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(54) **Broken-spiral stirrup and method for implementing the reinforcement of concrete structures**

(57) Stirrup structure (1) shaped like a broken spiral, extending according to its longitudinal axis (A), constituted by a sequence of tracts substantially perpendicular (3) and substantially oblique (2) with respect to the longitudinal axis, forming winding configurations, with the oblique tracts (2) tilted two by two in directions different between them to implement the spiral pitch (D) and positioned on faced surfaces, with which imple-

menting the method consisting in handling the single stirrup structure (1) in an axially compacted state, in positioning it in the site on a resting base or inside a form, in positioning inside thereof the reinforcement longitudinal members, in releasing the stirrup structure (1) from the ties in order to allow it extending elastically, then in fastening it with anchoring means to the reinforcement longitudinal members.

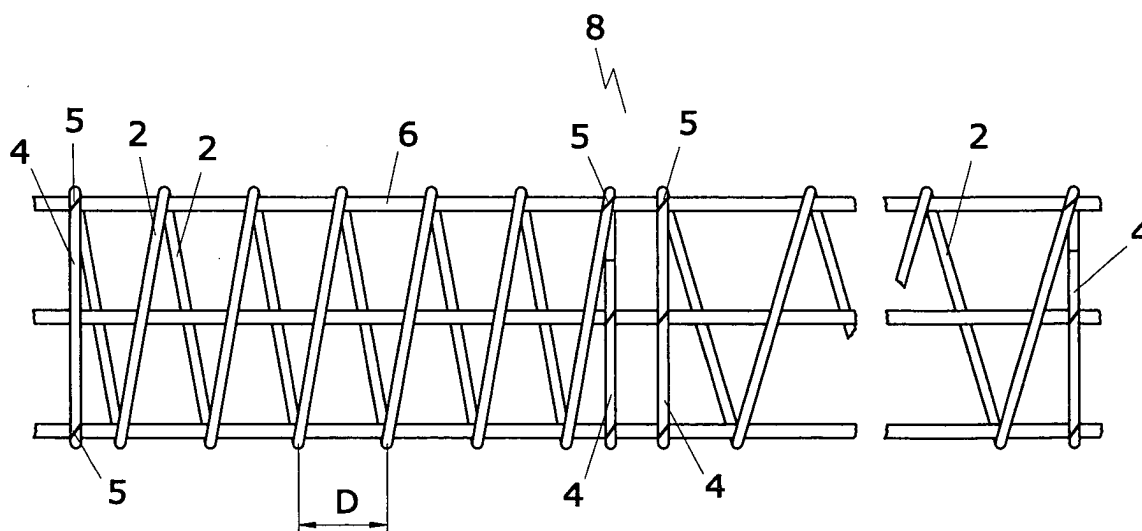


Fig. 10

Description

[0001] The invention relates to the broken-spiral stirrup and to the method with which the reinforcement of concrete structures is implemented and, in particular, the reinforcement of columns and beams.

[0002] In the current state of art the reinforcement of concrete columns and beams is implemented by a plurality of longitudinal members - arranged on the sides of a rectangle and among which the ones at the corner are called stirrup supports - and by a plurality of stirrups, implementing the cross reinforcement, each one constituted by a steel bar bent according to a closed line, with the ends bent like a hook at the same angle of the implemented rectangular figure.

[0003] Such stirrups are distributed along the length of the longitudinal members and they are fastened thereto with bindings, implemented with steel annealed wire, so that during the concrete casting they do not translate onto the longitudinal members themselves.

[0004] Such stirrups are usually distributed at a distance variable from 6 to 30 cm and on one hand they have the function of keeping in position the longitudinal members and of preventing the deformations and yieldings thereof if stressed, on the other hand they contribute to the resistance to the shear cross stresses.

[0005] The implementation of a 5-meter-long beam or column may require, for example, from 30 to 40 stirrups, therefore more than 120 bindings.

[0006] Furthermore, first of all it requires the marking on the longitudinal members of the positions wherein the stirrups are to be placed, then the insertion thereof in a position winding said longitudinal members and, at last, the bindings thereof. That is to say a long and precise work, to be implemented with attention.

[0007] As the stirrups require the use of a bending-shearing machine, usually they are implemented in the workshop and then transported in bundles to the site wherein the building with concrete columns and beams to be reinforced is under construction.

[0008] However, said stirrups tend to tangle, therefore, in order to reduce such drawback, they are bound in packs, then they are transported to the site and, at last, they are loosened and unravelled to be combined with the longitudinal reinforcement members, arranged onto appropriate stands and marked with chalk in order to show the places wherein said stirrups are to be positioned and joined to the members themselves.

[0009] For the problems arising before splitting the stirrups in bundles, then unravelling them in the site and combining them with the longitudinal members, lastly binding them to the longitudinal members themselves, it is usually preferable to implement the assembly of the longitudinal members and of the stirrups in the workshop. With small transportation means the so-assembled reinforcements are transported to the site, with the drawbacks due to their huge overall dimension and then to the number of trips required from the workshop to the

site.

[0010] In the current state of art the implementation of reinforcements for concrete castings results extremely complex and expensive, apart from being subjected to irregularities due both to the bad positioning of the stirrups in the reinforcement structures and to the lack of performing some bindings of the stirrups themselves. In this last case, during the casting and the vibration of the form destined to make easier the compaction thereof, the stirrups not well anchored to the longitudinal members can slide or move thereon, thus going away from the position provided in the design.

[0011] In order to overcome the drawbacks existing in the known building art, a process has been devised which provides the implementation of a continuous spiral, mechanically wound around a member with a pre-established shape, so that each winding is perfectly adjacent to the preceding one. Such product also offers some advantages concerning the storage and transportation costs.

[0012] The so-obtained reinforcement spiral is cut off to required lengths, then it is lengthened, with great efforts, until reaching the required pitch between one winding and the other.

[0013] Then, the spiral is fastened to the reinforcement longitudinal bars so as to obtain the complete reinforcement.

[0014] If such process is advantageous for the spiral storage and transportation from the workshop, wherein it is manufactured, to the site, wherein it is utilized, it is not advantageous as well as far as the fulfilment of the design conditions is concerned. In fact, the shear stresses which the stirrup positioned inside the concrete structure has to balance are directed in the direction perpendicular to the axis of the concrete structure itself, therefore the inner stirrup of the concrete structure should be parallel to such stresses, in the places wherein they arise, and not oblique with respect to such directions. Differently, a higher reinforcement iron quantity is required with the easily understandable consequent drawbacks. Furthermore, the pitch of the stirrup should be constant and however well defined. The lengthening of the spiral structure, in particular when it is quite long, does not guarantee instead the correct positioning thereof, therefore, once said spiral has been stretched, its deformation should be adjusted and stabilized in many places to the irons or to the reinforcement longitudinal members it combines therewith. Since upon increasing its expansion, its cross sizes decrease, the not uniform expansion causes the deflection of said reinforcement longitudinal members, which then can assume a sinuous course with the damages which follow therefrom.

[0015] Due to all this, such continuous spirals are not much utilized.

[0016] In another known solution, the one illustrated in the European patent with publication No. EP 0152397A2 dated 24/01/1985, it is provided the use of

a reinforcement spiral implemented by an automatic process therewith the produced spirals are individually sized.

[0017] In such solution a spiral reinforcement structure is provided which is constituted by a wire, or metal bar, bent to form a number of consecutive windings with a distance "D" one from the other, each one with three sides substantially perpendicular to the longitudinal direction of the structure and lying on the same plane. On the contrary, the fourth side, originating the pitch, is arranged in oblique direction and it constitutes a limited tract of the spiral. It is always placed on the same side of the spiral reinforcement structure (as exemplified in figure 3).

[0018] Such structure is provided to be combined directly in the workshop with the irons or reinforcement longitudinal members thereto it is fastened with welding spots so as to obtain a finished structure, ready to be transported to the site wherein it will be inserted in the form.

[0019] The objects of the present invention are to implement a structure and to find a method for the stirrup of the reinforcements for concrete columns and beams, so as to make easier on one hand the stirrup formation in the workshop, the storage and transportation thereof from the workshop to the site, on the other hand the quick and precise combination of the stirrup and the irons or the reinforcement longitudinal members in the site itself.

[0020] Still an additional object is to implement a stirrup structure which simplifies in the site the binding procedures therewith it is joined to the irons or to the reinforcement longitudinal members, that is which allows to reduce considerably the number of bindings of said reinforcement longitudinal members and, at the same time, which guarantees the stability of the stirrup position on said reinforcement longitudinal members, according to what is stated in the design.

[0021] At last, an additional object is to implement a stirrup structure which in the site could be inserted in the form in the state with which it comes from the workshop, which could be then brought to the working configuration and which in such state could be stabilized to said reinforcement longitudinal members, without changes or however intermediate interventions.

[0022] These and still additional objects are solved by a metallic structure, according to the invention, playing the stirrup function, hereinafter called stirrup structure, and by a method with which one or more of said structures are joined to the reinforcement longitudinal members, according to the enclosed claims.

[0023] The stirrup structure, extending according to its longitudinal axis, consists of a structure made of an iron bar for reinforced concrete or other materials or sections for bar and/or roll, hereinafter for sake of brevity called metallic bar, constituted by a sequence of tracts substantially perpendicular and substantially oblique with respect to said longitudinal axis and forming spiral

configurations with polygonal projection onto a plane substantially perpendicular to said longitudinal axis, with said oblique tracts tilted two by two in directions different between them to implement the spiral pitch and positioned at faced surfaces.

[0024] In particular, in a preferred embodiment solution wherein said stirrup structure has rectangular or squared projection onto a plane substantially perpendicular to said longitudinal axis A, said stirrup structure is constituted by a continuous sequence of tracts alternatively directed in the directions substantially perpendicular and substantially oblique with respect to said longitudinal axis A, originating the broken-spiral configuration. Usually, said stirrup structure ends at least at one end with a plane rectangular winding, the whole preferably to be implemented in the workshop.

[0025] The method consists in positioning also in the site on a resting base, or in the form, one or more stirrup structures aligned between them, positioning inside thereof the reinforcement longitudinal members, marking at least one of them so as to point out the beginning and ending points of each stirrup structure, then joining the beginning and ending windings of each stirrup structure to said reinforcement longitudinal members, in the marked points, by binding, welding or other equivalent method.

[0026] The method usually provides the compaction of the stirrup structure to the minimum volume, its stabilization with binding-anchoring means, the handling and positioning on the resting base or in the form of the stirrup structure(s) in a state compacted to the minimum volume, then their releasing from the anchoring means to allow them to stretch elastically and, also by virtue of the shape memory, to assume the state with which they will be joined to the reinforcement longitudinal members.

[0027] Other features will be evident, particularly to the skilled in the art, from reading the following description related to a preferred embodiment, which illustrates and does not limit the invention, referred to the drawings of the enclosed figures showing practical implementation examples, wherein:

- figure 1 is the front view of a reinforcement stirrup of known type;
- figure 2 is the axonometric view of the reinforcement constituted by longitudinal members and some reinforcement stirrups, joined by bindings at intersections, according to the known art;
- figure 3 is the axonometric view of the spiral stirrup with one single oblique side, according to the known art illustrated in the document EP 0152397 A2;
- figure 4 is the plan view of a spiral stirrup of figure 3 in a hypothetical state compacted in axial direction;
- figure 5 is the plan view of a stirrup structure according to the invention, constituted by a continuous alternated sequence of perpendicular tracts and ob-

- lique tracts;
- figure 6 is the side elevational view of the stirrup structure of figure 5;
- figure 7 is the comparative axonometric view of a stirrup structure of the type of figure 5 and figure 1, wherein the reinforcement longitudinal members and the single stirrups of known type are marked with a thin and continuous mark, the structure according to the invention is marked with thick and sketched lines;
- figure 8 is the plan view of a stirrup structure according to the invention in the compacted state, kept in such state by compacting means with handle;
- figure 9 is the elevational view of the structure of figure 8 wherein the lower and upper compacting means are evident;
- figure 10 is the view of a sequence of stirrup structures according to the invention, combined with reinforcement longitudinal members in the implementation of the reinforcement structure of a beam.

DESCRIPTION OF THE INVENTION

[0028] The drawings, reproduced in the figures 1, 2, 3 and 4 represent the state of art and, in particular, the first two reproduce a single stirrup and a plurality of single stirrups combined with reinforcement longitudinal members. The figures 3 and 4, instead, represent a tract of spiral stirrup of the type forming the subject of the document EP 0152397 A2 and the same stirrup in a hypothetical compacted state.

[0029] The subsequent drawings exemplify the present invention and have just an exemplifying character to make easier the comprehension, without being a limitation for it.

[0030] The invention, then, consists of a stirrup structure 1 with extension according its longitudinal axis A, implemented with a metallic bar and constituted by a sequence of tracts substantially perpendicular 3 and substantially oblique 2 with respect to said longitudinal axis A and forming winding configurations with polygonal projection onto a plane substantially perpendicular to said longitudinal axis A, with said oblique tracts 2 tilted two by two in directions different between them to implement the spiral pitch, as well as positioned at faced surfaces.

[0031] Said oblique tracts 2 have a tilting angle and a length so as to make the distance between the projections on the axis of the stirrup structure 1 the same at the beginning and at the end of each oblique tract 2, equal substantially to half the stirrup pitch, as exemplified in figure 6.

[0032] They will be positioned in the reinforcement structure 8 onto almost horizontal planes, whereas the tracts 3 of said stirrup structure 1 will be directed vertically in order to react effectively to the shear stresses arising in the concrete structure wherein the reinforcement structure 8 will be buried, independently from the

specific shape (squared, rectangular, with double T and others) of the projection of the stirrup structure 1 onto a plane substantially perpendicular to said longitudinal axis A.

[0033] The subject stirrup structure 1 usually ends, at least one of its ends, with a plane polygonal winding 4 almost orthogonal to the longitudinal axis A according thereto it develops.

[0034] Said plane windings 4 only aim at making easier the positioning and anchoring of the stirrup structure 1 on the reinforcement longitudinal members 6, as it will be explained later.

[0035] Thus, the structure portion comprised within said plane windings 4 is a continuous alternance of tracts 3, substantially perpendicular to the axis A according thereto the same structure develops, and oblique tracts 2, which allow the stirrup structure to develop lengthwise.

[0036] The tracts 3, directed in the direction almost perpendicular to the direction of the axis A of the structure 1 itself, are the ones which support the shear stresses, whereas the oblique tracts 2 have a tilting angle and a length so as to make the distance between the projections onto the axis of the stirrup structure 1 of the beginning and of the end of each oblique tract 2 equal to half the stirrup pitch.

[0037] The number of oblique tracts 2 is apt to provide a whole length so as to cover the tract of reinforcement structure 8 to be implemented, with a pre-established length. Within each stirrup structure 1, in the preferred embodiment solution, the pitch D is constant.

[0038] In another embodiment solution, in the same structure 1, the stirrup pitch D, instead, is not constant, with oblique tracts 2 with different lengths, so as to approach the arrangement of the substantially perpendicular tracts 3 to the longitudinal axis A, equal to the one provided in the theoretical calculation of the concrete structure reinforcement to be implemented.

[0039] In an embodiment solution the subject broken-spiral stirrup structure 1 comprises a plurality of plane polygonal windings 4 substantially orthogonal to said longitudinal axis A, alternated by portions of broken-spiral stirrup structures which usually will be the only parts fastened with ties to the reinforcement longitudinal members 6.

[0040] The subject stirrup structure 1 is usually implemented in the workshop and it is produced in order to be utilized in the site, wherein it will be combined with said reinforcement longitudinal members 6. Usually, said stirrup structure 1, from the production until the utilization, is kept in the compacted state, therefore it comprises anchoring means 7 apt to keep it in such state.

[0041] That is, it is compressed in the axial direction, like a spring, until making it to assume the shape of a "suitcase", as in the figures 8 and 9, with a width equal to the length of the oblique tracts 2, a height equal to the length of the tracts 3 and a thickness equal, or almost equal, to the one of the elongated member with which

the stirrup structure 1 is implemented multiplied by the number of windings which are compacted. The compaction allows that the storage and the transport take place without tangling with other structures and, at the same time, they require a considerably reduced space. Therefore, for example a stirrup structure 1 with an axial length of 5 metres, implemented with an iron bar with a diameter of 10 mm and wherein the stirrup pitch D is equal to 20 cm, in the compacted state occupies a length of about 30-35 cm, with a reduction of the occupied volume of about 15 times.

[0042] Therefore, it results easy on one hand its storage and on the other its transportation to the site. In this way, with one single trip with a small means of transport it is made possible transferring from the workshop to the site all irons necessary for implementing several reinforcement structures 8.

[0043] Such stirrup structure 1 requires a method for its implementation and a method for its assembling with the reinforcement longitudinal members 6.

[0044] The method for its implementation comprises the bending of a metallic bar so as to obtain a stirrup structure 1 with extension according to said longitudinal axis A which comprises a sequence of tracts substantially perpendicular 3 and tracts substantially oblique 2 with respect to said longitudinal axis A, forming winding configurations, with polygonal projection onto a plane substantially perpendicular to said longitudinal axis A. Said bending comprises plastic deformations of the tracts constituting said winding configurations so that said oblique tracts arrange tilted in directions different between them and on faced surfaces.

[0045] In this way the substantially perpendicular tracts 3 are allowed to position along the development of the stirrup structure 1 at a distance, one from the subsequent and adjacent one, equal to the stirrup pitch D, as pointed out in the figures 7 and 10.

[0046] The method then comprises the compaction of the stirrup structure 1 until the state wherein said winding configurations are mutually adjacent, that is in mutually in contact or however very near positions.

[0047] At last, it comprises performing the locking of said stirrup structure 1 in the compacted configuration, carried out with appropriate anchoring means 7, such as for example cords, clamps, containers and other equivalent means made of any material, such as metal, plastic, fibres or other.

[0048] The method for assembling the stirrup structure 1 to the reinforcement longitudinal members 6, with the purpose of implementing the reinforcement structure 8, usually provides the use of a plurality of stirrup structures 1, so that, independently from the length of the reinforced concrete structure to be implemented, each one results easy to handle, with a weight not higher than 20-30 kg.

[0049] Such structures 1 in the compacted state, thus shaped like suitcases, in the required number and with the required features, are arranged aligned between

them above an assembly plane or, in particular directly inside a form, since as pointed out in the figures 7, 8 and 9, the change in length of the stirrup structure 1 during the passage from the extended state to the compacted state is limited, not higher than the thickness of the concrete layer outer of the reinforcement longitudinal members 6 in the concrete structure to be implemented.

[0050] Then, it is provided the step of introducing reinforcement longitudinal members 6 and the step of loosening the compacted stirrup structure(s) 1 with consequent re-assumption of the extended shape by each of the them, due to elastic effect and shape memory.

[0051] The step of loosening the stirrup structure 1 from the anchoring means 7 can be performed outside or directly inside the receiving structure and in the particular in the form.

[0052] The subject invention, thus, provides that the reinforcement structures 8 be implemented in the site, the stirrup structures 1 be implemented in the workshop and be handled in the compacted state and, in the site, said stirrup structures 1 in the compacted state be positioned onto the assembly plane or in the form, that the anchoring means 7 be removed and each of said stirrup structures 1 be thus released in axial direction in order to assume the extended state, with the pitch equal to the one provided in the design. Once reached the extended state, said stirrup structures are stabilized in such state to the reinforcement longitudinal members 6. Then, it is usually provided the arrangement of a plurality of stirrup structures 1 aligned between them, the marking on at least one reinforcement longitudinal member 6 of the ending points of each stirrup structure 1, the positioning of the reinforcement longitudinal members 6 within the stirrup structures 1, as well as at least a step of binding to the said longitudinal members 6 at least the beginning and the end of each stirrup structure 1, wherein the bindings are performed at the marks shown on at least one of the reinforcement longitudinal members 6. Such reinforcement longitudinal members 6 and the stirrup structures 1 are joined by ties 5, implemented with a steel annealed wire, with clips, with clamps or even with welding spots at the windings 4 and in case in other intermediate spots of the stirrup structures 1 themselves. Dependently upon the reinforcement structure 8 to be implemented, thus depending upon the role played by the stirrup structure 1 within the whole reinforcement structure 8, the stirrup structures 1, if more than one, are consecutive between them and they are anchored to the reinforcement longitudinal members 6 immediately one after the other, or the ones consecutive between them are anchored to the reinforcement longitudinal members 6 at distances between them substantially equal to the stirrup pitch. Said stirrup structures 1, arranged consecutive between them, can have the same stirrup pitch D or even different stirrup pitches. In case in the production of reinforced concrete structures three or more stirrup structures 1 are used, the central one or ones are usually provided with a stirrup pitch

higher than the one of the side stirrup structures 1, thus implementing what provided in the common designs of reinforced concrete structures.

[0053] It will be noted that with the structure illustrated in the document EP 0152397 A2 the compaction of the stirrup structure cannot be obtained because the length of the oblique side of each winding is considerably higher than the one on the opposite side transversal to the longitudinal axis A according thereto the winding itself develops, therefore if the windings were brought to adhere one to the other with an axial stress to reduce the volume occupied by them and therefore to make easier the storage and the transportation, the spiral structure would expand sideways by assuming a configuration recalling a rhombus shape (as exemplified in the figure 4 of the enclosed drawings) and in such state it could not be stabilized by locking means neither introduced in a form destined to house it, unless after being brought again to the extended configuration. With such solution, then, it is not possible to compact the spiral with an axial sliding, then it is not possible to obtain the reduction in volume and therefore in the costs of storage and transportation from the workshop wherein it is produced to the site wherein it is utilized.

[0054] On the contrary, the subject invention is particularly advantageous since it is constituted by a metal bar, whereon the substantially perpendicular tracts 3 and the oblique tracts 2 are alternatively produced, upon the tilting and length thereof the distance between the adjacent perpendicular tracts 3, and thus the stirrup pitch D which can be finely adjusted, depends.

[0055] It results advantageous since, being rested on an assembly surface, it keeps itself positioned, without requiring stands or auxiliary structures, by making easier in this way its combination with reinforcement longitudinal members 6.

[0056] It results advantageous because, compacted in axial direction, it assumes a box-like configuration which is kept as such with appropriate ties or compacting means 7, resulting in such state to be easily transported and stored.

[0057] It results advantageous because the alternation in opposite directions of the oblique sides makes easier the axial lengthening thereof without side twists, if released from the anchoring means 7, by making easier the sliding inside forms.

[0058] As far as the method with which the stirrup structure 1 is combined with the reinforcement longitudinal members 6 is concerned, it results particularly advantageous because the stirrup structure 1, in order to be positioned, requests minimum means keeping it in the coupling state.

[0059] It results advantageous because it is required that the reinforcement longitudinal members 6 be marked only in the beginning and ending points of each stirrup structure 1 and because, usually, it is required that only one of such longitudinal members be marked.

[0060] It results advantageous because the stirrup

structure 1 is positioned on the assembly plane or in the form in the compacted state, then it is released from the anchoring means 7 to be brought to the state wherein it is joined to the reinforcement longitudinal members 6 thereto it is sufficient be fastened only towards its ends, since the broken spiral, once established its beginning and its end, cannot avoid arranging according to its pitch established during the bending step of its oblique sides, thus considerably reducing the number of bindings, apart from guaranteeing the mutual correct position of the substantially perpendicular tracts 3 of said stirrup structure 1 destined to react to the shear stresses which arise in the structure under construction.

[0061] During the implementation step the stirrup structure 1 could even undergo changes and regulations, without altering its constructive and functional logic, as defined by the following claims.

Claims

1. Broken-spiral stirrup for the reinforcement of concrete structures, comprising a stirrup structure (1) with extension according to its longitudinal axis (A), implemented with a metallic bar, constituted by a sequence of tracts substantially perpendicular (3) and substantially oblique (2) with respect to said longitudinal axis (A) and forming winding configurations with polygonal projection onto a plane substantially perpendicular to said longitudinal axis (A), **characterized in that** said oblique tracts (2) are tilted two by two in directions different between them to implement the spiral pitch and they are positioned at faced surfaces.
2. Stirrup according to claim 1, **characterized in that** said oblique tracts (2) have a tilting angle and a length so as to make the distance between the projections onto the axis of the stirrup structure (1) itself of the beginning and of the end of each oblique tract (2) equal substantially to half the stirrup pitch.
3. Stirrup according to one or more of the preceding claims, **characterized in that** the stirrup structure (1) shaped like a broken spiral comprises at least at one end a plane polygonal winding (4) substantially orthogonal to said longitudinal axis (A) according thereto the stirrup structure (1) itself develops.
4. Stirrup according to one or more of the preceding claims, **characterized in that** it comprises a number of oblique tracts (2) apt to provide a whole length so as to cover a tract of reinforcement structure (8) to be implemented with a pre-established length.
5. Stirrup according to one or more of the preceding claims, **characterized in that** it has a not constant

pitch and oblique tracts (2) with different lengths.

6. Stirrup according to one or more of the preceding claims, **characterized in that** it comprises a plurality of plane polygonal windings (4) substantially or-
thogonal to said longitudinal axis (A) and alternated
by portions of broken-spiral stirrup structure. 5
7. Stirrup according to one or more of the preceding claims, **characterized in that** it comprises anchoring
means (7) to keep said stirrup structure in a
compacted state. 10
8. Method for implementing a broken-spiral stirrup ac-
cording to the preceding claims, comprising the
bending of a metallic bar so as to obtain a stirrup
structure (1) with extension according to its longitu-
dinal axis (A) which comprises a sequence of tracts
substantially perpendicular (3) and tracts substan-
tially oblique (2) with respect to said longitudinal ax-
is (A) forming winding configurations with polygonal
projection onto a plane substantially perpendicular
to said longitudinal axis (A), **characterized in that**
said bending comprises plastic deformations of the
tracts constituting said winding configurations, so
that said oblique tracts arrange tilted in directions
different between them and on faced surfaces. 15
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9. Method according to claim 8, **characterized in that**
it comprises the compaction of said stirrup structure
(1) until the state wherein said winding configura-
tions are mutually adjacent. 30
10. Method according to claim 9, **characterized in that**
it comprises the locking of said stirrup structure (1)
in the compacted configuration performed with an-
choring means (7). 35
11. Method for assembling the reinforcement structure
(8), **characterized in that** it comprises steps of in-
troducing reinforcement longitudinal members (6)
in one or more stirrup structures (1) in the compact-
ed state and steps of loosening the compacted stir-
rup structure(s) (1) with consequent re-assumption
of the extended configuration by the same due to
elastic effect and shape memory. 40
45
12. Method according to claim 11, **characterized in**
that the step of loosening the stirrup structure (1)
from the anchoring means (7) is performed outside
or directly inside the receiving structure, in particu-
lar in the form. 50
13. Method according to claim 12, **characterized in**
that the reinforcement structures (8) are imple-
mented in the site, the stirrup structures (1) are im-
plemented in the workshop and they are handled in
the compacted state and wherein in the site said 55

stirrup structures (1) in the compacted state are po-
sitioned onto the assembly plane or in the form, the
anchoring means (7) is removed and each of said
stirrup structure (1) is released in axial direction in
order to assume the extended state, with the pitch
(D) equal to the one provided in the design, then
said stirrup structures (1) are stabilized in such state
to the reinforcement longitudinal members (6).

14. Method according to claim 13, **characterized in**
that it comprises the arrangement of a plurality of
stirrup structures (1) aligned between them, the
marking on at least one reinforcement longitudinal
member (6) of the ending points of each stirrup
structure (1), the positioning of the reinforcement
longitudinal members (6) inside the stirrup struc-
tures (1), as well as at least a step of binding to said
longitudinal members (6) the beginning and the end
of each stirrup structure (1), wherein the bindings
are performed at the marks shown on at least one
of the reinforcement longitudinal members (6).
15. Method according to claim 13 and 14, **character-**
ized in that the reinforcement longitudinal mem-
bers (6) and the stirrup structures (1) are joined by
ties (5) only at the ends of the stirrup structures (1)
themselves.
16. Method according to claim 13, 14 and 15, **charac-**
terized in that the stirrup structures (1) consecutive
between them are anchored to the reinforcement
longitudinal members (6) immediately one after the
other.
17. Method according to any of the claims 13, 14 and
15, **characterized in that** the stirrup structures (1)
consecutive between them are anchored to the re-
inforcement longitudinal members (6) at a distance
between them substantially equal to the stirrup pitch
(D).
18. Method according to any of the claims 13 to 17,
characterized in that the stirrup structures (1) con-
secutive between them have the same stirrup pitch
(D).
19. Method according to any of the claims 13 to 17,
characterized in that the reinforcement structure
(8) is implemented with stirrup structures (1) with
different stirrup pitches.
20. Method according to any of the claims 13 to 17,
characterized in that in the production of reinforce-
ment structures (8) three or more stirrup structures
(1) are used with the central one or ones provided
with the stirrup pitch higher than the side stirrup
structures (1).

21. Structural member manufactured with the stirrup structure (1) shown in the claims 1 to 7, obtained with a reinforcement structure (8) according to the claims 8 to 20.

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Fig. 1

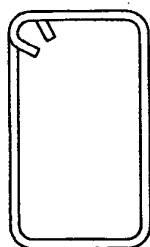


Fig. 2

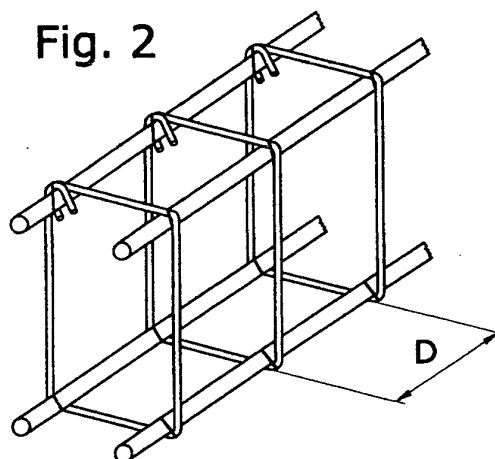


Fig. 3

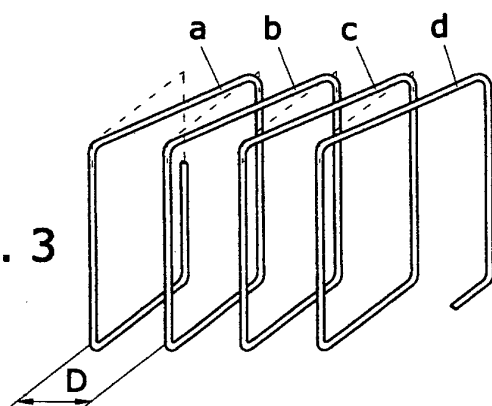
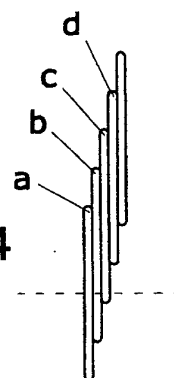


Fig. 4



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State of art

Fig. 5

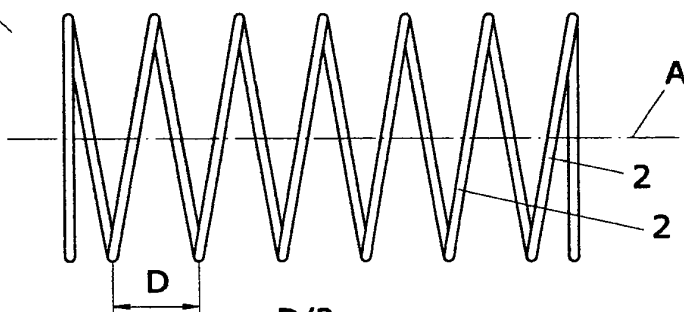
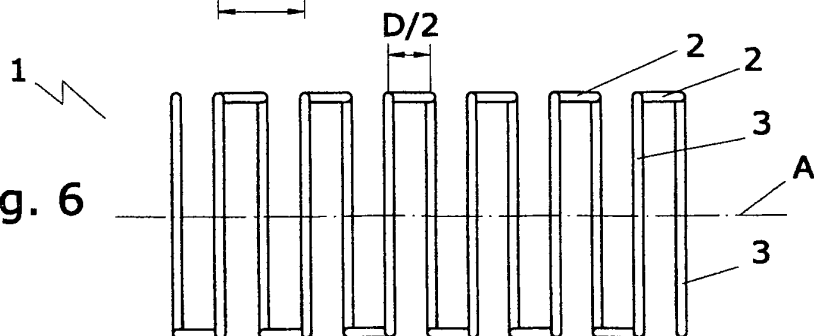


Fig. 6



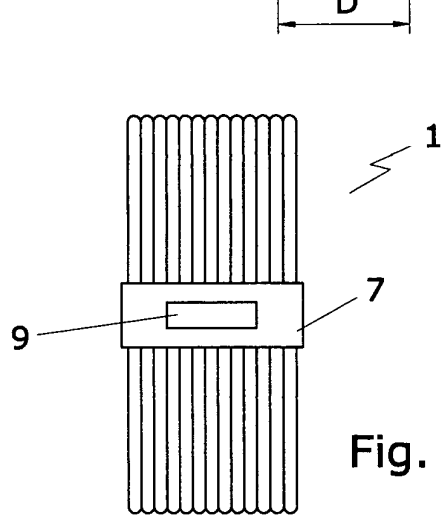
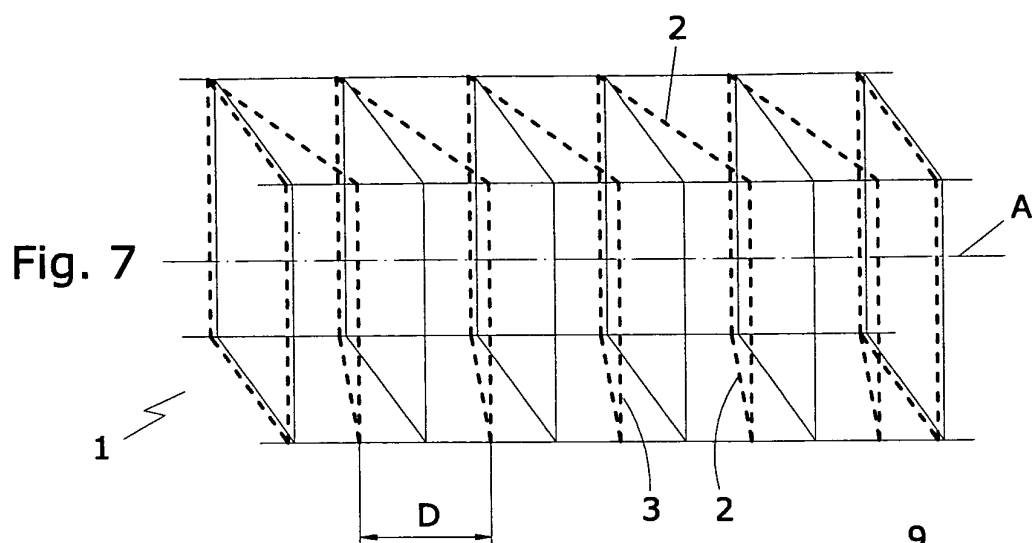


Fig. 8

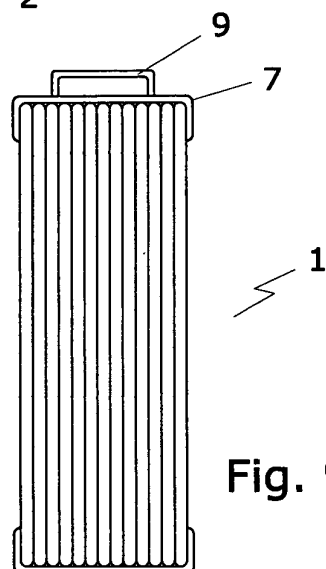
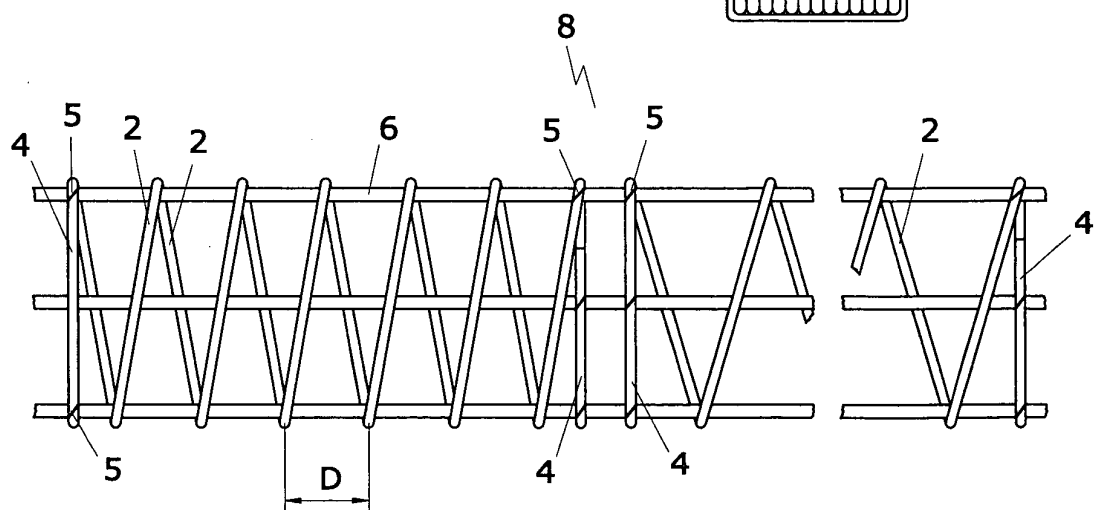


Fig. 9





European Patent
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EUROPEAN SEARCH REPORT

Application Number
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