool is used to move the reinforcement through the cut in the outer leaf and to insert it into the groove in the inner leaf.

The number of reinforcing bars inserted into one groove may vary according to the requirements of the design and the thickness of the wall. The wire loops and tails prevent the central cores 2 of the bars 1 from touching one another and ensure that the bond material flows around the full perimeter of the central core.

Claims

1. A reinforcement (1) for insertion into a slot, groove or hole (5,7,9) in a masonry structure, the reinforcement including a central elongate core (2) and a plurality of spacers on the central core for holding the central core (2) away from the edges of the slot, groove or hole.

2. A reinforcement (1) according to claim 1 wherein each spacer includes one or more projections (4) extending radially outwards from the central core (2).

3. A reinforcement (1) according to claim 2 wherein the projections (4) are shaped so as to snag or engage masonry.

4. A reinforcement (1) according to claim 2 or claim 3 wherein the projections (4) are positioned such that when the reinforcement is positioned horizontally its maximum vertical extent varies as it is twisted about its axis.

5. A reinforcement (1) according to claim 2, 3 or 4 wherein each spacer includes two projections (4) approximately diametrically opposed to one another.

6. A reinforcement (1) according to any preceding claim wherein each spacer consists of a piece of wire (3) twisted around the central core.

7. A reinforcement according to any preceding claim wherein the central core (2) is machined or surface roughened or includes ridges to increase adhesion between the central core and a bonding material.

8. A method of reinforcing a masonry structure by positioning a reinforcement (1) in a slot, groove or hole (5,7,9), wherein the reinforcement (1) is according to any preceding claim.

9. A method according to claim 9 wherein the reinforcement (1) is surrounded by a flexible sheathing material.

10. A method according to claim 9 or claim 10 wherein the reinforcement is tensioned after insertion into the slot, groove or hole.

FIG 1

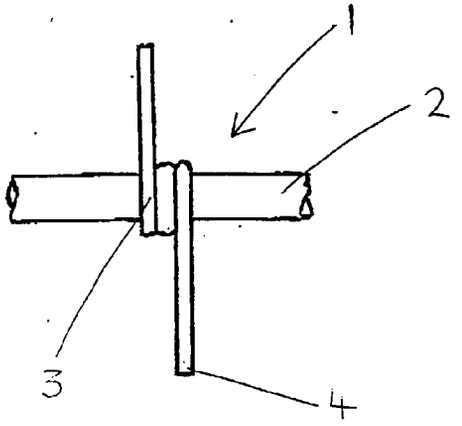
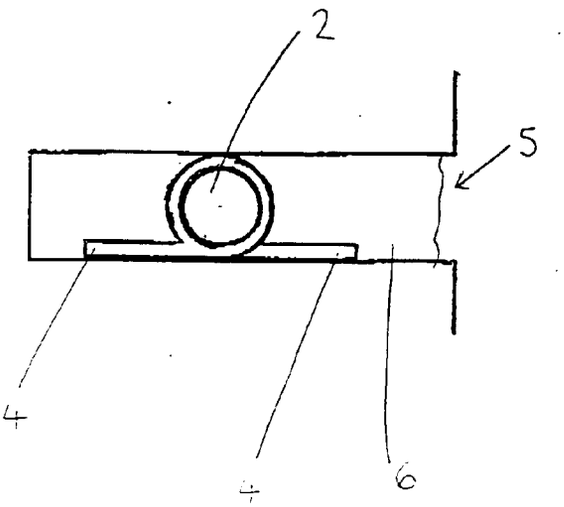


FIG 2



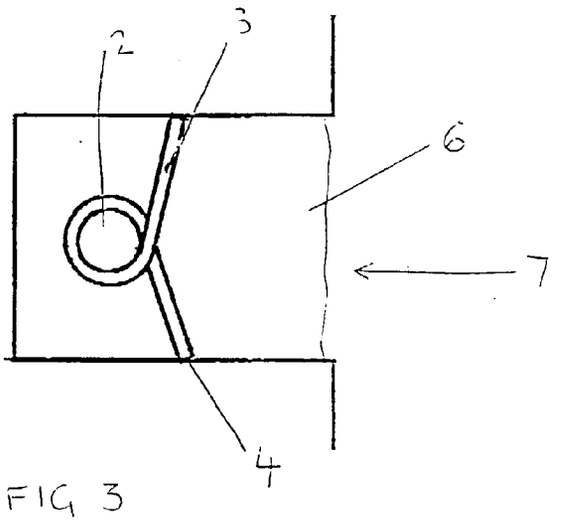


FIG 3

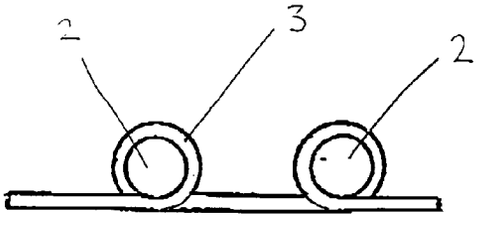


FIG 4

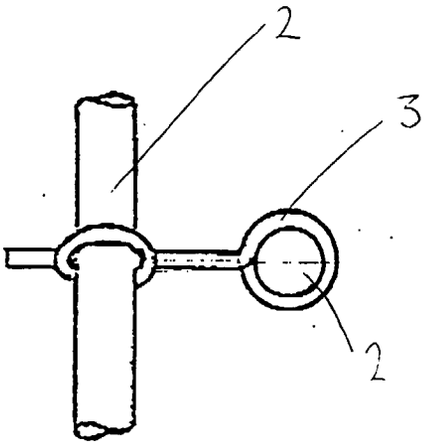


FIG 5

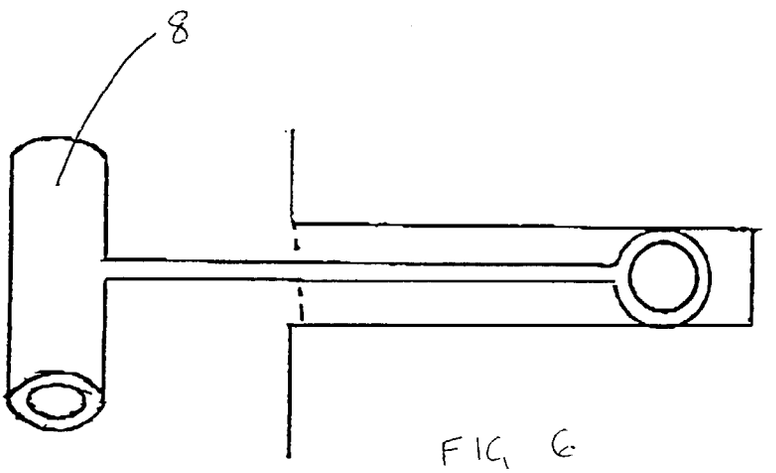


FIG 6

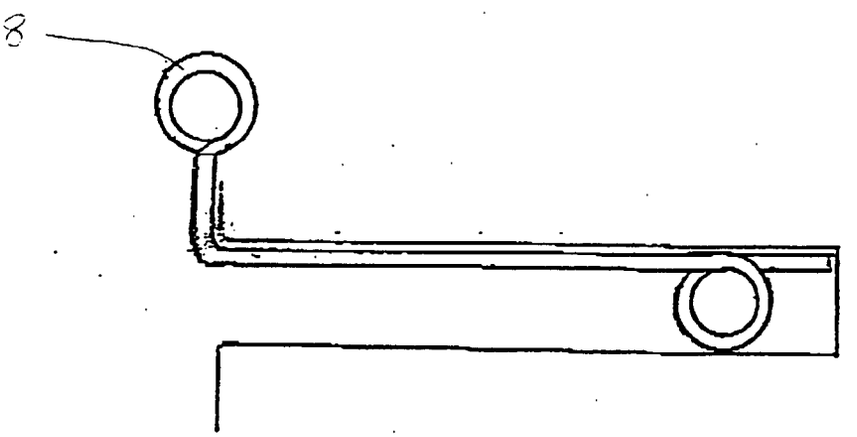


FIG 7

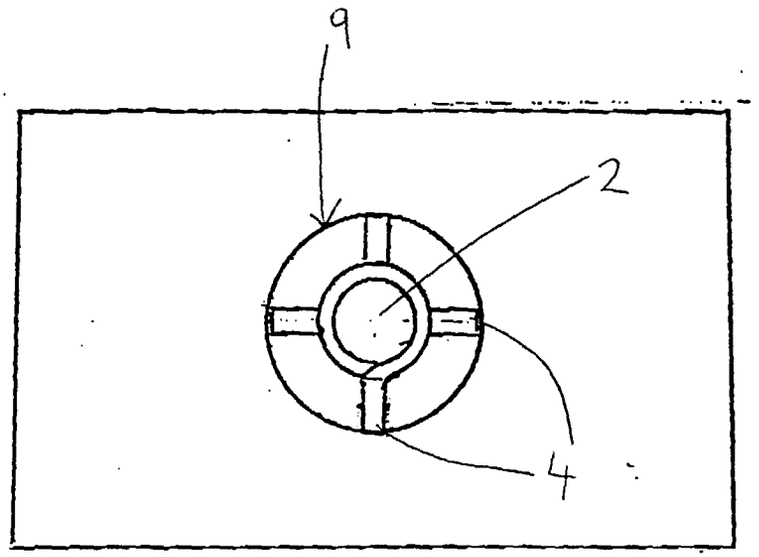


FIG 8

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EUROPEAN SEARCH REPORT

Application Number
EP 97 30 3835

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.6)
X A	EP 0 494 099 A (OLLIS) * column 3, line 16 - column 7; figures *	1-3,8 7	E04G23/02
A	DE 19 40 423 A (SPIRITO) * page 3 - page 4; claims; figures *	1,2,4-7, 10	
A	FR 1 135 748 A (MEYER) * the whole document *	1-6	
A	FR 1 358 698 A (AVI ALPENLÄNDISCHE VEREDELUNGS-INDUSTRIE GES.)		
A	GB 2 137 273 A (BARNETT)		
A	EP 0 241 708 A (INTEC)		
A	EP 0 351 668 A (MÄCHTLE)		

TECHNICAL FIELDS SEARCHED (Int.Cl.6)

E04G
E04C

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	27 August 1997	Vijverman, W

CATEGORY OF CITED DOCUMENTS

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