



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
21.03.2007 Bulletin 2007/12

(51) Int Cl.:
E04B 1/41 (2006.01)

(21) Application number: **06120258.6**

(22) Date of filing: **07.09.2006**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IS IT LI LT LU LV MC NL PL PT RO SE SI SK TR
Designated Extension States:
AL BA HR MK YU

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(30) Priority: **16.09.2005 GB 0518954**

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(54) **Fixing embedments in reinforced concrete**

(57) An embedment (2) is anchored into a mass of concrete by means of an anchorage (6) made up of strips (18) of thin sheet metal. The anchorage strips (18) are individually displaceable when they come into conflict

with a rebar of the reinforcement cage. The advantage of this type of anchorage is that it does not need to be modified or redesigned specifically for each reinforcing structure. The anchorage is particularly suitable for use with carpet reinforcement.

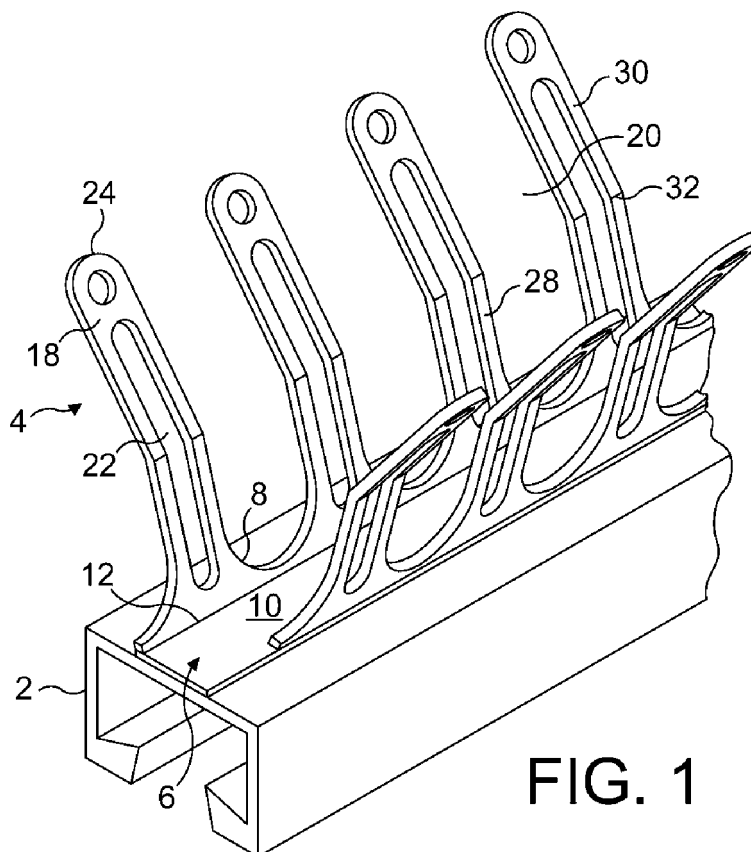


FIG. 1

Description

Technical Field

[0001] The present invention relates to fixing embedments in concrete and, more particularly, to an anchorage to facilitate the fixing of such embedments in reinforced concrete.

Background Art

[0002] In order to allow other construction elements to be fixed to concrete, it is known to embed within the concrete an insert or embedment to which such other elements can be fixed.

[0003] GB 1281673 (ILLINOIS TOOL WORKS INC) 04.07.1972 describes an insert to be made from sheet steel such as AISI 1010. The preferred thickness is not given. The insert is a generally channel shaped element having two leg portions of differing lengths. The insert is held within the body of the concrete by angularly offset foot portions at the end of each leg portion.

[0004] CA 2179227 (DI BENEDETTO, FRANK) 18.12.1997 describes a metal anchor bracket intended to be embedded into the surface of a semi-solid concrete wall. Di Benedetto provides a vertically extending leg to anchor the bracket in the concrete. The vertically extending leg has apertures, which are said to assist in allowing the leg to move through the partially set concrete. Di Benedetto suggests that this type of anchor is superior to inserts that are nailed to the formwork before pouring of the concrete such as that described by Illinois Tool Works.

[0005] It is now established practice to use an embedded channel insert that allows for the flexible positioning of other construction elements by means of a T-headed stud that can be positioned within the channel. The channel is fixed to the formwork before the concrete is poured and thus cast into the concrete. The channel is provided with a series of anchors in the form of headed studs in order to lock it into the mass of concrete. Such channel embedments are manufactured by Halfen Ltd. The anchors used to hold the channel in position are typically headed bolts or studs. See, for example EP 0758039 A (HALFEN GMBH & CO KG) 26.07.1995. The current products are described in detail in a publication by Halfen-Deha dated May 2005 and entitled "Halfen Cast-in Channels - Concrete".

Disclosure of Invention

Technical Problem

[0006] When embedments are used with reinforced concrete, it is taught that the anchors must always be positioned within the reinforcement cage, not in the concrete cover. In order to achieve this, the anchors must be positioned so that they do not conflict with the positions

of the rebars within the cage. This is particularly difficult when using reinforcement arrangements such as ROLL-MAT® supplied by Express Reinforcements Ltd or BAMTEC® supplied by BAM AG. These are prefabricated semi-rigid rebar assemblies and can be rolled out just like a carpet onto the formwork on site. Since the embedments must be fixed in specified places in the formwork, there is a high probability of conflict between an anchor and the rebars within the carpet. If the carpet has been designed for use with the intended embedments, it is still necessary to direct the site staff to position the carpet accurately on the formwork. This positioning is only necessary to avoid conflict with embedment anchors.

[0007] Since there may be numerous embedments required in different configurations on a large project, the design burden is high if each carpet is to be configured to match standard anchor positions on the embedments. Alternatively, the positioning of the anchors on the embedments can be custom designed. However, this still does not overcome the need to accurately position the carpet relative to the embedments.

[0008] There is therefore a significant technical problem in using embedments with this type of reinforcement. The problem also arises with traditional reinforcement cages and is not addressed by the earlier prior art from Illinois Tool Works or Frank Di Benedetto.

Technical Solution

[0009] The problem is solved by using more but displaceable anchors such as fingers of thin (for example 1-2mm possibly up to 5mm thick) metal plate, or coils or spikes of small diameter wire -typically 3 to 5 mm - strips of thin metal sheet, or distortable metal sheet in place of studs or other rigid anchorages including bolts and lengths of welded reinforcement. These weaker anchors are formed as part of a continuous element and are individually or locally displaceable by any rebar into which they come into conflict. The anchors can be bent and/or buckled to displace them.

[0010] More specifically, the present invention provides an anchorage for an elongate embedment comprising anchor means adapted to extend into a concrete mass into which the embedment is to be embedded, characterised in that the anchorage is a continuous element which extends along the length of the embedment and defines a plurality of anchors that are displaceable when they come into conflict with a rebar in the concrete mass.

[0011] Another embodiment is characterised in that the anchorage is a continuous distortable metal sheet which extends along the length of the embedment and is locally displaceable where it comes into conflict with a rebar in the concrete mass.

[0012] Alternatively, the present invention provides an elongate embedment having a coil comprising a plurality of individual loops each welded to a rear surface of the embedment such that a loop is displaceable when it

comes into conflict with a rebar in a concrete mass in which the embedment is placed.

[0013] The loop spacing is typically in the range 20 to 100 mm. The spacing can be determined in dependence on the thickness of the coil wire, its stiffness, the load to be carried by the embedment and the concrete aggregate size.

Advantageous Effects

[0014] A displaceable anchorage avoids the issues arising when there is interference between reinforcement and anchor studs on the embedments. By avoiding such conflicts, productivity is increased on site. The anchorage as a whole is effective. Although some of the multiple anchors are taken out by conflicts with rebars, the remainder are sufficient to hold the embedment in position.

[0015] The use of a coil to create the anchorage has the advantage that the spacing of the anchors is self-setting. Cutting through the individual loops opposite the points at which they are welded to the embedment effectively provides two rows of wires.

Brief Description of Drawings

[0016] In order that the invention may be well understood, seven embodiments thereof will now be described, by way of example only, with reference to the accompanying diagrammatic drawings, in which:

[0017] Figure 1 is a perspective view of a first embodiment of a thin sheet anchorage;

[0018] Figure 2 is a top plan view of the embodiment of Figure 1;

[0019] Figure 3 is a front view of the embodiment of Figure 1;

[0020] Figure 4 is a side view of the embodiment of Figure 1;

[0021] Figure 5 is a perspective view of a channel to which a helical anchorage is fitted;

[0022] Figure 6 is a perspective view of a channel with multiple wire anchors;

[0023] Figure 7 is a perspective view of a channel with an alternative design of wire anchors;

[0024] Figure 8 is a perspective view of a channel with a sheet anchor;

[0025] Figure 9 shows an end elevation of the channel of Figure 8 in which some of the anchor strips have been displaced;

[0026] Figure 10 is a perspective view of a channel with a second embodiment of a sheet anchor; and

[0027] Figure 11 is a perspective view of a channel with a third embodiment of a sheet anchor.

Best Mode for Carrying Out the Invention

[0028] It will be appreciated that the anchor system described here can be used with other forms of inserts or embedments apart from the channels described.

[0029] An elongate channel 2 is provided with anchor means 4 which are two continuous thin plate anchorage elements 8 that together provide an anchorage 6 adapted to extend into a concrete mass into which the embedment 2 is to be embedded. This concrete mass contains rebars for reinforcement.

[0030] The anchorage is formed from a 1.5mm sheet of metal such as galvanized steel plate and shaped to create a flat base strip 10 with elongated edges 12. This base strip can be welded to a rear face 14 of the channel 2. Two serrated wings 16, 16' project away from the strip along each elongate edge 12 in order to form the anchorage elements. These anchorage elements project into the reinforcement cage defined by the rebars.

[0031] The wings 16 are angled outwardly at 105° to the plane of the base strip 10. Each wing 16 defines a plurality of spaced finger strips 18 with gaps 20 between them. The strips 18 along one wing 16 are positioned opposite the gaps 20 in the opposite wing 16'. Although all the fingers in a wing are shown as extending at the same angle, the strips could be fanned out so that adjacent strips are at different angles relative to the rear surface 14 of the embedment.

[0032] Each finger strip 18 has an oval opening 22 extending from near a root at which it joins the base strip 10 to close to its tip 24. A circular opening 26 is stamped out above the oval opening 22 close to the tip 24. The finger strips 18 are bent more steeply away from the vertical at an intermediate position so that whereas an outer face of a lower part 28 of the strip 18 is at an angle of 75° to the horizontal and an upper part 30 of the strip is inclined at an angle of 52° to the horizontal. The finger strips 18 are, in this embodiment, 46mm long with a bend line 32 between the upper and lower parts 28, 30 25 mm from the tip 24. When embedded in a concrete mass concrete will flow through the openings 24, 26 to hold the anchors firmly within the concrete mass. The spaced arrangement of the fingers with gaps 20 permits the flow of concrete around each strip.

[0033] The finger strips 18 are designed to be displaceable and/or broken off when they come into conflict with the rebar in the concrete mass. The strips 18 need to have sufficient rigidity to remain intact during storage and transport of the anchorage. The strips 18 need to be sufficiently flexible to give way when they encounter a rebar. The bend line 32 facilitates the movement of the finger out of the way when it comes into conflict with a rebar. The presence of the openings 22, 26 also serves to make the finger strips 18 less stable and flexible when confronted by a rebar.

Mode(s) for Carrying Out the Invention

[0034] Using the same principle as the embodiment of Figures 1 to 4, it is possible to design other configurations of anchorage that have the same ability to provide a plurality of displaceable anchors or in the case of Figures 10 and 11 a locally displaceable anchor. In the embodi-

ment of Figure 5, the channel 2, which is to be embedded in concrete, has a helical coil 34 welded along its length to serve as an anchorage 6.

[0035] The coil 34 is made of a relatively thin gauge wire -for example 3 mm wire- and is welded in position to a rear face 14 of the channel by means of a welding arm (not shown) that passes through the centre of the coil 34 along a central axis indicated by line 40 in order to create spot welds 42 at 20mm spacing between each individual loop of the anchorage and the rear face 14 of the channel 2. In order to permit the welding arm to pass down through the coil, it may be necessary to cut through the loops at their crown opposite the welding position 42. This cutting takes place behind the welding arm. The resulting anchorage 6 will therefore consist of a plurality of thin wires 44 arranged in two rows each wire extending generally upwardly from the rear face 14 of the channel 2.

[0036] Although a helical coil 34 in which each individual loop is substantially circular has been illustrated, it will be appreciated that the coil could be square or rectangular in profile.

[0037] This anchorage configuration is particularly advantageous as it is easy to manufacture as pulling out of the coil effectively sets the spacing of the loops. When this assembly of embedment 2 and anchorage 6 is placed on the formwork together with the reinforcement cage, any of the wires 44 that come into conflict with a rebar will be displaced or broken off. Where the anchor wires 44 are bent out of position they will still contribute to the anchorage effect. However, the strength and integrity of the anchorage 6 as a whole is secured by the number of individual anchors 44 rather than their individual strength. Halfen teaches anchor spacing of 200 - 250 mm for long channel embedments. With this configuration the spacing of anchors 44 is reduced to 20mm although with a thicker wire coil, say 5 mm, the coil 34 could be stretched out so that individual loops were welded at 30mm spacing to the rear face 14 of the embedment 2. A spacing of less than 100mm is suggested as suitable even for small embedments. The skilled man will appreciate that the exact design parameters can be determined in dependence on the load to be carried by the embedment, concrete aggregate size and other relevant factors by appropriate tests and calculations.

[0038] In the embodiment of Figure 6, in which like reference numerals are used for similar parts, anchor wires 44 are paired, vertical spikes. The spikes 44 may be assembled to a mat to create a continuous element and facilitate welding to the rear face 38 of the channel 2. A double row of spikes is preferable to a single row in case of conflict with a rebar which runs parallel to the embedment 2.

[0039] Although the wire spikes 44 are illustrated as being straight, it is preferable for them to be formed with a small deformation along their length as shown at 46 in the callout in Figure 6. The presence of the deformation 46 improves the bond between the wire and the surrounding concrete. It also facilitates the movement of the spike

out of the way when it comes into conflict with a rebar. Because part of the spike is offset, a bending moment is created when the spike is subjected to an axial load and this helps to start the bending and buckling process to displace the spike.

[0040] In the embodiment of Figure 7, the spikes 44 are each angled outwardly away from the embedment 2.

[0041] As shown in Figure 8, the wire anchors 44 are replaced by an anchorage 6 fabricated from a thin sheet 50 which has been cut into strips 52 to form a comb or brush like structure along each side. The cuts permit each strip 52a to be positioned during manufacture with a displacement relative to the adjacent strips 52b. Therefore, adjacent strips extend at different angles relative to a rear surface 14 of the embedment 2. This arrangement permits the flow of concrete around each strip 52. The sheet 50 is welded along an intermediate line or lines 54 to the rear face 14 of the embedment so that the strips of the comb or brush like structure project away from the embedment 2 into the main body of the concrete. Where a strip 52c conflicts with the position of a rebar crossing its intended position, the strip 52c of sheet 50 will become displaced or buckled to a position nearer the surface of the concrete as indicated by way of example by means of the dotted line in Figure 9. The displaced strips 52c are not considered during the development of the design. The remaining strips 52a and 52b which are not displaced by the conflict serve to anchor the embedment 2.

[0042] The fanning arrangement of this embodiment is advantageous as it produces an effective variation in height of the anchors so that the initial conflicts between the wire anchors and the reinforcement do not all occur simultaneously. Similarly the fingers 18 or wire spikes 44 of the earlier embodiments could be cut to differing lengths to ensure such a progressive loading.

[0043] As shown in Figures 10 and 11, the anchor 6 is made of a sheet of distortable metal 56 that is welded to the rear face 14 of the embedment with each edge shaped to extend at an angle to the face 14. The sheet 56 is sufficiently flexible that it can distort, compress or bend locally where it comes into conflict with a rebar whilst leaving adjacent portions of the sheet extending into the concrete mass to provide anchorage. Suitable sheet materials include expanded metal mesh or woven or knitted wire fabric. An anisotropic material that is weak enough to be locally compressed or bent but provides a strong anchorage overall can be used. The metal mesh manufactured by The Expanded Metal Company Limited and described at <http://www.experf.co.uk> could be used for this purpose.

[0044] The sheet 56 can be shaped so that it extends transversely away from the rear face 14 of the embedment 2 as shown in Figure 10. Alternatively, as shown in Figure 11, the edges may be angled outwardly in a similar arrangement to the fingers 18 of Figure 1 or wire spikes 44 of Figure 7. It will be appreciated that other configurations may be employed. A number of separate sheets spaced along the length of the embedment could also be

used.

[0045] Anchors made of sheets 50 or 56 can also be provided with deformations to improve bonding and displacement under axial loading as described for the wire spikes 44 of Figure 6.

Claims

1. An anchorage (6) for an elongate embedment (2) comprising anchor means (4) adapted to extend into a concrete mass into which the embedment (2) is to be embedded, **characterised in that** the anchorage is a continuous element which extends along the length of the embedment and defines a plurality of anchors (18, 44, 52) that are displaceable when they come into conflict with a rebar in the concrete mass. 10
2. An anchorage (6) as claimed in claim 1, wherein the anchor means (4) comprises a plurality of thin wires or strips (18, 44, 52). 15 20
3. An anchorage (6) as claimed in claim 1, wherein the anchorage element comprises two wings (16, 16') each defining a series of spaced finger strips (18) that act as anchors, the strips of one wing (16) being positioned opposite gaps (20) between strips in the opposite wing (16'). 25
4. An anchorage (6) as claimed in claim 2, wherein the wires or strips (18, 44, 52) are arranged in at least two rows along the length of the embedment (2). 30
5. An anchorage (6) as claimed in claim 1, wherein the anchor means comprises a coil (34). 35
6. An anchorage (6) as claimed in claim 4, wherein loops of the coil (34) are cut.
7. An anchorage (6) as claimed in claim 2 or 3, wherein adjacent wires or strips (18, 44, 52) extend at different angles relative to a surface (14) of the embedment (2). 40
8. An anchorage (6) for an elongate embedment (2) comprising anchor means (4, 50, 56) adapted to extend into a concrete mass into which the embedment (2) is to be embedded, **characterised in that** the anchorage is a continuous distortable metal sheet (56) which extends along the length of the embedment and is locally displaceable where it comes into conflict with a rebar in the concrete mass. 45 50
9. An anchorage (6) as claimed in claim 7, wherein the distortable metal sheet (56) is a mesh or a woven or knitted wire fabric sheet. 55
10. An embedment (2) having an anchorage (6) as

claimed in any one of the preceding claims.

11. An elongate embedment (2) having a coil (4) comprising a plurality of loops each welded to a rear surface (8) of the embedment such that a loop is displaceable when it comes into conflict with a rebar in a concrete mass in which the embedment is placed. 5

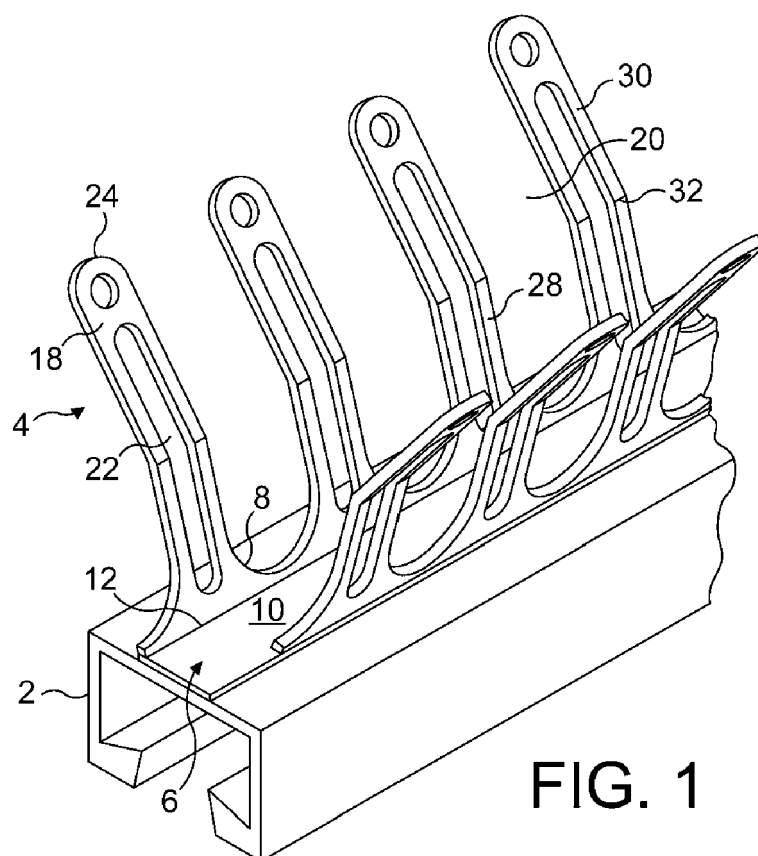


FIG. 1

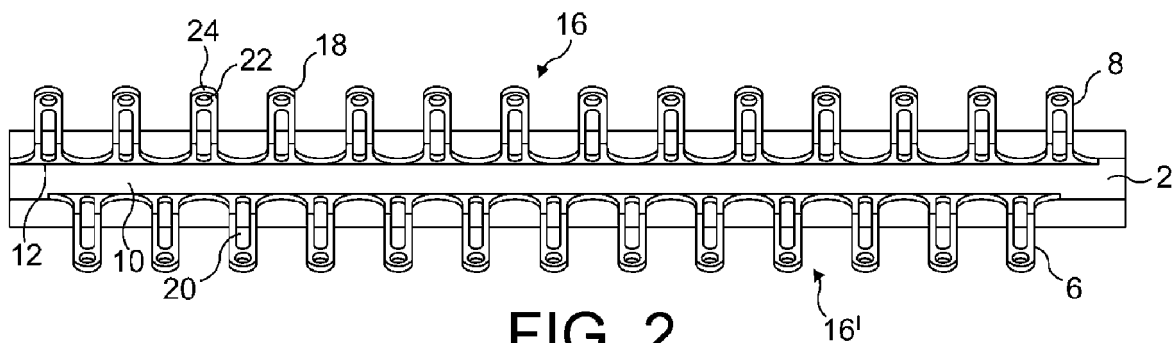


FIG. 2

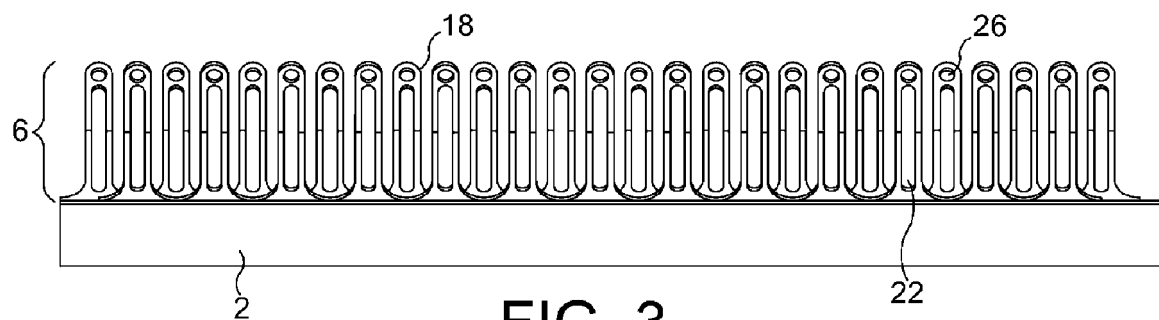


FIG. 3

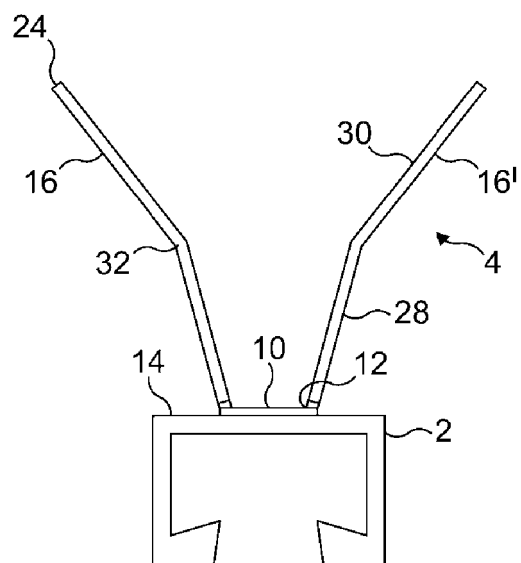


FIG. 4

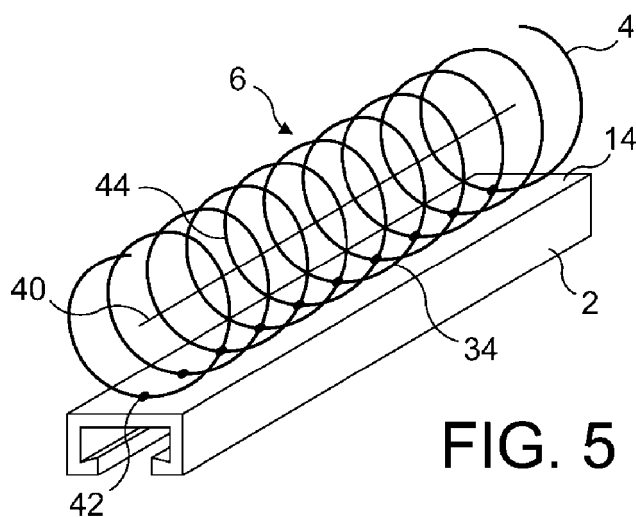


FIG. 5

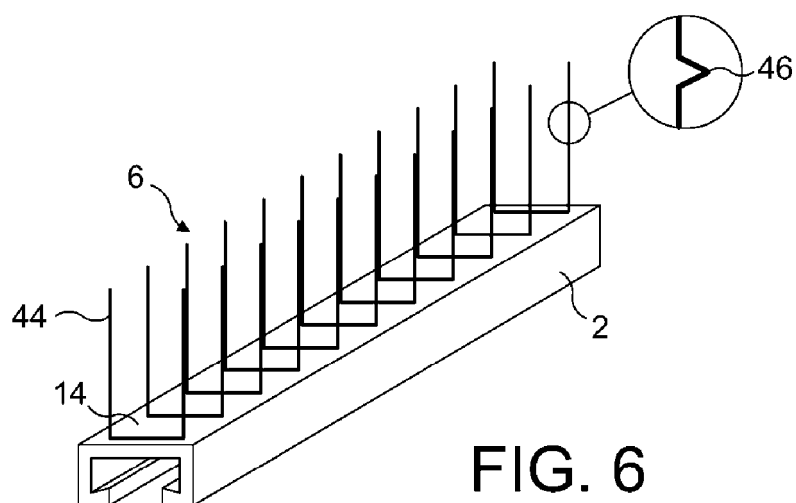
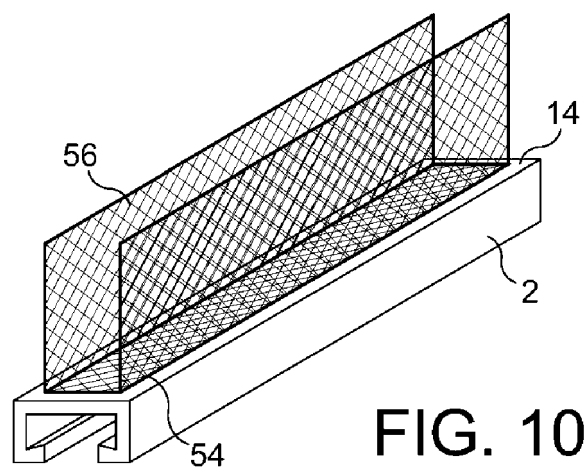
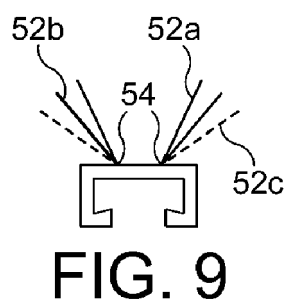
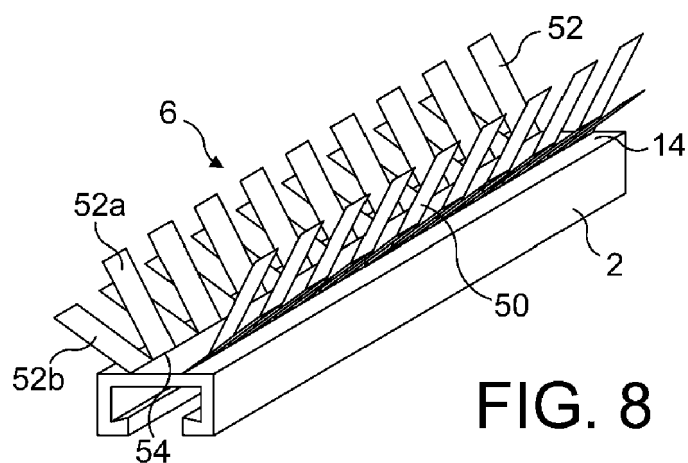
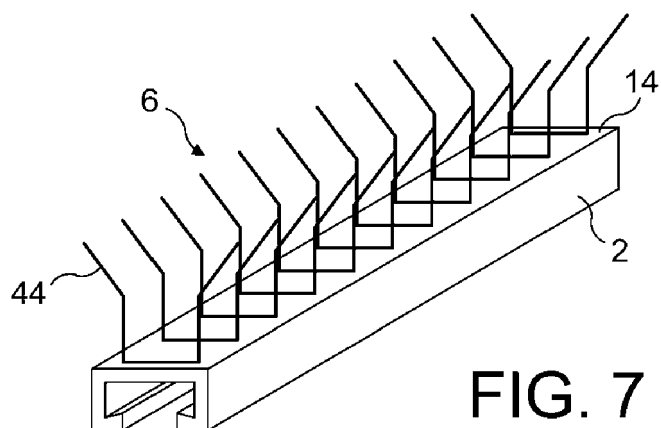


FIG. 6



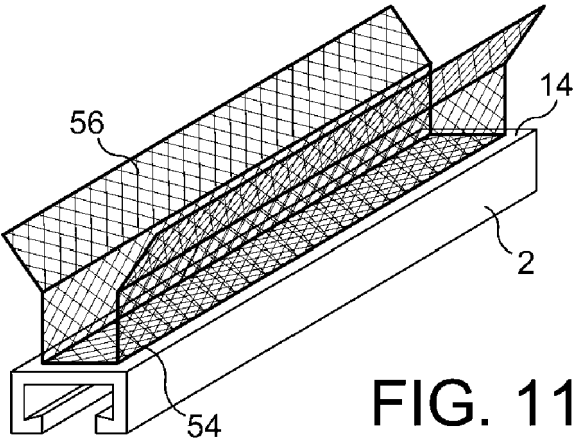


FIG. 11

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- GB 1281673 A [0003]
- CA 2179227 [0004]
- EP 0758039 A [0005]

Non-patent literature cited in the description

- **HALFEN-DEHA.** *Halfen Cast-in Channels - Concrete*, May 2005 [0005]