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An agency of Industry Canada

CA 2541978 C 2008/05/13

(11)(21) **2 541 978**

(12) **BREVET CANADIEN**
CANADIAN PATENT

(13) **C**

(86) **Date de dépôt PCT/PCT Filing Date:** 2004/03/09
(87) **Date publication PCT/PCT Publication Date:** 2004/09/23
(45) **Date de délivrance/Issue Date:** 2008/05/13
(85) **Entrée phase nationale/National Entry:** 2006/04/07
(86) **N° demande PCT/PCT Application No.:** DE 2004/000458
(87) **N° publication PCT/PCT Publication No.:** 2004/081313
(30) **Priorité/Priority:** 2003/03/10 (DE103 10 715.0)

(51) **Cl.Int./Int.Cl.** *E04C 5/16* (2006.01), *E04C 5/06* (2006.01)

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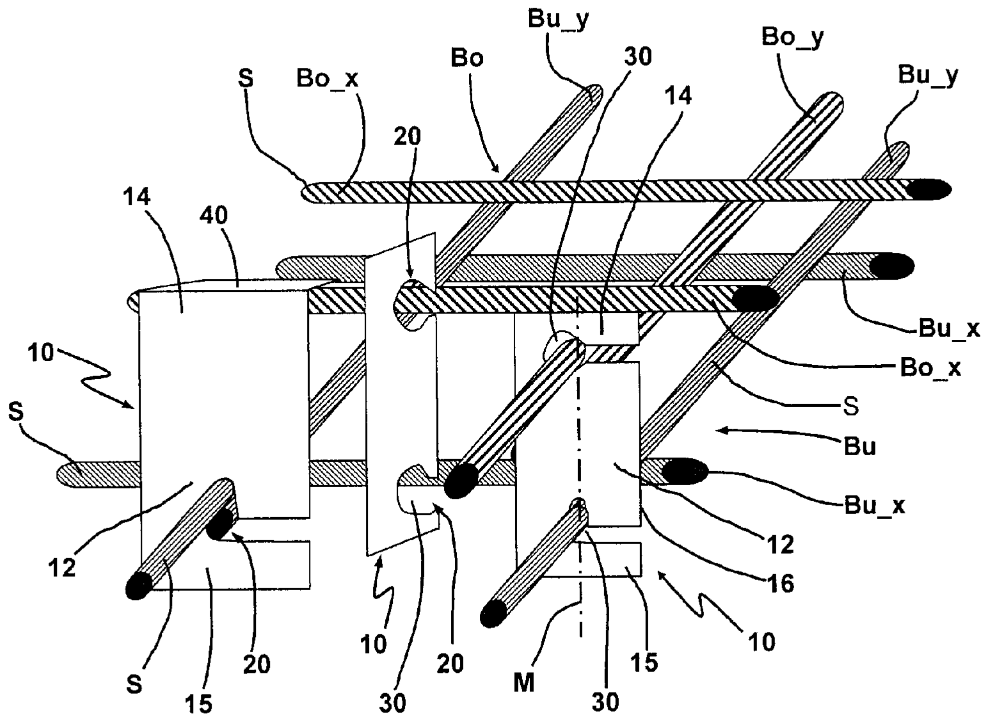
(54) Titre : ELEMENTS D'ARMATURE ET PIECES EN BETON ARME OU PRECONTRAINT PRODUITES AVEC CES ELEMENTS D'ARMATURE

(54) Title: REINFORCING ELEMENTS AND REINFORCED CONCRETE OR PRESTRESSED CONCRETE PARTS PRODUCED BY MEANS OF THE SAME



(57) Abrégé/Abstract:
The innovation concerns components and their application in concrete components, in particular in shear stressed reinforced concrete components. Proposed are novel concrete components which, apart from the flexural reinforcement, also intend different types of shear reinforcements in the form of novel components which at least partially encircle the flexural reinforcement.

Abstract

The innovation concerns components and their application in concrete components, in particular in shear stressed reinforced concrete components. Proposed are novel concrete components which, apart from the flexural reinforcement, also intend different types of shear reinforcements in the form of novel components which at least partially encircle the flexural reinforcement.

Patent application

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REINFORCING ELEMENTS AND REINFORCED CONCRETE OR PRESTRESSED CONCRETE PARTS PRODUCED BY MEANS OF THE SAME

The invention concerns a concrete reinforcement element as well as a reinforced concrete or pre-stressed concrete components made using this element.

Shear stressed reinforced concrete or pre-stressed concrete components, such as a supported reinforced concrete ceiling, require shear reinforcement in the area of columns of the ceiling to ensure shear safety.

Known shear reinforcement includes the following: shear reinforcements made of concrete reinforcing steel with shear reinforcement elements in the form of S-hooks (although this is no longer allowed according to DIN 1045) or stirrups , dowel bars, double headed dowels, open web girder, Tobler Walm, "Geilinger Kragen", retaining plate mesh, "Riss Stern", etc.

Shear reinforcement with reinforcement elements in the form of S-hooks or stirrups has to be encircled with a usually available flexural longitudinal reinforcement, due to bad anchorage in order to prevent the shear reinforcement being ripped out. It must be noted that this only achieves a moderate increase in the shear force resistance. The fitting of the concrete reinforcement elements is complicated and thus costly. In addition, conventional concrete reinforcement elements, such as stirrups are no longer considered fittable if exposed to high degrees of concrete reinforcement and a high proportion of shear reinforcement.

The alternative option is to use dowel bars, which are usually put on the lower formwork, so that – if available – the lower layer of reinforcement is encircled by a cross-section of the bar. For the load bearing capacity, however, an exact positioning and fixing of the bar is crucial, which cannot always be ensured on a construction site. The dowel bars are furthermore individually made and welded, which in proportion to the very high costs brings hardly any demonstrable improvement of the shear force resistance.

Joining elements or spacers for the upper and lower layers of reinforcement are known from DE-U1-71 18 881, DE-U1-298 14 923, DE-OS-2 111 243 or DE-OS-1 913 104. These elements, however, do not serve as concrete reinforcement elements; instead they fix only the reinforcement bars intended within the concrete component in a desired location or position before pouring in the concrete. This has no influence on the punching shear strength or even on the lateral load-bearing capability of the concrete ceiling.

Other known concrete reinforcement elements such as double headed dowels, Tobler Walm and "Geilinger Kragen" can improve the load-bearing capability or the punching shear strength of reinforced concrete or pre-stressed concrete components, in particular in the area of ceiling support. However, the lateral load-bearing capability of the concrete component is also hardly influenced through their use. Furthermore, these elements which mostly have to be produced individually on site, are characterised by a very expensive production. They are also very time-consuming both in mounting and in production, and so much time is often not available on a construction site.

The task of the invention is to overcome these and further disadvantages of the technical state of the art, by providing concrete reinforcement elements to be mounted in reinforced concrete or pre-stressed concrete components, which have a simple structure and are cheap to produce. Furthermore the invention aims to achieve a good anchorage of the concrete reinforcement elements between the reinforcement bars, while keeping the mounting quick and uncomplicated to execute. The concrete reinforcement elements have to improve the stability of the finished reinforced concrete or pre-stressed concrete component, in particular increasing significantly the lateral load-bearing capability of the component. The reinforced concrete or pre-stressed concrete component also has to be cheap to produce and easy to handle.

In accordance with the present invention, there is provided a concrete reinforcement element (10) for a reinforced concrete or pre-stressed concrete structural component (1) wherein said concrete reinforcement element (10) comprises a main component (12), an upper surface and a lower surface and which further comprises at least one reinforcement layer (Bo, Bu) on the upper surface and one reinforcement layer on the lower surface wherein each reinforcement layer comprises at least one outer layer (Bo_x, Bu_x) which is adjacent to the upper surface or lower surface and one inner layer (Bo_y, Bu_y) which is adjacent to the outer layer (Bo_x, Bu_x) on a side opposite the upper surface or lower surface and wherein the main component (12) is a central element of the concrete reinforcement element (10) and is adapted to extend substantially over the thickness of the reinforced concrete or pre-stressed concrete structural component (1) and up to at least an innermost layer of the one inner layer (Bo_y, Bu_y) of the reinforcement layer of the upper surface and the lower surface and wherein the main component (12) is a bi-dimensional structure which comprises an upper area (14) and a lower area (15) and further comprises at least one retaining element (20) in each of the upper and the lower area wherein said retaining element (20) is adapted to at least partially encircle the circumference of a concrete reinforcement bar (S) of the reinforcement layer on the upper surface and of the reinforcement layer on the lower surface and wherein at least one retaining element (20) comprises a single or double recess formed at an end of the main component (12).

In a further aspect of the invention, there is provided a reinforced or pre-stressed concrete structural component comprising the concrete reinforcement element of the subject invention.

A concrete reinforcement element in the form of a bi-dimensional component, which joins together, with a continuity of strength, the upper and lower layers of the reinforcement, located on the surface of the concrete component, with suitable upper and lower retaining elements, forms the core of the invention. This significantly increases the shear force resistance of the reinforced concrete or pre-stressed concrete components.

The concrete reinforcement elements can be made as simple free-falling punched parts, to which further splays can be added if necessary. This enables a very cost-effective production, which has a positive effect on the production costs for the concrete components.

The concrete reinforcement elements are easy to handle and quick to assemble. They simply have to be hooked in. No special knowledge or skills are required, as for example in the case of welding work.

The retaining elements can be realised as drilled holes, side recesses out of the bi-dimensional component and/or as splays, which encircle at least the innermost layers of each upper and lower layer of reinforcement in the case of there being more than one upper and more than one lower layer of reinforcement.

Surprisingly it was found that concrete reinforcement elements of this kind improve especially the shear force resistance, as well as the punching shear strength as compared to conventional structures, when they are mounted according to the invention interacting with the layers of reinforcement within a concrete component.

In addition to this surprising result, it was also found that a minimum thickness of the bi-dimensional components, of 1mm for example, was sufficient when using conventional structural steel, which has a very favourable effect on production costs.

Further traits, details and advantages of the invention arise from the text of the claims, as well as in the following description of execution examples by means of the illustrations. They show:

Fig. 1	a schematic side view of a concrete reinforcement element,
Fig. 2	a schematic side view of another embodiment of a concrete reinforcement element,
Fig. 3 to 6	a schematic side view each of further embodiments of a concrete reinforcement element,
Fig. 7	a schematic side view of a concrete reinforcement element with a securing means,
Fig. 8	a schematic side view of a concrete reinforcement element with a different embodiment for a securing means,
Fig. 9	a schematic side view of a concrete reinforcement element with yet another embodiment for a securing means,
Fig. 10 to 15	a schematic side view each of further embodiments of a concrete reinforcement element,
Fig. 16	a schematic representation of a further embodiment of a concrete reinforcement element,
Fig. 17	a schematic representation of a concrete reinforcement element with a indented bi-dimensional structure,
Fig. 18	two joined concrete reinforcement elements,
Fig. 19	three joined concrete reinforcement elements,
Fig. 20	a different embodiment of two joined concrete reinforcement elements,
Fig. 21	another different embodiment of two joined concrete reinforcement elements,
Fig. 22	a schematic sectional view of a concrete reinforcement element divided into two parts,
Fig. 23	a schematic sectional view of a different embodiment of a concrete reinforcement element divided into two parts,
Fig. 24	yet another embodiment of a concrete reinforcement element divided into two parts,
Fig. 25	a further variation of a concrete reinforcement element,

Fig. 26 a schematic representation of a reinforced concrete or pre-stressed concrete component,

The concrete reinforcement element which is generally called 10 in Fig. 1 is for use in the reinforced concrete or pre-stressed concrete component 1 (which is not represented here in any further detail). It has as its main part 12 a simple flat structure made of structural steel, which has a recess 30 each in its upper area 14 and its lower area 15. The recess is formed by a slot, which is open to the longitudinal edge 16 on the side of the bi-dimensional structure 12, which extends vertically from its longitudinal centre M.

Each recess 30 forms a retaining element 20 for the concrete reinforcement element S (which is also not shown here), in particular for a reinforcement bar of an upper and lower reinforcement layer Bo, Bu in the reinforced concrete or pre-stressed concrete component 1 (see Fig. 26). These lie on each surface of the component (which is also not shown in any further detail here). They are formed by a least one inner layer Bo_y, Bu_y and at least one external layer Bo_x, Bu_x, which runs vertically to the inner layer.

During assembly, the bi-dimensional structure 12, with its side-opening recesses 30, is simply put on two reinforcement bars S of the inner layers Bo_y, Bu_y, lying directly on top of each other and running in the same direction. This means that each reinforcement bar is at least partially encircled. The clearance of the recesses 30 is calculated in such a manner that the bi-dimensional structure 12 with force transmission by friction sits tightly on the reinforcement bar S, so that it can not become loose while the concrete is poured in.

Hereby it is important that each concrete reinforcement element 10 always lies laterally to its bi-dimensional structure 12, and preferably vertically to the reinforcement bars S, extending, on the whole, over the thickness of the reinforced concrete or pre-stressed concrete component 1, namely to at least each upper and lower of the innermost of at least one inner layer Bo_y, Bu_y of the upper and lower reinforcement layers Bo, Bu. The latter are thereby bound together with a continuity of strength.

Comparative measurements have surprisingly shown that the concrete reinforcement element 10 according to the current invention significantly increases the punching shear strength as well as the shear force resistance of the reinforced concrete or pre-stressed concrete component 1 as compared to conventional constructions. It is sufficient here to produce the bi-dimensional structure 12, using conventional structural steel, with a thickness of 1mm. This has a very favourable effect on material costs.

A further advantage of the concrete reinforcement element 10 is that due to its simple geometry it can be made, for example, as free falling punched parts, which further lowers production costs. They are quick and uncomplicated to mount and do not require any special knowledge or skills. This also leads to a considerable reduction in production costs for the reinforced concrete or pre-stressed concrete component 1.

In the embodiment of Fig. 2 the concrete reinforcement element 10 has as a retaining element 20 in the upper area 14 a slot 30, whereas a round or oval recess 30 is designated for the lower area 15.

The embodiment of Fig. 3 designates two slots 30 open on the side as retaining elements 20, which run diagonally to the top at an angle α to the longitudinal centre M of the bi-dimensional structure 12. In contrast, the shape of Fig. 4 intends that the slots 30 run diagonally down at an angel α. In both cases putting the concrete reinforcement element 10 on the reinforcement bars S is made easier, in particular within tight spaces.

The concrete reinforcement elements 10 represented in Fig. 5 has proven to have a particularly high increase in the lateral load-bearing capability of the reinforced concrete or pre-stressed concrete component 1. Here a total of four retaining elements 20 are designated for the upper and lower areas 14 and 15 of the bi-dimensional structure 12, namely two recesses 30 each, which are open to the longitudinal edge 16 and lie symmetrically to the longitudinal centre M.

Therefore, each concrete reinforcement element 10 covers in total four reinforcement bars S of the upper and lower reinforcement layers Bo, Bu, binding them together with continuing strength, which has a particularly positive effect on the lateral load-bearing capabilities of component 1. At the same time, each concrete reinforcement element 10 is firmly anchored between the reinforcement layers Bo, Bu. It can neither mistakenly fall out, nor can it slip when the concrete is poured in. The intervals and the positions of the reinforcement layers Bo, Bu are reliably secured at all times.

In order to further improve the fixing of the reinforcement bars S to the retaining elements 20 or in the recesses 30, the latter can have an extension 32 each up and down, so that in the area of the longitudinal edges 16 of the concrete reinforcement element 10 notched edges 33 are formed for the reinforcement bars S.

The embodiment in Fig. 6 designates that the extensions 32 of the recess 30 in the upper area 14 of the bi-dimensional structure 12 lie across the longitudinal centre M, whereas the recess 30 in the lower area 15 is mainly L-shaped, namely with an upturned extension 32. Here one can see that the sub-area 31 of the recess 30, which is open to the longitudinal edge 16, has a lower clearance than the part of the recess 30 which lies in the longitudinal centre.

In order to further secure the reinforcement bars S of the upper and lower reinforcement layers Bo, Bu of the concrete reinforcement elements 10, the recesses 30 can be provided with a securing means 34. This can, for example, be a mainly U-shaped clip made of elastic material which can be reduced breadthwise by pressure on both of its outer legs, so that it can fit into the recess 30 (see Fig. 7). If the legs are released, they then lie within the walls of the slot 30 in the bi-dimensional structure 12, so that a reinforcement bar which lies in the recess 30 can not slip out sideways.

In the embodiment in Fig. 8 the securing means 34 consist of pins which are brought into the gable-end of the bi-dimensional structure 12 or onto the side mounted receptions 35. It is advantageous to use preferably brightly coloured indicatory agents, so that the insertion of a pin 34 can be easily marked and recognised on the construction site.

Alternatively a rotatable pin 34 or another rotatable bolting element, as well as a positioning pin, can be arranged on the longitudinal edge 16 of the bi-dimensional structure 12, whereby the pin 34 is turned after the concrete reinforcement element S is brought in between the concrete reinforcement element 10 and the positioning pin. The indicatory agents 36 on the pin 34 would then show all in the same direction, or indicate the same inclination or position relative to the concrete reinforcement element 10, thus enabling a fast check of the secured condition even for a large number of concrete reinforcement elements.

Fig. 9 shows further advantageous embodiments for securing means 34, for example in the form of a simple elastic element, such as a strip or a simple wedge.

Another important embodiment of the concrete reinforcement element 10 according to this invention is shown in Fig. 10. The retaining element 20 is formed by an end-sided formed simple splay 40 in the upper area 14 of the bi-dimensional structure. Preferably this will encircle a reinforcement bar S of the outer layer Bo_x of the upper reinforcement layer Bo (see Fig. 26, left element 10). The retaining element 20 in the lower area 15 of the bi-dimensional structure 12 is a L-shaped recess 30, which encircles a reinforcement bar S of the inner layer Bu_y of the lower reinforcement layer Bu.

As shown by Fig. 11 to 13, the retaining elements 20 can be combined in almost any way in the form of recesses 30 and splays 40, whereby reinforcement bars S of the inner or outer layers Bo_y, Bu_y, Bo_x, and Bu_x can be grasped at the same time.

In Fig. 11a the splay 40 which is formed onto the upper area 14 is bent upwards, whereas the splay 40 in the lower area 15 points forward. The concrete reinforcement element 10 has thereby a mainly Z-shaped form in a cross-section– as can be seen in Fig. 11b, whereas the execution form of Fig. 12 and 12a has a U-profile in a cross-section.

According to Fig. 13a and 13b the splays 40 can be doubled or multiplied, whereby the concrete reinforcement element 10 can have an S-shape in the cross-section – as shown by Fig. 15b.

The embodiment of Fig. 16 is based on the construction form of Fig. 6, that means that in the upper and lower areas 14 and 15 of the bi-dimensional structure 12 a total of four recesses 30 are intended symmetrical to its longitudinal centre as retaining elements 20, which encircle the reinforcement bars with a continuity of form. The recesses 30 are not open to the longitudinal edges 16, that means that the reinforcement bars S are mainly introduced vertically into the bi-dimensional structure 12. Additional splays 40 encircle in each case the outer layer Bo_x, Bu_x of the upper and lower reinforcement layers Bo, Bu as additional retaining elements, so that the concrete reinforcement elements 10 are integrated in an optimal manner into the reinforced concrete or pre-stressed concrete component 1 for the purpose of increasing the lateral load-bearing capability. Furthermore, its ductility is also increased when there is strain on the shear force.

The same advantages are also found in yet another form of the concrete reinforcement element (Fig. 17). Here the bi-dimensional structure 12 is indented in the cross-section, whereby the indentation 24, formed through simple and preferably right-angled splays, is realised between the upper and lower reinforcement layers (Bo, Bu).

If required, the concrete reinforcement elements 10 can encircle more than four reinforcement bars S. The bi-dimensional structure 12 must correspondingly be extended horizontally to its longitudinal centre M and the required number of retaining elements 20 must be added.

In the embodiment of Fig. 18 two concrete reinforcement elements 10 are arranged in longitudinal direction at least one reinforcement bar (S) next to each other in a V-shape, whereby the bi-dimensional structures in their upper areas 14 are joined to one another or are one piece.

The construction form of Fig. 19 provides for many concrete reinforcement elements 10 to be standing parallel one after the other. Each bi-dimensional structure 12 is bound in a T-shape with its upper area 14 to a flat bar 26, which protrudes over the breadth of the concrete reinforcement element 10 in order to at least partially hold or encircle an element S of the upper reinforcement layer.

The embodiment in Fig. 20 is made up of concrete reinforcement elements 10 and a flat bar 26, which together form a U-profile, whereby the latter also serves as a retaining element 20, in that it encircles at least one reinforcement bar S of the upper reinforcement layer Bo.

The recesses 30 in the upper area 14 of the bi-dimensional structure 12 can also be realised in a rectangular form – as shown by Fig. 21– and join two parallel concrete reinforcement elements 10, which are arranged next to each other, with a flexible spring clamp 28, whereby the clamp 28 with its legs (which are not described in any further detail) is set in the recesses 30, encircling also at least one reinforcement bar S of the upper reinforcement layer Bo.

Yet another important embodiment of the current invention can be seen in Fig. 22 to 24, when namely the bi-dimensional structure 12 of the concrete reinforcement element 10 is divided, vertically to its longitudinal centre M, into a lower half 50 and an upper half 60, whereby both halves 50 and 60 are joined to each other in a separable manner.

Thereby it is possible, for example, to prefabricate reinforced concrete or pre-stressed concrete components, for example ceiling elements in which the lower halves 50 of the concrete reinforcement elements 10 are built or poured into the lower half of the ceiling. Therefore, on the construction site, only the missing upper reinforcement layer Bo has to be added, whereby the upper halves 60 of the concrete reinforcement elements 10 are joined to the lower half 50 which is protruding from the prefabricated ceiling component. Afterwards, the ceiling can be completed by pouring in the concrete.

Ceiling elements which have been prefabricated in this way have the advantage of being much easier to handle and transport, as not only do they weigh less, but also the dimensions are smaller. Furthermore it also enables more flexible arrangement possibilities on the construction site. For example the thickness of the concrete ceiling can be individually designed, by using upper halves 60 with different lengths of the concrete reinforcement elements 10. Various retaining elements 20, in particular also splays 40, can be added to them in their final areas 14 and 15.

The halves 50 and 60 are preferably joined by means of the hook-shaped joining elements 52 and 62, which encircle one another with a continuity of strength and form. It is important here that the joint is constantly subjected to tension.

In the embodiment of Fig. 24 the lower half 50 of the concrete reinforcement element 10 is complemented by an upper half 60 made of coiled rods 66, whereby this is tilted in a Z-shape and can be put into an appropriate recess in the lower half 50.

Fig. 25 shows two views on the broad side of a further embodiment of the concrete reinforcement element 10 according to the current invention. This embodiment is characterised by the fact that the area between the broken lines compared to the areas above or below is shifted backwards or forwards from the image plane, going in or going out against the upper and lower area. This becomes visible when viewed on the narrow edge of both components. Alternatively, component 10 can also be realised in such a way, that, for example, only an upper part is shifted against a lower part of the component, for example, by tilting or stressing.

Herby, in both cases it is achieved that two such identical components 10, if they are pushed into each other with the edges 16, in which there are the openings of the side recesses 30, form a dovetail and a covered area comes into being, so that both components 10 together form a recess 30, which secures an element S, which is threaded through it, of a reinforcement layer Bo or Bu from slipping upwards or downwards. The concrete reinforcement element 10 in the middle of Fig. 26 encircles per element S each of the outermost layers Bo_x and Bu_x of the upper and lower reinforcement layers Bo, Bu, while the concrete reinforcement element 10 represented on the right of Fig. 26 only joins elements S of the inner layers Bo_y, Bu_y of the upper and lower reinforcement layers Bo, Bu.

The number and embodiment of components 10 have to be calculated according to the type of concrete used and the desired load-bearing capability, in order to achieve the necessary punching shear strength, for example in the area of a column. In each case this results in a significant increase in the shear force resistance of the component 1.

The current invention is not limited to one of the aforementioned embodiments, but instead can be varied and altered in many different ways. The concrete reinforcement elements can, for example, be fabricated from other materials such as steel sheeting, plastic or composite material. One can also extend the concrete reinforcement elements 10 or their bi-dimensional structure 12 horizontally to their longitudinal centre M, in order to be able to encircle several reinforcement bars S of the upper and lower reinforcement layers Bo, Bu simultaneously. It is important here as well that the concrete reinforcement elements 10 are always simple, flat sheet metal components, if necessary tilted at the ends or in the middle, featuring retaining elements in the upper and lower areas which receive or encircle the reinforcement bars S of the upper and lower reinforcement layers Bo, Bu. Mounting is achieved without any complex welding or assembly work, whereby the upper and lower reinforcement layers Bo, Bu are pulled tight by the concrete reinforcement elements 10, joining them with a continuity of strength.

All of the traits and advantages in the claims, description and the illustrations, including constructive details, spatial arrangements and procedural steps can be essential to the current invention on there own or various different combinations.

List of reference numerals

α	Angle
Bo, Bu	Reinforcement layer
Bo_y, Bu_y	Inner layer
Bo_x, Bu_x	Outer layer
M	Longitudinal centre
S	Concrete reinforcement element
1	Reinforced concrete or pre-stressed concrete component
10	Concrete reinforcement element
12	Main component
14	Upper area
15	Lower area
16	Longitudinal edge
20	Retaining elements
24	Indentation
26	Flat bar
28	Clamp
30	Recess
31	Sub-area
32	Extension
33	Notched edge
34	Securing means
35	Reception
36	Marking
40	Splay
50	Lower half
52	Joining element
60	Upper half
62	Joining element
66	Coiled rods

CLAIMS:

1. A concrete reinforcement element (10) for a reinforced concrete or pre-stressed concrete structural component (1) wherein said concrete reinforcement element (10) comprises a main component (12), an upper surface and a lower surface and which further comprises at least one reinforcement layer (Bo, Bu) on the upper surface and one reinforcement layer on the lower surface wherein each reinforcement layer comprises at least one outer layer (Bo_x, Bu_x) which is adjacent to the upper surface or lower surface and one inner layer (Bo_y, Bu_y) which is adjacent to the outer layer (Bo_x, Bu_x) on a side opposite the upper surface or lower surface and wherein the main component (12) is a central element of the concrete reinforcement element (10) and is adapted to extend substantially over the thickness of the reinforced concrete or pre-stressed concrete structural component (1) and up to at least an innermost layer of the one inner layer (Bo_y, Bu_y) of the reinforcement layer of the upper surface and the lower surface and wherein the main component (12) is a bi-dimensional structure which comprises an upper area (14) and a lower area (15) and further comprises at least one retaining element (20) in each of the upper and the lower area wherein said retaining element (20) is adapted to at least partially encircle the circumference of a concrete reinforcement bar (S) of the reinforcement layer on the upper surface and of the reinforcement layer on the lower surface and wherein at least one retaining element (20) comprises a single or double recess formed at an end of the main component (12).

2. The concrete reinforcement element according to claim 1, wherein the at least one retaining element (20) is a recess (30) formed within the main component (12).

3. The concrete reinforcement element according to claim 2, wherein the recess (30) is open to a longitudinal edge (16) of the main component (12).

4. The concrete reinforcement element according to claim 3, wherein the recess (30) runs approximately vertically to the longitudinal centre (M) of the main component (12).

5. The concrete reinforcement element according to claim 3, wherein the recess (30) is at an angle (α) to the longitudinal centre (M) of the main component (12).

6. The concrete reinforcement element according to any one of claims 2 to 5, wherein the recess (30) extends into the longitudinal centre (M) of the main component (12).

7. The concrete reinforcement element according to any one of claims 2 to 6, wherein the recess (30) is a slot.

8. The concrete reinforcement element according to any one of claims 2 to 7, wherein the recess (30) comprises an extension (32) which extends upwards or downwards from the recess (30) along the longitudinal centre (M) of the main component (12).

9. The concrete reinforcement element according to any one of claims 2 to 7, wherein the recess (30) comprises an extension (32) which extends upwards and downwards from the recess (30) along the longitudinal centre (M) of the main component (12).

10. The concrete reinforcement element according to any one of claims 2 to 9, wherein the recess (30) further comprises securing means (34) in order to secure the position of the concrete reinforcement bar (S) of at least

one of the upper reinforcement layer and the lower reinforcement layer (Bo, Bu).

11. The concrete reinforcement element according to claim 10, wherein the securing means (34) is inserted from the longitudinal edge (16) sideways into the recess (30).

12. The concrete reinforcement element according to claim 10 or 11, wherein the securing means (34) is a wedge, an elastic clip, or a pin inserted into a reception (35).

13. The concrete reinforcement element according to any one of claims 10 to 12, wherein the securing means (34) bears a marking (36).

14. The concrete reinforcement element according to claim 13, wherein the marking (36) is a coloured marking.

15. The concrete reinforcement element according to any one of claims 2 to 6 wherein at least two recesses (30) are formed within the main component (12), which both lie symmetrically to its longitudinal centre.

16. The concrete reinforcement element according to claim 15 wherein at least one of the at least two recesses (30) is a slot.

17. The concrete reinforcement element according to claim 15 or 16 wherein at least one of the at least two recesses comprises an extension (32) which extends upwards or downwards from the recess (30) along the longitudinal centre (M) of the main component (12).

18. The concrete reinforcement element according to claim 15 or 16 wherein at least one of the at least two recesses comprises an extension (32) which extends upwards

and downwards from the recess (30) along the longitudinal centre (M) of the main component (12).

19. The concrete reinforcement element according to any one of claims 15 to 18 wherein at least one of the at least two recesses (30) further comprises securing means (34) in order to secure the position of the concrete reinforcement bar (S) of at least one of the upper reinforcement layer and the lower reinforcement layer (Bo, Bu).

20. The concrete reinforcement element according to claim 19 wherein the securing means (34) can be inserted from the longitudinal edge (16) sideways into the at least one of the at least two recesses (30).

21. The concrete reinforcement element according to claim 19 or 20 wherein the securing means (34) is a wedge, an elastic clip, or a pin inserted into a reception (35).

22. The concrete reinforcement element according to any one of claims 19 to 21 wherein the securing means (34) bears a marking.

23. The concrete reinforcement element according to claim 22 wherein the marking (36) is a coloured marking.

24. The concrete reinforcement element according to any one of claims 1 to 23, wherein the main component (12) is made of structural steel.

25. The concrete reinforcement element according to any one of claims 1 to 24, wherein the main component (12) has a thickness of at least 1 mm.

26. The concrete reinforcement element according to any one of claims 1 to 25, wherein the main component (12) comprises an indented cross-section.

27. The concrete reinforcement element according to claim 26, wherein an indentation (24) is formed between the upper and lower reinforcement layer (Bo, Bu).

28. The concrete reinforcement layer according to any one of claims 1 to 27, wherein the main component (12) is divided vertically to its longitudinal centre (M) into a lower half (50) and an upper half (60).

29. The concrete reinforcement element according to claim 28, wherein the lower half (50) and the upper half (60) are joined to each other in a separable manner.

30. The concrete reinforcement element according to claim 28 or 29, wherein the lower half (50) and the upper half (60) can be joined to each other by means of at least two hook-shaped joining elements which encircle each other with a continuity of strength and form.

31. The concrete reinforcement element according to any one of claims 28 to 30, wherein the upper half (60) of the main component (12) is made of S-shaped or Z-shaped coiled rods (66).

32. A reinforced or pre-stressed concrete structural component (1) comprising at least one concrete reinforcement element (10) according to any one of claims 1 to 31.

33. The reinforced or pre-stressed concrete structural component (1) according to claim 32 which comprises several concrete reinforcement elements (10) which are joined together on at least one of an upper and a lower part via a joint concrete reinforcement element (26).

34. The reinforced or pre-stressed concrete structural component of claim 33, wherein the joint concrete reinforcement element is a bar or a flat bar.

35. The reinforced or pre-stressed concrete structural component (1) according to claim 33 or 34, wherein the joint concrete reinforcement element (26) comprises a further concrete reinforcement element which is located below or above the outer layer (Bo_x) which is closest to the upper surface and the lower layer (Bo_x) which is closest to the lower surface.

36. The reinforced or pre-stressed concrete structural component according to claim 35, which comprises at least two reinforcement layers on each of the upper surface and the lower surface and wherein the joint concrete reinforcement element (26) further comprises additional concrete reinforcement elements located between each of the upper reinforcement layers and the lower reinforcement layers.

37. The reinforced or pre-stressed concrete structural component (1) according to any one of claims 33 to 36, which comprises two concrete reinforcement elements on either side of the joint concrete reinforcement element (26) and wherein the two concrete reinforcement elements are connected by at least one concrete reinforcement bar (S) arranged in the recesses (30) of the concrete reinforcement element (10).

38. The reinforced or pre-stressed concrete structural component of any one of claims 33 to 36, which comprises two concrete reinforcement elements on either side of the joint concrete reinforcement element (26) and wherein the two concrete reinforcement elements are connected by a welding.

39. The reinforced or pre-stressed concrete structural component of claim 38, wherein the joint concrete reinforcement element is a flat bar or a flat metal shield which, on at least one of the upper surface or the lower surface, protrudes beyond the edges of the concrete reinforcement elements.

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OTTAWA, CANADA

PATENT AGENTS

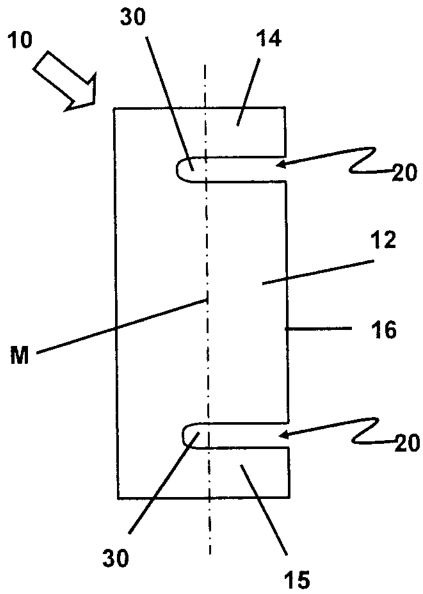


Fig. 1

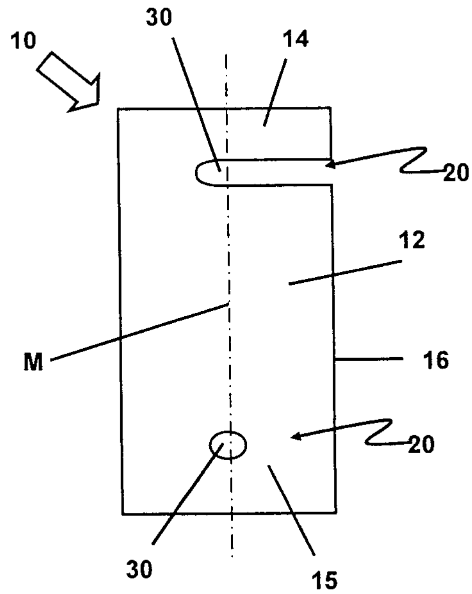


Fig. 2

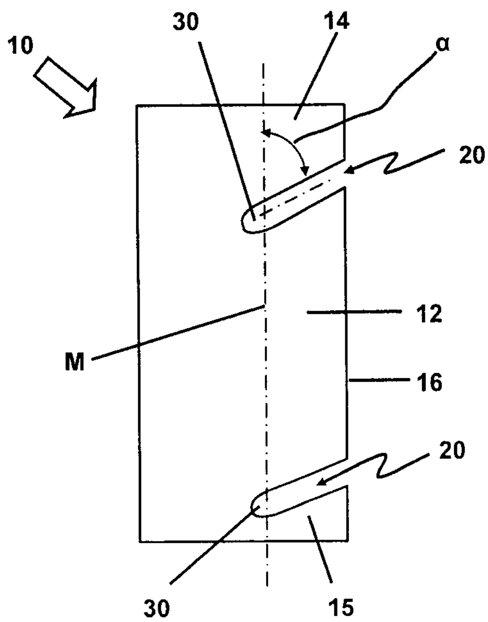
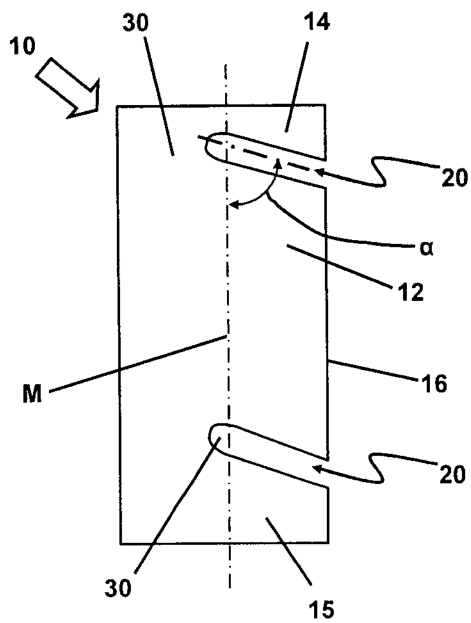


Fig. 3



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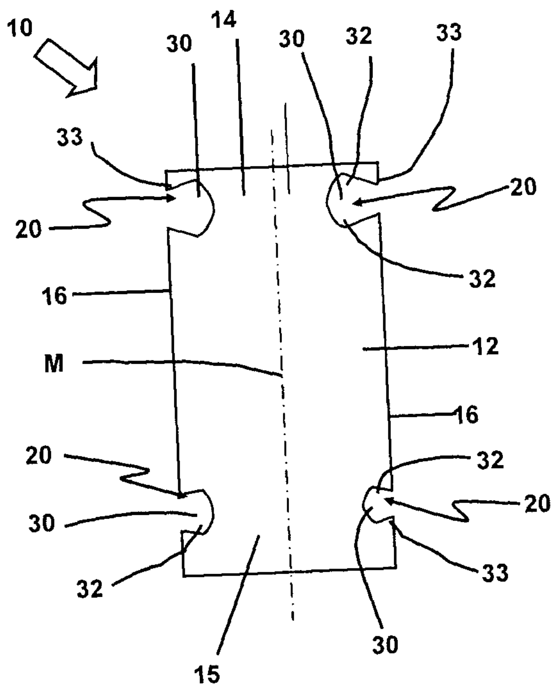


Fig. 5

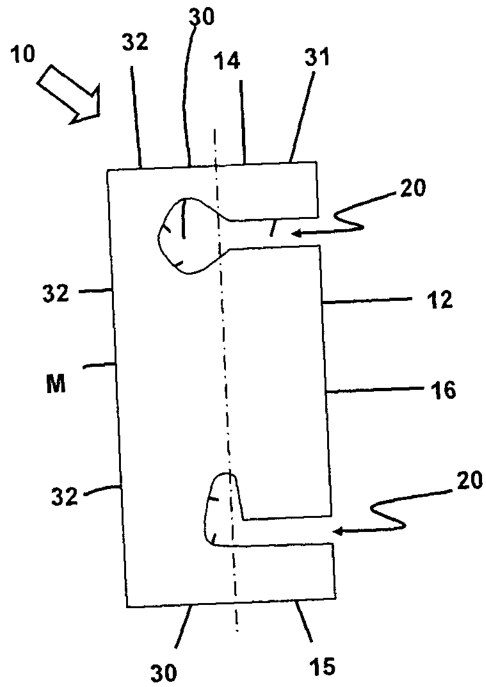


Fig. 6

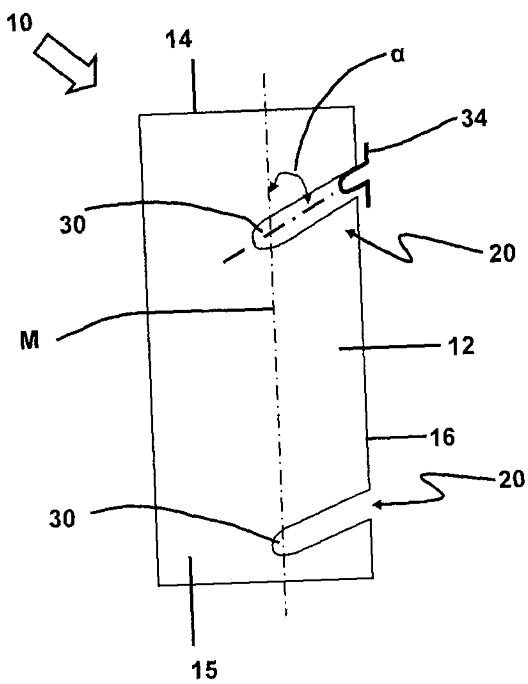
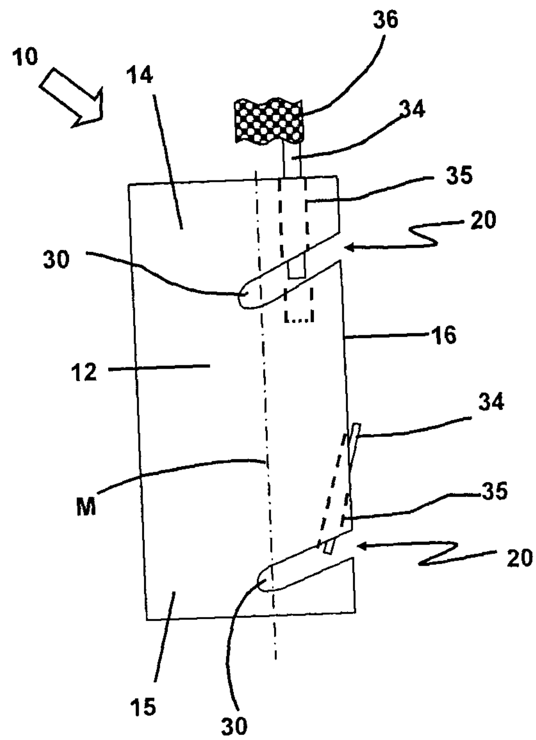


Fig. 7



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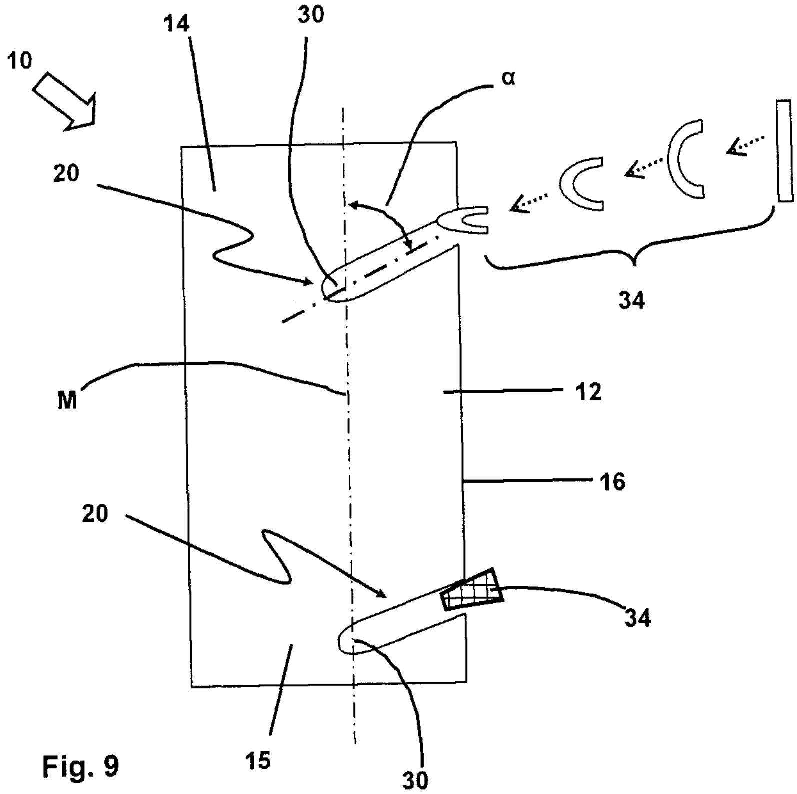


Fig. 9

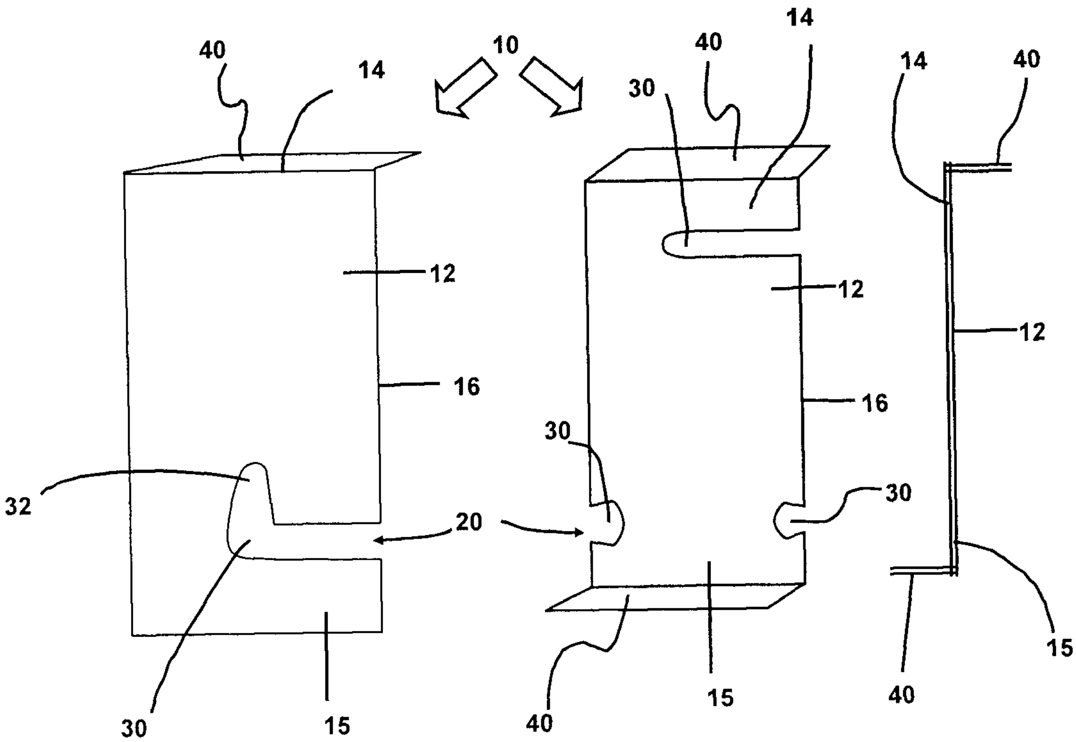


Fig. 10

Fig. 11a

Fig. 11b

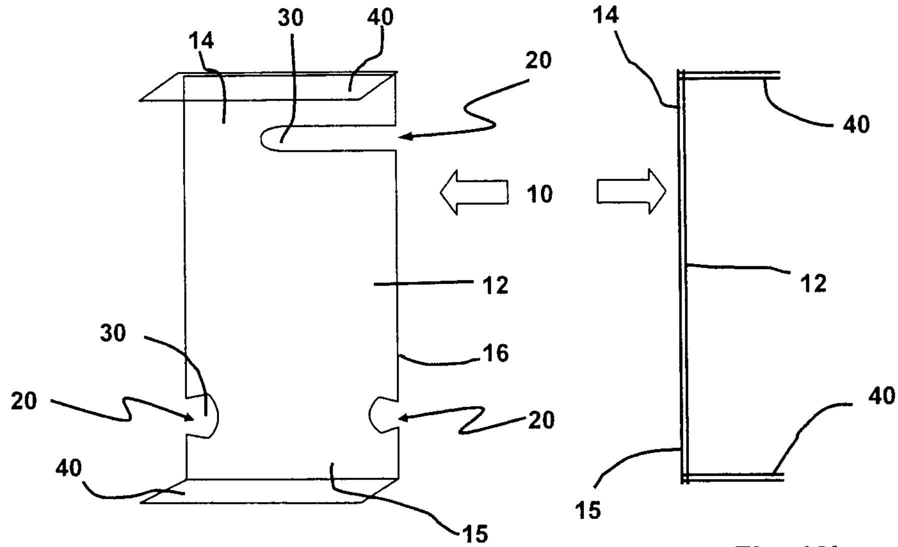


Fig. 12a

Fig. 12b

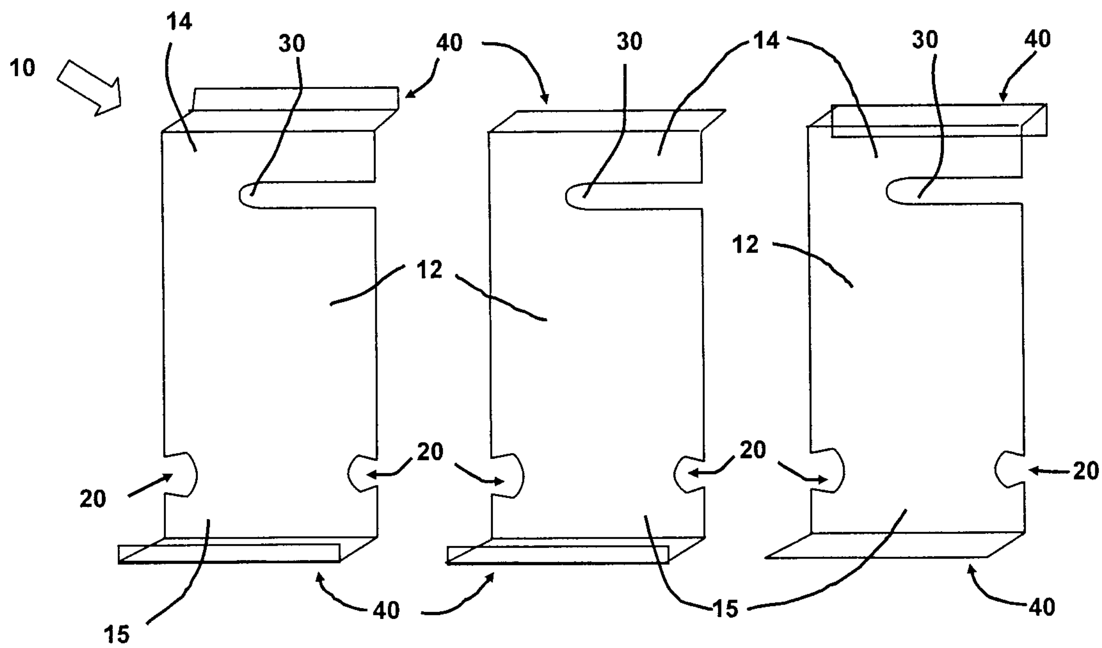
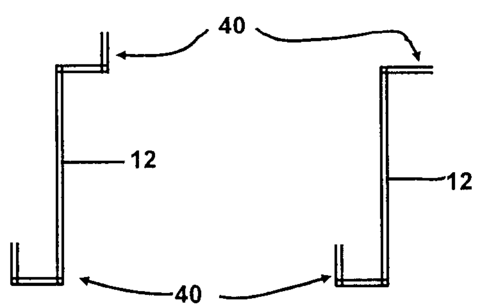


Fig. 13a

Fig. 14a

Fig. 15a



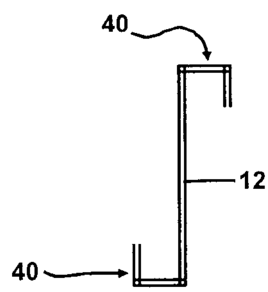
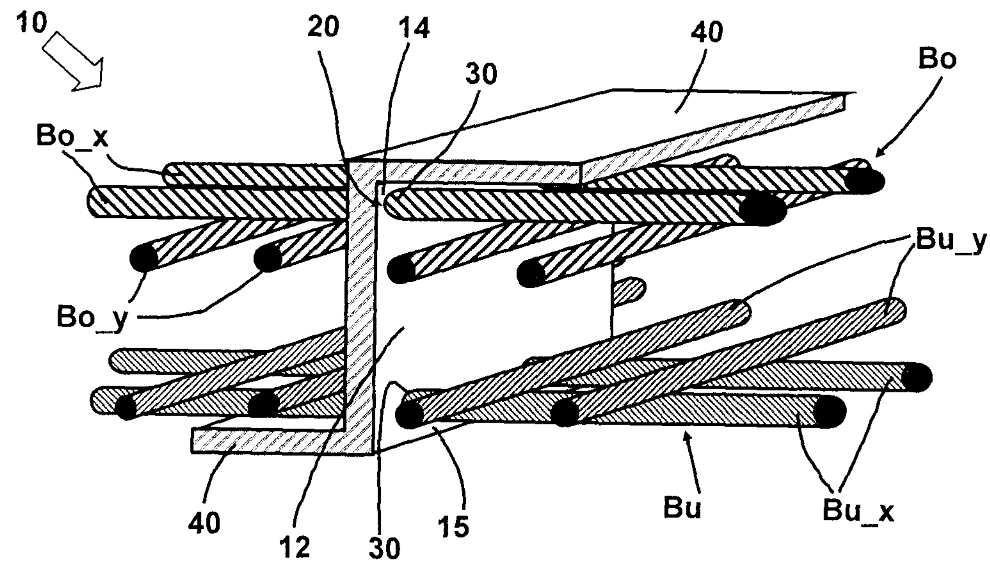


Fig. 13b

Fig. 14b

Fig. 15b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14
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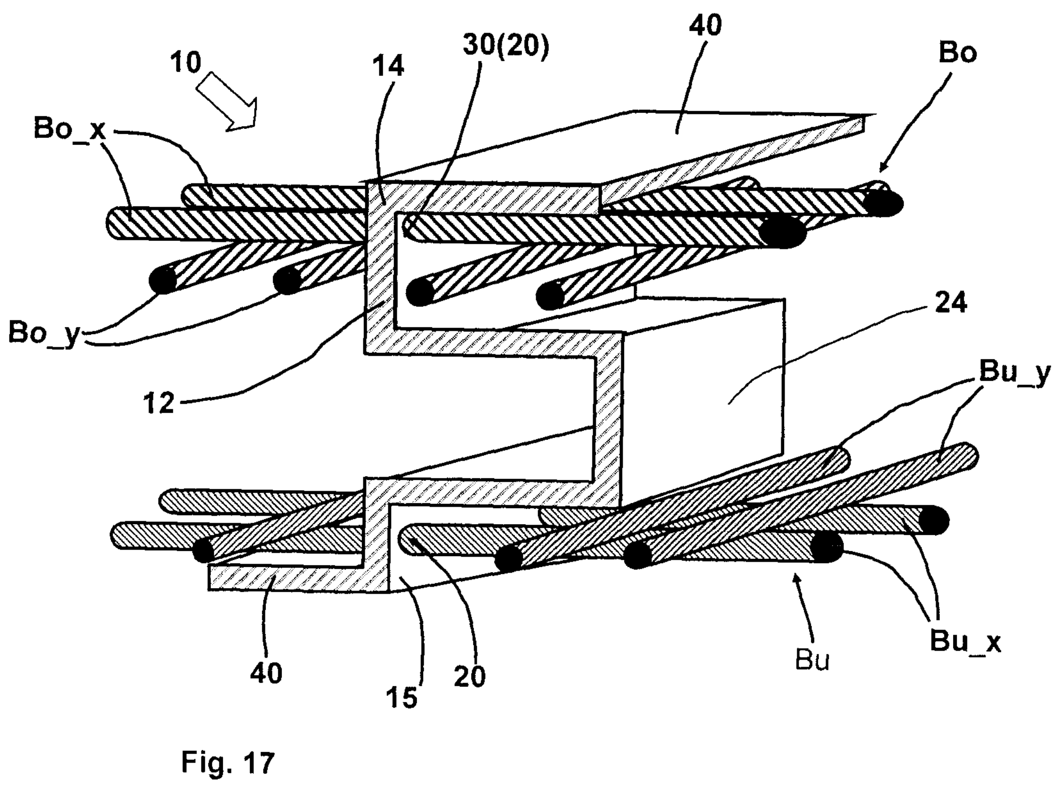
30
Bo
Bo_x
Bo_y
Bu_y
40
12
30
15
Bu
Bu_x

Fig. 16


10
14
30(20)
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Bo
Bo_x
Bo_y
24
12
Bu_y
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20
Bu
Bu_x

Fig. 17

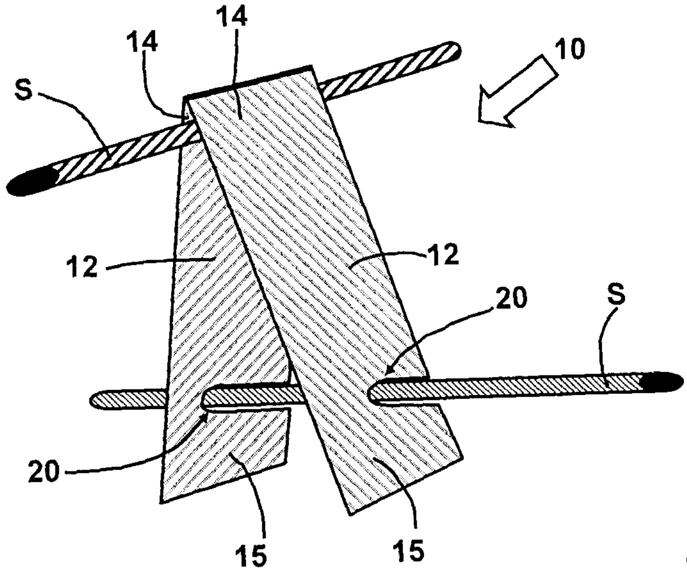

Fig. 18

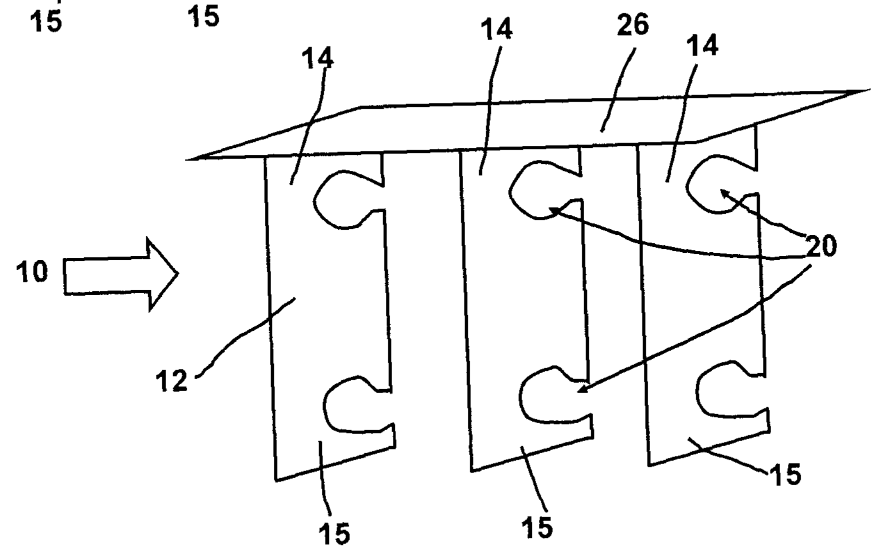

Fig. 19

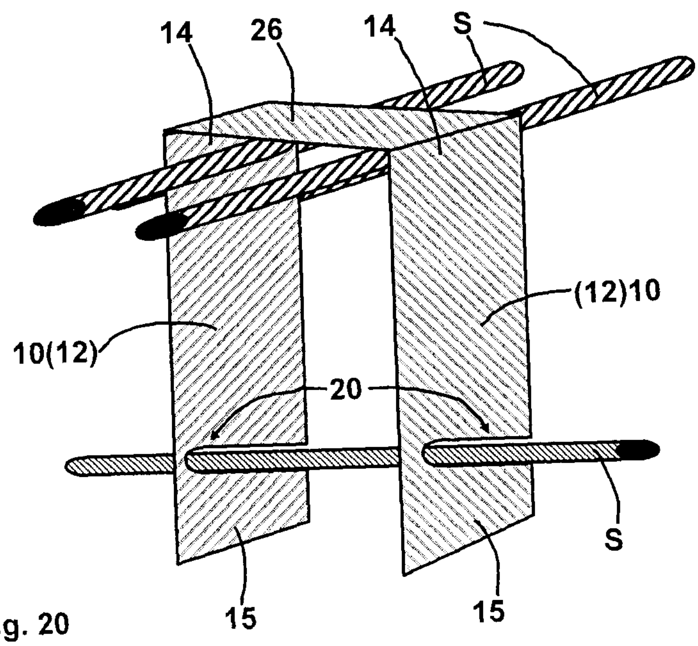

Fig. 20

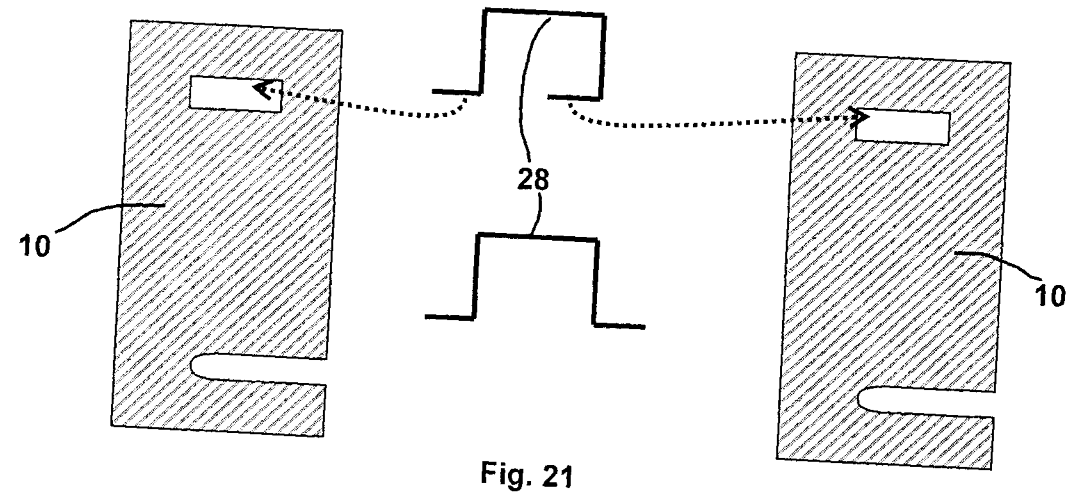

Fig. 21

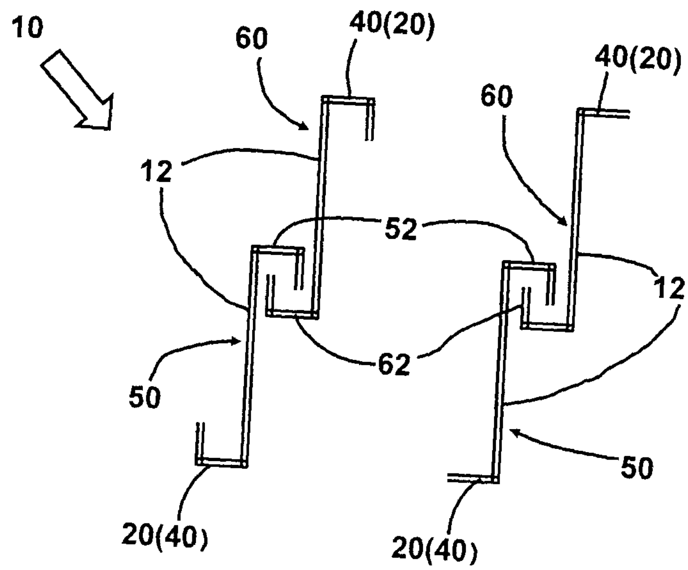

Fig. 22

Fig. 23

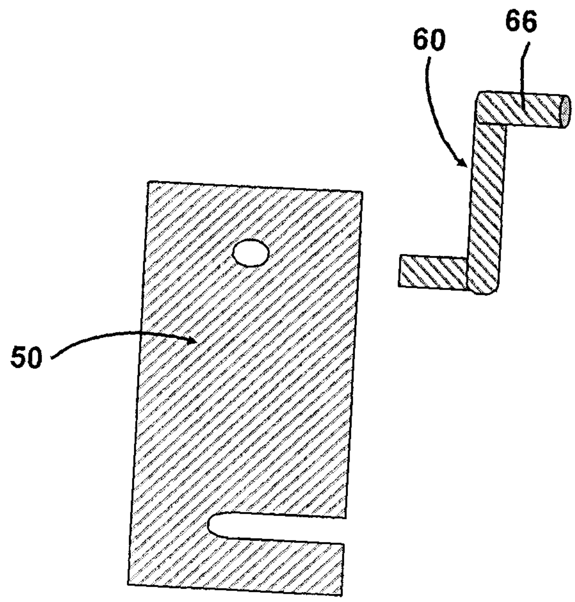

Fig. 24

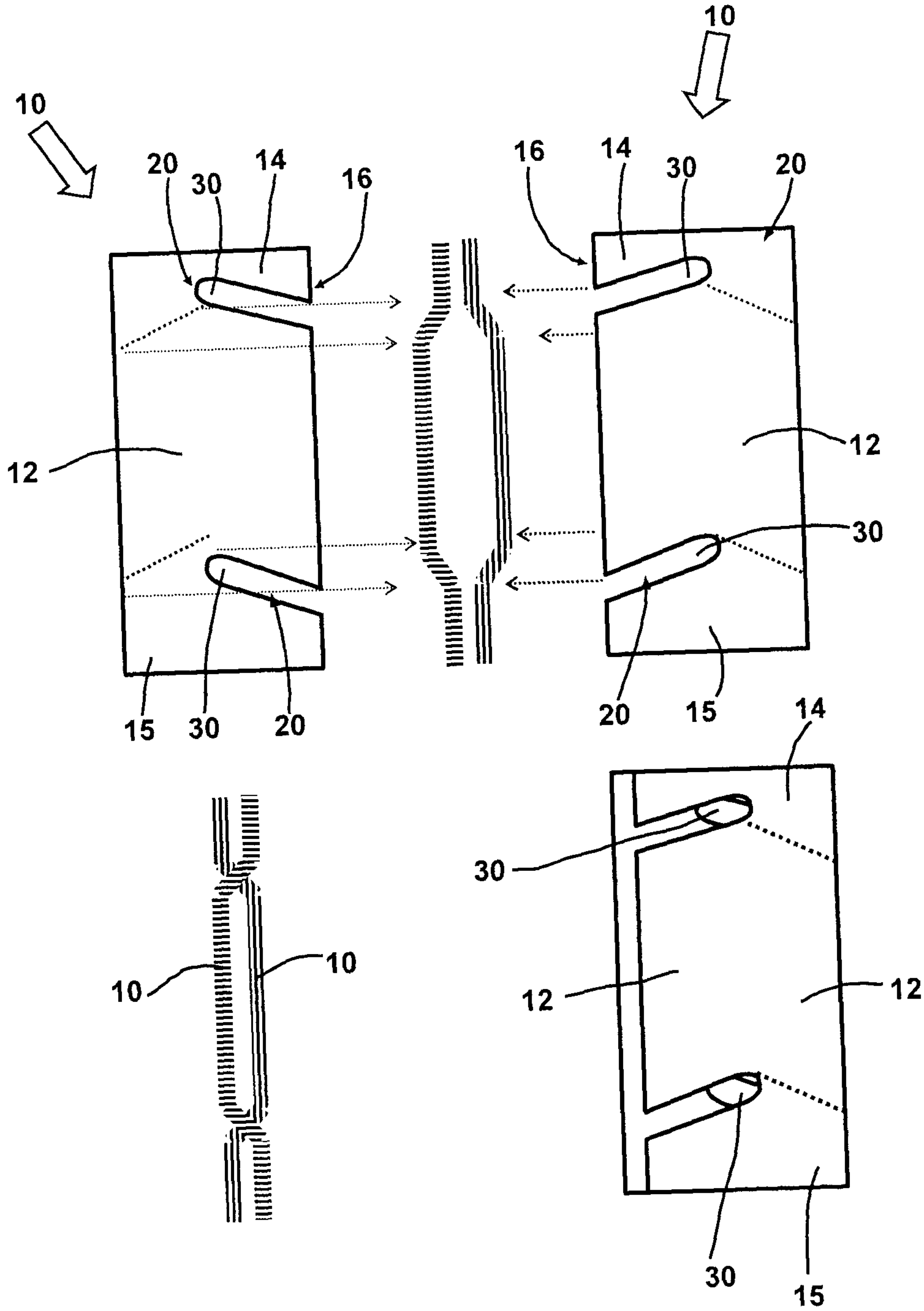
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Fig. 25

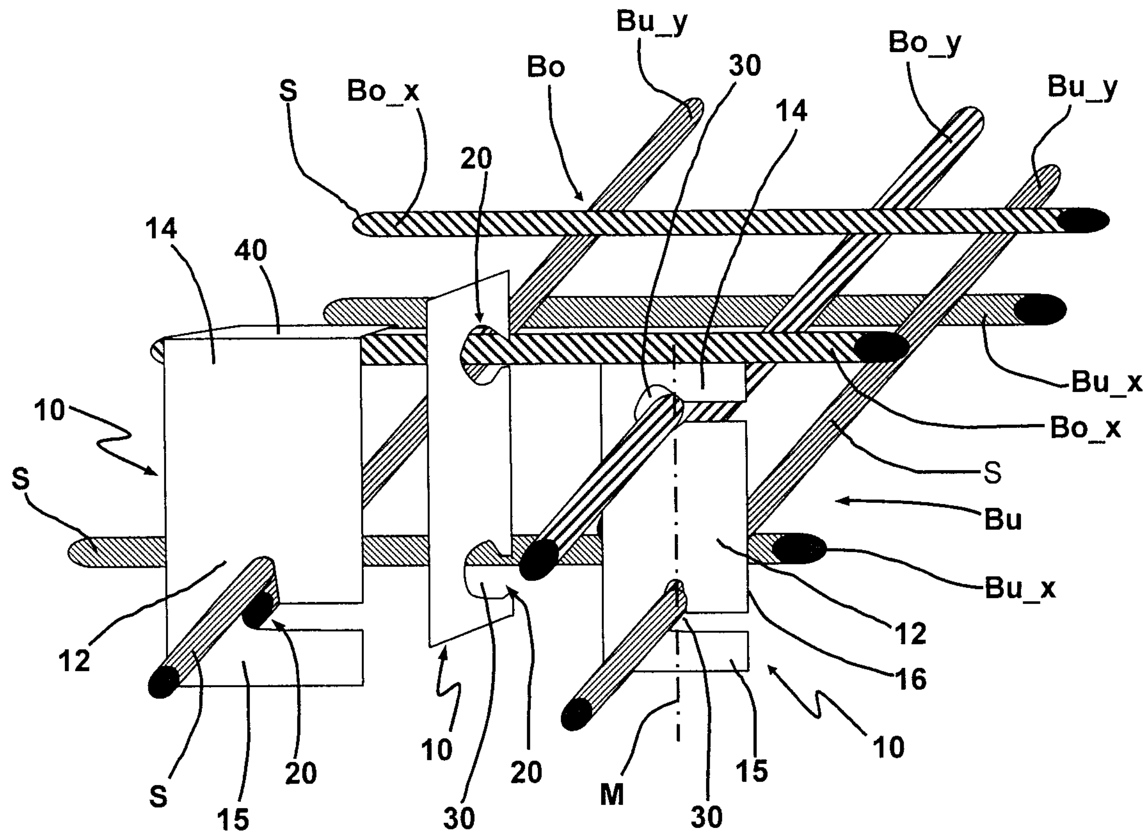
Bu_y
Bo_y
Bu_y
30
Bo
14
S
Bo_x
20
14
40
Bu_x
Bo_x
10
S
S
Bu
S
Bu_x
12
12
16
20
10
10
S
20
20
M
15
15
30
30

Fig. 26