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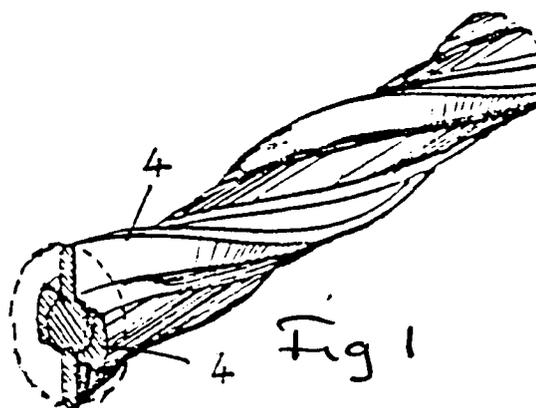
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54 Structural ties.

57 A structural tie in the form of a length of wire (15) of corrosion resistant material, comprising a core and two externally projecting fins (4). Each fin follows a continuous helical path about the axis of the core. One end of the tie is pointed, the remainder of the tie having a substantially uniform cross-section. The diameter of the core is 2 to 6mm and the maximum diameter of the entire tie is 10mm.



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This invention relates to structural ties for example for use in the walls of brick walled and other buildings.

One object of the invention is to provide a cheap and easy-to-use tie for securing together the inner and outer walls of a cavity wall principally for use in new building, but possibly also for use as a replacement tie in an old building where the tie has failed. Another object is to provide a tying system to strengthen an existing wall which has cracked or slipped.

According to the present invention, there is provided a structural tie in the form of a length of wire, comprising a core and two or more externally projecting fins or ridges, each fin or ridge following a continuous helical path about the axis of the core, characterised in that one end of the tie is pointed, the remainder of the tie having a substantially uniform cross-section, the diameter of the core being 2 to 6mm and the maximum diameter of the entire tie being 10mm.

The wire may be of corrosion resistant material. For use as a wall tie between the inner and outer leaves of a cavity wall, the length of the wire may be perhaps between 18 and 20 cm whereas for use as strengthening for a brick wall, the length might be up to 1 or 2 metres.

A preferred feature of the invention is the smallness of the core diameter since it is fine enough to be driven into unbored material or only needs a very fine bore hole to be driven into. The fins might be about 1 or 2 millimetres proud of the surfaces of the core or possibly they might be a distance from the core equal to the effective diameter of the core to leave a substantial flange for cutting into and making a good grip in the surrounding wall.

In the case of a cavity wall, the fins give a good grip between the tie and the mortar and also define drip points from which water can drop into the cavity to avoid moisture being transferred from one wall leaf to another across the tie.

The tie is particularly suitable where one of the wall leaves is of timber into which the tie can be directly driven.

The tie can be easily made using a pair of rollers of novel form. The rollers will have generally cylindrical surfaces with a substantially parallel sided slot at the centre and then as round or square section rod is fed into the nip of the rolls, the section will be first cut at the edge of the slots and then deformed so that the cut material is squeezed into the gap between the rollers at their closest point to define a pair of opposed fins. No material is lost but the material is deformed to leave a generally rectangular sectioned core with fins extending from either side, and the section can then be uniformly twisted in a subsequent manufacturing

step. This generally forms the subject matter of the present Applicants' EP-A-171250, from which the present Application is divided.

The method of forming the fins by a combination of shearing and squeezing forces work hardens and stretches the fin material without hardening the core material. This predisposes the material for transformation by twisting into a tight and constant helix without the need for annealing and provides maximum hardness in the fins which in some applications have a cutting function.

If the slot is deep enough, wear on the rollers can be easily taken up by adjusting the spacing between them, and in general the width of the fins can be chosen by appropriate setting of the spacing between the rollers.

A single pass of the rollers can be sufficient to form the desired section, even with a hard metal such as stainless steel. However, a double pass enables four fins to be provided.

A tool may be provided for driving one end of the tie into a nailable material or through two or more nailable materials close together or separated by a cavity space, the tool having a bore for accommodating the tie to be driven. The tool may be adapted to drive the end of a wire slightly below the surface of one of the materials being connected together so that the fastening is effectively hidden.

The tie may also provide tensile reinforcement to improve the performance of structural members made of materials in which a particularly efficient mechanical bond is necessary to transfer the stresses from the material to the tie. Such materials may include for example portland cement and/or resin based concretes which are aereated or made with lightweight aggregates and natural organic materials such as timber. The ties may be embedded in some materials as they are cast and with others such as timber may be pressed into grooves cut in their surfaces.

The ties can also be used to assist in the transfer of loads from the end of one structural member into another structural member which may be of a dissimilar material.

The invention may be carried into practice in various ways, and certain embodiments will now be described by way of example with reference to the accompanying drawings in which:-

Figures 1 and 2 are perspective views of ties embodying the invention;

Figure 3 is a sectional elevation illustrating a method of manufacture of a tie of cross section similar to that shown in Figure 1, from a round section bar;

Figure 4 is a section that can be achieved from the rod of Figure 3;

Figure 5 to 8 are sketches illustrating various

uses of a tie between two walls as they are being built, or where one or both walls already exist;

Figures 9 and 10 are an elevation and a section of brickwork stabilised by a rod as shown in Figure 1; and

Figure 11 shows cracks and a lintel and in brickwork for which the method of stabilisation of Figures 9 and 10 is suitable.

The rod shown in Figure 1 is straight and of constant cruciform cross section, the arms of the cruciform being uniformly twisted about the axis of the rod and forming helical ribs or fins 4 around the central solid core of the rod.

The helical fins 4 of the rod shown in Figure 1 serve to provide a strong grip of the rod within mortar and timber over short distances of penetration; A further feature of the helical fins 4 is that they provide the rod with natural drip features which hinder the passage of water in an undesirable direction, i.e. from an outer to an inner wall leaf, along the surface of the rod by providing localised downward inclinations due to the helix angle of the fins, even when the general axis of the rod is slightly inclined downwardly. Because all the rod surfaces are substantially circular or curved there are no exposed flat surfaces onto which mortar droppings could easily lodge to provide means for transmitting water.

The helical fins 4 of the Figure 1 embodiment may be as shown in Figure 1 with two opposed thick ribs 11 alternating with thinner fins 12; but alternatively the uniform section may be as shown in Figure 4 with four equally circumferentially spaced fins 13 extending from the sides of a square.

The overall diameter of the rods is about 4-8 mms thick. The rods are made from a strong flexible non-corrosive material such as copper or stainless steel so that a rod may hold an outer wall against wind suction and pressure yet flex readily to accommodate different settlement of walls between which the rod is affixed. Rods made of stainless steel will not corrode after long exposure to the atmosphere or encasement in mortar.

Uses of the rod shown in Figure 1 will now be described.

The helical type of rod as shown in Figure 1 and described above (and also that of Figure 2) is particularly useful as a tie 27 between a brick wall 28 and a wooden wall 29 as shown in Figure 5.

In this use the tie comprises a straight rod as shown in Figure 1 and described above, one end 30 of which is pointed and driven into the wooden wall 29. The helical fins 4 give the tie 27 a stronger grip than would be provided by friction alone, even with a short length of penetration within the wood. The outer end of the tie is embedded within a

mortar layer of the brick wall 28 as described above, so that the wooden wall 29 is fixed in relation to, yet spaced from, the brick wall. The tie 27 can bend to accommodate drying shrinkage of the wooden wall 29, which shrinkage may be as great as 18mm, but is not normally more than 12mm. The pitch of the helix is much less than the width of the cavity and the tie can bend about an axis that is perpendicular to the thinner arm of the cruciform cross section close to the cavity faces of the walls. Because of the tight bend the central portion 17 follows a straight path, thus giving the tie 27 the ability to resist forces tending to push or pull the outer wall.

A tool which enables the tie 27 to be driven to a set distance into the wooden wall 29 has a handle 31 and a shank 32 with a central blind bore of slightly greater diameter than the tie 27. The tie 27 is inserted blunt end first, into the bore, and the tool is held with the shank 32 resting on the brick wall 28. The tie is then driven - pointed end 30 first - to a preset depth into the wooden wall 29 by hammering on the handle 31 until the face of the handle abuts the brick wall 28. Flexing of most of the length of the slender tie during hammering is prevented by the supportive bore. The tool is then withdrawn so that the mortar layer may be applied on the wall 28 around the blunt end of the tie.

If a brick wall 35 is having an external brick wall 36 built spaced outside it as shown in Figure 5 a brick in the internal wall has to be pre-drilled with a pilot hole as shown at 37 to accommodate the core of the tie 27 which is then driven into the brick using the tool of Figure 5. The tie is then cranked and rotated in its pilot hole until the outer end can lie just above the upper brick in the partly built external wall 36 so that when the mortar is applied in preparation for the next brick 38 the outer end of the tie will be firmly keyed to the inner wall. It will be noted that the wire tie is driven into a brick in the old wall rather than into the mortar which is unlikely to be strong enough to give a good mechanical grip even if it happened to be at the right level.

If the distance between the two ends is approximately equal to the width of a cavity in cavity brickwork then the tie is very suitable for use in new cavity brickwork because where a tie is introduced, one of the parallel ends can be located above one course and even if the top of the corresponding course on the other wall is not exactly the same height, the tie can merely be rotated about a horizontal axis through the one end until the other end is at the right height and then the tie will be secured in position as mortar is applied, followed by the next course of bricks.

The length of the central part between the bends would correspond with the width of the wall

cavity, and might be about 6cm or some other standard distance.

Figure 7 shows a similar arrangement applicable when the original ties in old cavity wall are found to have corroded and need to be replaced. A clearance hole 41 is bored through the outer leaf 36 and then a pilot hole 42 is bored into the inner leaf 37. A tie 27 is then driven in using a tool similar to that of Figure 5 through the outer leaf clearance hole which is then injected with grout to anchor the outer end of the helically fixed or rigid tie.

Figure 8 shows a somewhat similar arrangement of a tie between outer and inner timber layers 43 and 44 with insulating slab filling 45. In such an application it is likely that the tie can be driven directly in without first drilling a pilot bore and it will turn and cut its way into the two timber layers. If soft bricks are substituted for the timber layers 43, it may be possible to drive the tie directly in without drilling a pilot hole.

The rod shown in Figure 1 can also be used within a mortar layer as shown in Figures 9, 10 and 11. A crack as shown at 51 or 52 in Figure 11 can be stabilised by removing about a quarter - say 25mm - into the wall, of the layer of mortar for some distances to each side of the crack, positioning the rod 53 longitudinal between the bricks, and repointing the wall as shown at 54 in Figures 9 and 10. Brick lintels can also be stabilised using the above method and by overlapping the rods as at 55, the stabilised bricks can be made to act as beams.

The inserted rods may be long enough to extend through the length of at least 2, and perhaps 3 or 4 bricks, or even, as shown in Figure 11, through the length of about 9 bricks.

The preferred helical rod shown in Figure 1 is conveniently produced from square, rectangular, or round section austenitic stainless steel wire by a single or double pass rolling/shearing process shown in Figure 3 followed by twisting. The rollers 56 and 57 are each approximately 150mm in diameter and each has a rectangular section circumferential groove 58 around its mid portion. The very pronounced fins, which are required for satisfactory location within mortar, are formed by shearing and squeezing the material in the area A so that it is transferred to the adjacent area B of the fin. The fins become work hardened due to the above process, but the core remains unhardened, thus giving desirable configuration of hardened fins with good cutting and wear resistant properties, and an unhardened core with good flexibility.

Because the space between the rollers 56 and 57 can be adjusted it is possible to alter the fin thickness. Sharpening of the cutting edges 59 of the grooves 58 is possible by use of a grinding

stone between the sides of the grooves while the rollers rotated. The bevels 60 can also be sharpened by application of a square grinding stone to the groove away from the common tangential space between the two rollers. The groove depths are made to allow for a substantial amount of re-sharpening resulting in a reduction in roller diameter and hence groove depth. Further adjustability of the rollers can be achieved by dividing them along the line marked x-x so that they may be bolted together with shims inserted, thus enabling the cutting space between the edges to varied, and hence different size wire to be accommodated.

A single pass would produce a section as shown dotted in Figure 3. A second pass with the rod rotated through 90° could produce the four-finned section shown in Figure 4. In each case material is cut and squeezed from the original section to the fins.

Uniform twisting follows to leave a long length of formed wire which can be cut into suitable lengths and pointed.

Claims

1. A structural tie in the form of a length of wire (15), comprising a core and two or more externally projecting fins or ridges (4), each fin or ridge following a continuous helical path about the axis of the core, characterised in that one end of the tie is pointed, the remainder of the tie having a substantially uniform cross-section, the diameter of the core being 2 to 6mm and the maximum diameter of the entire tie being 10mm.
2. A tie as claimed in Claim 1 characterised in that the fins or ridges (4) are equally angularly spaced about the core.
3. A tie as claimed in Claim 1 or Claim 2, characterised in that the fins or ridges (4) extend equally in a radial direction from the core.
4. A tie as claimed in any preceding Claim, characterised in that the fins (4) are formed by repositioning material from the wire and subsequently twisting the wire.
5. A method of fitting a tie as claimed in any preceding Claim, characterised by driving the tie axially into a structure (35,43) whereby the fins or ridges cut into the structure as the tie turns.
6. A method of connecting the leaves (21,22) of a layered structure such as a cavity wall, characterised by driving a tie as claimed in any of

Claims 1 to 4 axially through one leaf and into another leaf, whereby the tie grips into the layers of material.

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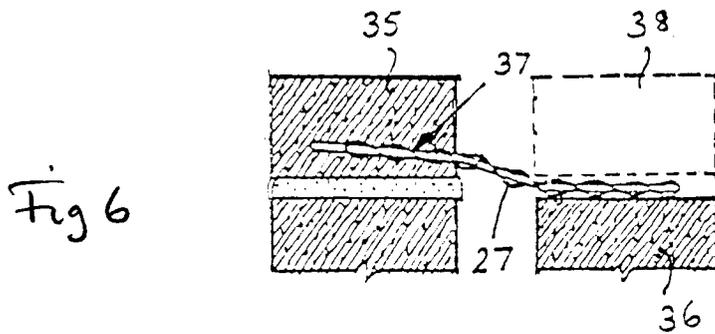
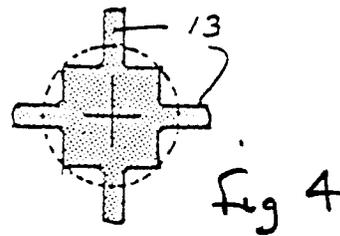
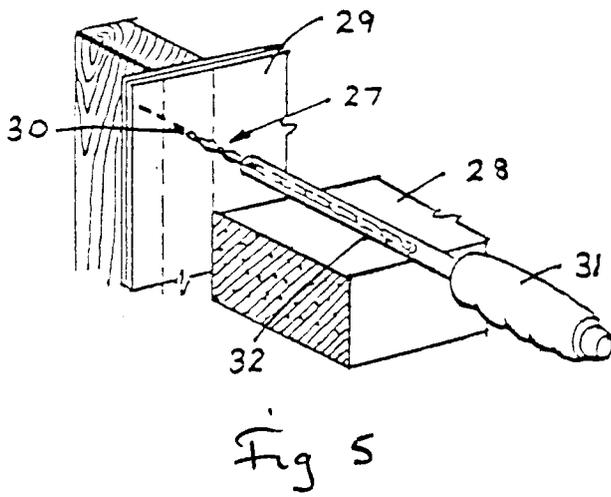
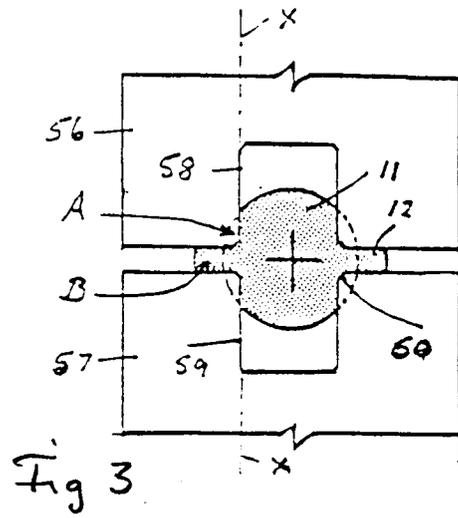
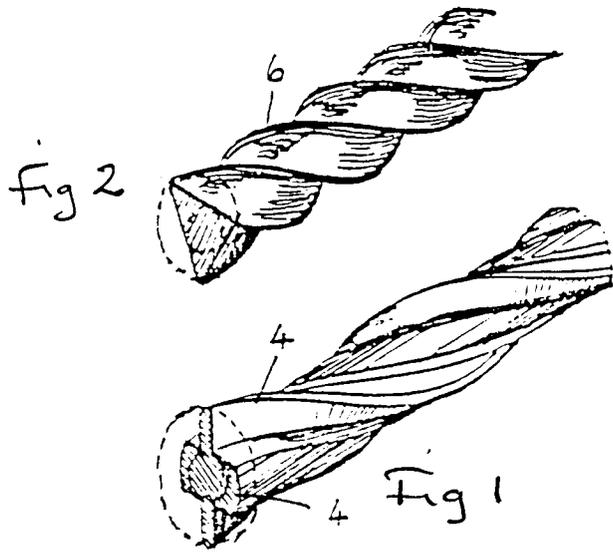
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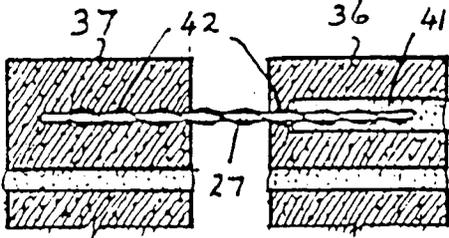


Fig 7

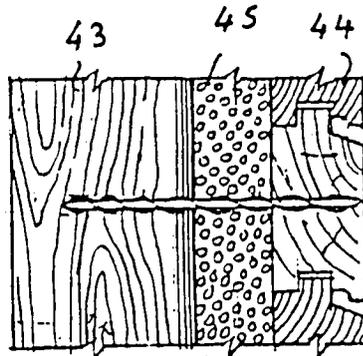


Fig 8

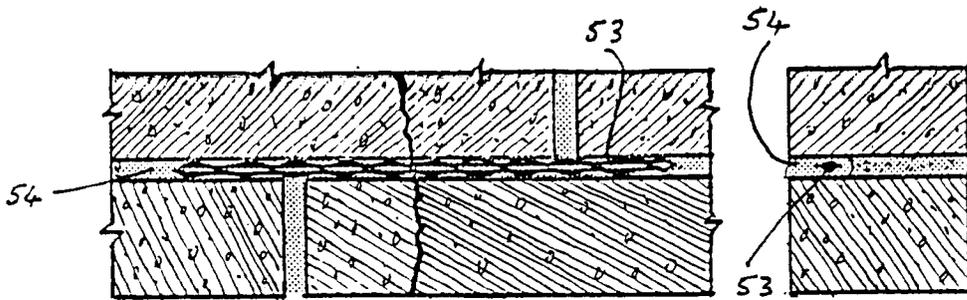


Fig 9

Fig 10

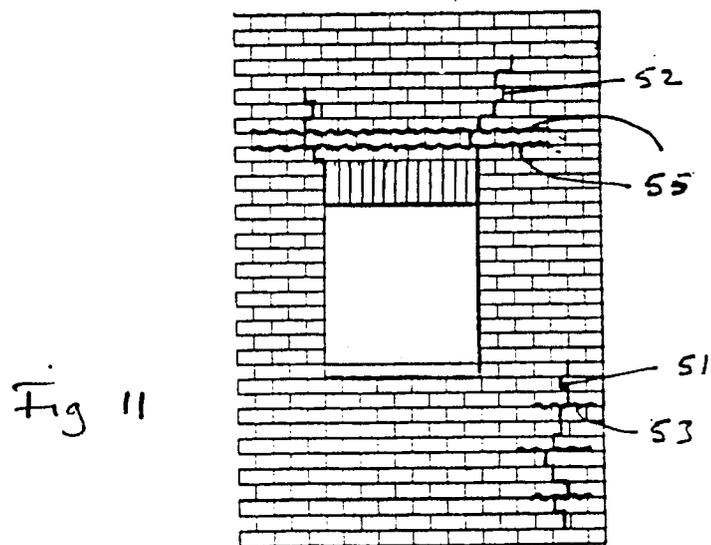


Fig 11