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(54) **Method and Machine for Production of Three-Dimensional Stirrups**

Verfahren und Maschine zur Herstellung von dreidimensionalen Bügeln

Procédé et machine pour la production d'étriers tridimensionnels

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Description

Technical Field

[0001] The invention refers to a machine according to the preamble of claim 1 and method according to the preamble of claim 6 for production of three-dimensional stirrups 1 a from rods, wire, or other material of any cross-section. Such a machine and method are disclosed in document DE-A-34 166 784. Such three-dimensional stirrups may be employed for joining construction elements of reinforced concrete that are either fabricated onsite at construction sites, or are prefabricated.

Background Art

[0002] With reference to FIGS. 9-10, similar three-dimensional stirrups 1a are produced currently according to the following manners:

(a) Manually with the aid of hand-operated or semiautomatic tools. US 919206 A (NEWLIN) 4/20/1909 discloses a manually-operated rod bending tool applicable in bending rods used for reinforcing concrete. US 1425261 A (KARDONG) 8/8/1922 also discloses a manually-operated rod bending tool applicable in bending rods used for reinforcing concrete. A more recent publication, US 6997030 A (WILLIAMS) 2/14/2006 also discloses a manually-operated rod bending tool applicable in bending rods used for reinforcing concrete. US 3908425 A (WARE) 9/30/1975 discloses a manually-operated power tool suitable for bending rods used for reinforcing concrete.

(b) With the aid of automated stirrup machines having a first bending mechanism, bending on only one plane, where is first produced a planar stirrup 3a with converging side legs 4,5. This first bending mechanism thus makes at least four bendings. Afterwards the planar stirrup 3a is manually positioned on another, usually hand-operated or semiautomatic suitable mechanism, where for the generation of the third dimension, bends are made of the two angles out-of-the plane at locations 12,13 simultaneously.

(c) With the help of automatic stirrup machines, which include an arrangement of two bending mechanisms, wherein a first bending mechanism generates the planar stirrup 3a, with converging legs 4,5. This typically requires at least four bendings. Then the second bending mechanism, which includes an arrangement of two parallel arms, one fixed and a second which moves cyclically about the fixed one, bends two angles simultaneously at locations 12,13 so that the third dimension of the product is formed. Prior US 235538 A (KILMER)12/12/1880, discloses a bending mechanism for wires including an arrangement of two parallel arms, including one moving cyclically. Prior DE 4117965 A1 (HIENDL) 03/12/1992, discloses, at Figure 4, a pliers (35) mechanism for relocating a stirrup (1) by rotating and removing it out of a bending tool (27) into a second bender (31). Similarly, prior FR 2657547 A1 (DITRICHSTEIN) 02/08/1991 discloses a pusher (41) for relocating and positioning a stirrup in a second station and into a second bender (30, 32).

[0003] General relevance to the preceding categorizations (b), (c) may be found in several previous patent publications. For example, prior US 5511402 A (KAUFFMAN) 4/30/1996 , dated 1996-04-30, discloses a program-controlled automatic stirrup machine. EP 194478 A (MACCHINE ELETTRONICHE PIEGATRICCI) 9/17/1986 discloses an automated stirrup machine. US 4161110 A (RITTER ET AL.) 7/17/1979 discloses an automatic machine for producing concrete-reinforcing elements. Prior US 3563283 A (TUFEKTSHIEV) 2/16/1971 discloses an electrically programmed automatic apparatus for bending stirrups. US 2782832 A (SHAW) 2/26/1957 discloses a machine for angularly bending the leg portions of U-shaped workpieces. Prior US 1512002 A (KARDONG) 10/14/1924 discloses a machine for forming plural planar stirrups simultaneously.

TECHNICAL PROBLEM

[0004] These existing machines, methods, and techniques present numerous problems which it would be desirable to alleviate. Again having reference to FIGS. 9-10, first, it may be noted that such three-dimensional stirrups 1a are typically placed in metallic cases with shape U or double-U, which are then covered with a suitably shaped cover of metal, synthetic materials, cardboard, or other suitable material. In this regard, it is required that their legs 4,5 which are located on one plane converge at suitable angle, that their opposing sides 6,7 that are located on the other plane be mutually parallel. Thus, in order that the three-dimensional stirrups 1 a be produced with these characteristics, it is necessary that at least five bendings must occur. First, four bendings on one plane, whereupon stirrups taking a planar shape 3a are formed. Subsequently there are formed the two angles that establish the third dimension, which usually are bent simultaneously in the fifth bending with a suitable mechanism.

[0005] The first method (a) discussed above has a high cost of production since it requires the manual involvement of laborers, it is time-consuming, and productivity is low. Furthermore, the quality of the resulting three-dimensional stirrups 1 a is not always that required for their further use. Since the shape of the in-question product does not have absolute precision as to its geometric characteristics this creates difficulties in its placement in the metallic cases.

[0006] In the second method (b) discussed above, there again must occur at least five bendings of the material.

[0007] In the third method (c) discussed above, there again must also occur at least five bends of the material. Here the disadvantage is that the bends in the third dimension must fall precisely on the two opposing locations 12,13 of the planar shape 3a, something which is not feasible with precision, because of the torsions that the material has and the qualitative alterations that are present within the same spool from which it originates. The result is that the thus-produced product creates difficulty in its further application.

[0008] It may be noted from the aforegoing discussion that all of the methods according to the state of the art have a common characteristic that the converging legs 4,5 are produced first in the planar stirrup 3a by effecting at least four bending operations. The third dimension is generated subsequently.

Technical Solution

[0009] The invention is defined in independent claims 1 and 6.

[0010] The innovative machine and method that are here presented concern the automated production of three-dimensional stirrups 1 a, 1 b, 1 c, 1 d, 1 e from rods, wire, or other suitable materials of any cross-section, wherein first a planar stirrup 9 is produced with parallel legs 4,5 by making two bends. Then the free leg 5 is pulled, at a suitable location 11 towards the opposite leg 4 which is held unmoved. Finally, a third dimension is created by bending simultaneously at suitable locations 12,13 the stirrup out of the plane. In this fashion the creation of the planar stirrup 9, which leads to the final three-dimensional stirrup 1a, may require only two bending operations.

Advantageous Effects

[0011] In relation to the enumerated disadvantages of the methods that existed, which we already referred to, and in contrast thereto, we set forth following several of our specific advantages:

- The time for production of the stirrups is shortened by far.
- As a result of the high quality of the product and the great precision of the shape the further placement of stirrups in the special cases is easy and in parallel time is economized here also.
- As a result of the requirement of two less bendings for the generation we have a fair amount of economization of energy during the production of each three-dimensional stirrup 1a as something very significant if we contemplate that these products are produced at many thousands.
- The cost of production is reduced to a great degree.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] The details of the method according to the present invention will be understood from the following description and from the attached drawings, where:

[0013] FIG. 1 depicts a first form of three-dimensional stirrups that may be produced in accordance with the present invention.

[0014] FIG. 2 depicts a second form of three-dimensional stirrups that may be produced in accordance with the present invention.

[0015] FIG. 3 depicts a third form of three-dimensional stirrups that may be produced in accordance with the present invention.

[0016] FIG. 4 depicts a fourth form of three-dimensional stirrups that may be produced in accordance with the present invention.

[0017] FIG. 5 depicts a fifth form of three-dimensional stirrups that may be produced in accordance with the present invention.

[0018] FIG. 6 helps depict in idealization the method of production and its kinematic requirements, according to the present invention and shows a planar stirrup.

[0019] FIGS. 7-8 likewise help depict in idealization the method of production and its kinematic requirements, according to the present invention.

[0020] FIGS. 9-10 depict idealized the method of production of the three-dimensional stirrups according to the state of the art.

[0021] FIG. 11 depicts schematically one of the machines which effect the method of production of three-dimensional stirrups according to the present invention.

MODES FOR CARRYING OUT THE INVENTION

[0022] With reference to FIGS 1-8 and 11, the innovative method that is here presented concerns the automated production of three-dimensional stirrups 1a, 1 b, 1c, 1d, 1e from rods, wire or other suitable materials of any cross-section. There is produced first a planar stirrup 9 with parallel legs 4,5 by making two bends, or alternatively there may be received a prepared and precut planar stirrup 9. Afterwards the free leg 5 is pulled at a suitable location 11 towards the opposite leg 4, which is held unmoved. Finally, we bend simultaneously at suitable locations 12,13 the stirrup out of the plane, so as to create a third dimension. In this fashion we may need for the creation of the planar stirrup 9 leading to the final three-dimensional stirrup 1a, only two bending operations.

[0023] This method effects the production of three-dimensional stirrups 1a from rod, wire or other suitable material of any cross-section. Such three-dimensional stirrups 1a typically have the two legs 4,5 on which are found the two ends of the stirrup 1a, being on the same plane and converging at a particular angle, though some of the other sides, that are located on a different plane, may converge under a different angle or may be parallel. The present method is characterized in that there is pro-

duced first the planar stirrup 9 from suitable layout; afterwards, with a suitable mechanism the leg 5 having a free end is trapped at a suitable location 11 and is pulled towards the opposite leg 4, so that the two legs' 4,5 two sides converge under a suitable angle. Finally, with another suitable mechanism 22 there are created simultaneously at least two sides 6,7 under a suitable angle, outside of the plane, so that there is formed the third dimension. A cutting may follow. The result is that the two free legs 4,5 converge under the desired angle even though the opposite sides 6,7 in the other plane maintain their geometry as it was prior to the creation of the third dimension. In another embodiment of the method as described above within the present paragraph, there may be produced simultaneously more than one three-dimensional stirrup 1a, applying the method to corresponding more than one locations.

[0024] In one embodiment, the method according to the immediately aforegoing paragraph may be yet further characterized in that the two-dimensional stirrups 9 may be prepared and shaped in the suitable dimensions and then be supplied to suitable mechanisms 25, 22 so as to undergo the further processing for the shaping of the end product.

[0025] As a further embodiment, the method according to the immediately preceding two paragraphs may be further characterized in that there can be received from the suitable layout more than one (i.e. plural) two-dimensional stirrups 9 simultaneously in more than one corresponding locations of receipt by suitable mechanisms so that they undergo further processing for the shaping of the final product.

[0026] It must be explained also, with particular reference to FIGS. 2-5, that with this method it is possible to produce three-dimensional stirrups, which in the third dimension can have any form, such as for example non-perpendicular angles, uneven leg sides with oblique slanted axial bend 1 b, with curved configuration 1 c, with triangular configuration 1 d, with polygonal configuration 1e and others.

[0027] In one aspect, and with reference to FIG. 11 of the appended drawings, our method may be implemented by an innovative mechanism 25 which is disposed in stirrup machines with the following characteristics: they have an arrangement of an advancement mechanism 21 for the rod, wire or other suitable material, that may come from a spool or from straightened pieces; they have a bending head 19 that bends the material in one place, creating planar stirrups; they have a cutter 20 for cutting the material after the creation of the three-dimensional stirrup 1a from a second bending mechanism 22, which comprises a stationary arm 23 and a second arm 24 that can move cyclically around the stationary arm 23 thus bending the two legs 4,5 of the planar stirrup simultaneously. In such an arrangement, the mechanism 25 which comprises our invention is placed between the first bending mechanism 19 and the second bending mechanism 22 and comprises one arm 16 that can move in an alternating, reciprocating manner with the aid of a suitable mechanism 18 and at a suitable angle as to the legs 4,5 of the planar stirrup 9 trapping with the aid of a suitable hook 17 the free leg 5 which it pulls towards leg 4, traversing a suitable distance, holds it until the second bending head 22 bends the two legs 4,5 at suitable locations 12,13 creating the third dimension. Afterwards the cutting of the material of leg 4 at a suitable location is made by cutter 20.

[0028] The machine of the present invention is further described with reference to FIG. 11 and FIGS. 1-8 of the appended drawings.

[0029] A mechanism 25 for the production of three-dimensional stirrups 1a, 1b, 1c, 1d, 1e, with converging free legs 4,5, from rod, wire, or other suitable material of any cross-section, which mechanism 25 is placed in stirrup machines. Such stirrup machines may include an arrangement of an advancement mechanism 21 for the rod, wire or other suitable material that may be supplied from a spool or from straightened pieces. In this case they may include a first bending mechanism 19 that bends the material in one plane to generate planar stirrups 9. Also in this case they may also include a cutter 20 for the cutting of the material after the generation of the three-dimensional stirrup 1a, 1b,1c, 1d, 1e by a second bending mechanism 22.

[0030] This second bending mechanism 22 comprises a fixed arm 23 and a second arm 24 that can move cyclically around the fixed arm 23 bending thus the two legs 4,5 of the planar stirrup simultaneously.

[0031] Alternatively, such stirrup machines may receive prepared and precut planar stirrups 9 trapping one free leg 4 with the aid of a grip. In this case, the arrangement includes a grip that can receive the planar stirrup restraining it via leg 4. Thus mechanism 25 may be used also in stirrup machines that work prepared, precut planar stirrups 9 and have an arrangement including only the second bending head 22 that can create the third dimension. It will be readily understood from the aforegoing description that in this second case the first bending mechanism 19 is not necessary.

[0032] Assuming the first case, above, for illustration, the mechanism 25 is placed between the first bender 19 and the second bender 22, under the plane of the under-production product. It comprises an arm 16 that can move with the aid of suitable mechanism 18 in an alternating, reciprocating manner and at a suitable angle relative to legs 4,5 of the planar stirrup 9, trapping with the aid of a suitable hook 17 the free leg 5, 11, which it pulls towards the leg 4. The arm 16 traverses a suitable distance, holding it until the second bending head 22 bends the two legs 4,5 at the suitable locations 12,13 creating the third dimension.

[0033] As a further alternative, the mechanism 25 may be characterized in that it is placed above the plane of the subjected-to-generation product. Thus it will be understood that the mechanism 25 may be located either under the plane of the under-production part or above it.

[0034] As a further alternative the mechanism 25, according to the aforegoing description may be characterized in that the free leg 5 of the planar stirrup 9 can be trapped with the aid of grip. Thus it will be understood that the free leg 5 may be trapped also with the aid of a suitable grip in place of the hook 17.

[0035] Finally, in a further embodiment, a mechanism 25 according to the aforegoing description, may be further characterized in that the maintenance, coordination, and control of all the functions of the process of production of the three-dimensional stirrup 1a is made by a suitable electronic computer, in which are entered the necessary product characteristics for the production of the three-dimensional product 1 a. Thus, the coordination and control of all the functions of the process of production of the three-dimensional stirrup 1a may be preferably effected by a suitable electronic computer, in which we enter all necessary product characteristics for the production of the product.

[0036] In the implementation of the invention the materials that are used as well as the dimensions of the individual elements can be in accordance with the requirements of the particular construction.

[0037] The present invention is not limited in any manner to the described and in-the-drawing-portrayed implementation, but may be implemented in many forms and dimensions without abandoning the region of protection defined by the claims.

Claims

1. A machine for production of three-dimensional stirrups (1a, 1b, 1c,1d, 1e) comprising a first bending mechanism (19) configured to bend material in one plane to create a planar stirrup (9), and a second bending mechanism (22) having an arrangement of two parallel arms (23,24), said machine **characterized by** said second bending mechanism (22) being configured to receive the planar stirrup (9) held by said first bending mechanism (19);
   a third mechanism (25) disposed to pull a free leg (5) of the stirrup towards the opposite stirrup leg (4) held by said first bending mechanism (19), said third mechanism (25) including an arm (16) configured to reciprocate with the aid of a suitable aiding mechanism (18) and at a suitable angle relative to legs (4, 5) of the stirrup (9).

2. A machine for production of three-dimensional stirrups (1a, 1b, 1c, 1d, 1e) as claimed in Claim 1, further **characterized in that**: said arm (16) is disposed under the plane of the under-production stirrup (9).

3. A machine for production of three-dimensional stirrups (1a, 1b, 1c, 1d, 1e) as claimed in Claim 1, further **characterized in that**: said arm (16) is disposed above the plane of the under-production stirrup (9).

4. A machine for production of three-dimensional stirrups (1a,1b, 1c, 1d, 1e) as claimed in any of Claims 1, 2, or 3 above, further **characterized by**:

   a hook (17) or a grip, disposed on said arm (16) for trapping free stirrup leg (5) so that said arm (16) may pull the free stirrup leg (5) toward the opposite stirrup leg (4).

5. A machine for production of three-dimensional stirrups (1a, 1b, 1c, 1d, 1e) as claimed in any of Claims 1, 2, 3, or 4 above, further **characterized by**:

   a suitable electronic computer configured to control all of the functions of production of the three-dimensional stirrups (1a, 1b, 1c, 1d, 1e).

6. A process for production of three-dimensional stirrups (1a, 1b, 1c, 1d, 1e) comprising either the step of forming a planar stirrup (9) with a first bender (19), or the step of restraining a prepared precut planar stirrup (9) via a first leg (4) by receiving it in a grip; and, further comprising the step of providing a second bending mechanism (22) to bend the two legs (4,5) of the planar stirrup (9) simultaneously; **characterized by** the steps of:

   reciprocating an arm (16) of a mechanism (25) with a suitable aiding mechanism (18) and at a suitable angle relative to the legs (4,5) of the stirrup (9), and
   pulling a free leg (5) of the stirrup (9) towards the first leg (4) with said mechanism (25) while the first leg (4) is restrained by the first bender (19) or by the grip.

7. A process for production of three-dimensional stirrups (1 a, 1b, 1c, 1 d, 1 e) as claimed in Claim 6, further **characterized by** the step of:

   either disposing said arm (16) under the plane of an under-production stirrup (9), or disposing said arm (16) above the plane of an under-production stirrup (9).

8. A process for production of three-dimensional stirrups (1a, 1b, 1c, 1d, 1e) as claimed in any of Claims 6 or 7, further **characterized by** the step of:

   trapping the free stirrup leg (5) with a hook (17) or with a grip disposed on said arm (16).

9. A process for production of three-dimensional stirrups (1a, 1b,1c, 1d, 1e) as claimed in any of Claims 6, 7, or 8, further **characterized by** the step of:

   receiving plural two-dimensional stirrups (9) simultaneously in respective plural locations of re-

ceipt by respective suitable mechanisms (25) so that said plural two-dimensional stirrups (9) undergo further processing for the shaping of the final products.

10. A process for production of three-dimensional stirrups (1a, 1b, 1c, 1d, 1e) as claimed in Claim 6, further **characterized by** the step of:

producing simultaneously a plurality of three-dimensional stirrups (1a, 1 b, 1c, 1d, 1e) by applying the process of production to a corresponding plurality of locations.

Patentansprüche

1. Maschine zur Herstellung von dreidimensionalen Bügeln (1a, 1b, 1e, 1d, 1e), umfassend einen ersten Biegemechanismus (19), der zum Biegen von Material in einer Ebene zum Schaffen eines planen Bügels (9) gestaltet ist, und einen zweiten Biegemechanismus (22), der eine Anordnung von zwei parallelen Armen (23, 24) aufweist, die Maschine **gekennzeichnet durch**
der zweite Biegemechanismus (22) zum Aufnehmen des planen Bügels (9) gestaltet ist, welcher von dem ersten Biegemechanismus (19) gehalten ist,
einen dritten Mechanismus (25), der zum Ziehen eines freien Schenkels (5) des Bügels zu dem gegenüberliegenden Bügelschenkel (4) hin angeordnet ist, welcher von dem ersten Biegemechanismus (19) gehalten ist, wobei der dritte Mechanismus (25) einen Arm (16) beinhaltet, der zum Hin- und Herbewegen mithilfe eines geeigneten Hilfsmechanismus (18) und in einem geeigneten Winkel zu den Schenkeln (4, 5) des Bügels (9) gestaltet ist.

2. Maschine zur Herstellung von dreidimensionalen Bügeln (1a, 1b, 1c, 1d, 1e) nach Anspruch 1, ferner **dadurch gekennzeichnet, dass** der Arm (16) unter der Ebene des Bügels (9) unter Herstellung angeordnet ist.

3. Maschine zur Herstellung von dreidimensionalen Bügeln (1a, 1b, 1c, 1d, 1e) nach Anspruch 1, ferner **dadurch gekennzeichnet, dass** der Arm (16) über der Ebene des Bügels (9) unter Herstellung angeordnet ist.

4. Maschine zur Herstellung von dreidimensionalen Bügeln (1a, 1b, 1e, 1d, 1e) nach einem der Ansprüche 1, 2 oder 3, ferner **gekennzeichnet durch**
einen Haken (17) oder Greifer, der zum Erfassen des freien Bügelschenkeln (5) an dem Arm (16) angeordnet, ist, sodass der Arm (16) den freien Bügelschenkel (5) zum gegenüberliegenden Bügelschenkel (4) hin ziehen kann.

5. Maschine zur Herstellung von dreidimensionalen Bügeln (1a, 1b, 1c, 1d, 1e) nach einem der Ansprüche 1, 2, 3 oder 4, ferner **gekennzeichnet durch**
einen geeigneten elektronischen Rechner, der zum Steuern aller der Funktionen zur Herstellung der dreidimensionalen Bügel (1a, 1b, 1c, 1d, 1e) konfiguriert ist.

6. Verfahren zum Herstellen von dreidimensionalen Bügeln (1a, 1b, 1c, 1d, 1e), umfassend entweder den Schritt des Ausbildens eines planen Bügels (9) mit einer ersten Biegevorrichtung (19) oder den Schritt des Einspannens eines vorbereiteten vorgeschnittenen planen Bügels (9) über einen ersten Schenkel (4) durch Aufnehmen in einem Greifer, und ferner umfassend den Schritt des Vorsehens eines zweiten Biegemechanismus (22) zum gleichzeitigen Biegen der zwei Schenkel (4, 5) des planen Bügels (9), **gekennzeichnet durch** folgende Schritte:

Hin- und Herbewegen eines Arms (16) eines Mechanismus (25) mit einem geeigneten Hilfsmechanismus (18) und in einem geeigneten Winkel zu den Schenkeln (4, 5) des Bügels (9), und
Ziehen eines freien Schenkels (5) des Bügels (9) mit dem Mechanismus (25) zu dem ersten Schenkel (4) hin, während der erste Schenkel (4) **durch** die erste Biegevorrichtung (19) oder **durch** den Greifer eingespannt ist.

7. Verfahren zum Herstellen von dreidimensionalen Bügeln (1a, 1b, 1c, 1d, 1e) nach Anspruch 6, ferner **gekennzeichnet durch** den Schritt des
Anordnens des Arms (16) entweder unter der Ebene eines Bügels (9) unter Herstellung oder Anordnens des Arms (16) über der Ebene eines Bügels (9) unter Herstellung.

8. Verfahren zum Herstellen von dreidimensionalen Bügeln (1a, 1b, 1c, 1d, 1e) nach einem der Ansprüche 6 oder 7, ferner **gekennzeichnet durch** den Schritt des
Erfassens des freien Bügelschenkels (5) mit einem Haken (17) oder einem Greifer, der an dem Arm (16) angeordnet ist.

9. Verfahren zum Herstellen von dreidimensionalen Bügeln (1a, 1b, 1c, 1d, 1e) nach einem der Ansprüche 6, 7 oder 8, ferner **gekennzeichnet durch** den Schritt des
gleichzeitigen Aufnehmens von mehreren zweidimensionalen Bügeln (9) in jeweiligen mehreren Aufnahmestellen **durch** jeweilig geeignete Mechanismen (25), sodass die mehreren zweidimensionalen Bügel (9) weiterer Verarbeitung zur Formgebung der Endprodukte unterzogen werden.

10. Verfahren zum Herstellen von dreidimensionalen Bügeln (1a, 1b, 1c, 1d, 1e) nach Anspruch 6, ferner **gekennzeichnet durch** den Schritt des gleichzeitigen Herstellen von mehreren dreidimensionalen Bügeln (1a, 1b, 1c, 1d, 1e) **durch** Anwenden des Herstellungsverfahrens auf entsprechende mehrere Stellen.

Revendications

1. Machine pour la production d'étriers tridimensionnels (1a, 1b, 1c, 1d, 1e), comprenant un premier mécanisme de flexion (19) configuré pour fléchir un matériau dans un plan, pour créer un étrier planaire (9), et un deuxième mécanisme de flexion (22) possédant un arrangement de deux bras parallèles (23, 24), ladite machine étant **caractérisée en ce que** :

ledit deuxième mécanisme de flexion (22) configuré pour recevoir l'étrier planaire (9) maintenu par ledit premier mécanisme de flexion (19),
un troisième mécanisme (25) disposé de manière à tirer une branche libre (5) de l'étrier vers la branche d'étrier opposée (4), maintenue par ledit premier mécanisme de flexion (19), ledit troisième mécanisme (25) comprenant un bras (16) configuré pour se balancer à l'aide d'un mécanisme auxiliaire approprié (10) et en un angle approprié par rapport aux branches (4, 5) de l'étrier (9).

2. Machine pour la production d'étriers tridimensionnels (1a, 1b, 1c, 1d, 1e) selon la revendication 1, en outre **caractérisée en ce : que** ledit bras (16) est disposé sous le plan de l'étrier (9) en cours de fabrication.

3. Machine pour la production d'étriers tridimensionnels (1a, 1b, 1e, 1d, 1e) selon la revendication 1, en outre **caractérisée en ce : que** ledit bras (16) est disposé au-dessus du plan de l'étrier (9) en cours de fabrication.

4. Machine pour la production d'étriers tridimensionnels (1a, 1b, 1c, 1d, 1e) selon l'une quelconque des revendications 1, 2 ou 3 ci-dessus, en outre **caractérisée par** :

un crochet (17) ou un grappin, disposé sur ledit bras (16) pour attraper la branche d'étrier libre (5), de manière à ce que le bras (16) puisse tirer la branche d'étrier libre (5) vers la branche d'étrier opposée (4).

5. Machine pour la production d'étriers tridimensionnels (1a, 1b, 1a, 1d, 1e) selon l'une quelconque des revendications 1, 2, 3 ou 4 ci-dessus, en outre **caractérisée par** :

un ordinateur électronique approprié, configuré pour contrôler toutes les fonctions de production des étriers tridimensionnels (1a, 1b, 1e, 1d, 1e).

6. Procédé pour la production d'étriers tridimensionnels (1a, 1b, 1e, 1d, 1e), comprenant soit l'étape de formation d'un étrier planaire (9) avec un premier mécanisme de flexion (19), ou l'étape de blocage d'un étrier planaire (9) prédécoupé et préparé, par le biais d'une première branche (4), en longeant celle-ci dans un grappin ; et comprenant en outre l'étape de mise à disposition d'un deuxième mécanisme de flexion (22) pour fléchir les deux branches (4, 5) de l'étrier planaire (9) simultanément ; **caractérisé par** les étapes suivantes :

balancement d'un bras (16) ou d'un mécanisme (25) à l'aide d'un mécanisme auxiliaire (18) approprié, en un angle approprié par rapport aux branches (4, 5) de l'étrier (9), et
traction d'une branche libre (5) de l'étrier (9) vers la première branche (4) avec ledit mécanisme (25), tandis que la première branche (4) est retenue par le premier mécanisme de flexion (19) ou par le grappin.

7. Procédé pour la production d'étriers tridimensionnels (1a, 1b, 1e, 1d, 1e) selon la revendication 6, en outre **caractérisé par** les étapes suivantes :

disposition dudit bras (16) sous le plan d'un étrier (9) en cours de fabrication, ou disposition dudit bras (16) au-dessus du plan d'un étrier (9) en cours de fabrication.

8. Procédé pour la production d'étriers tridimensionnels (1a, 1b, 1c, 1d, 1e) selon l'une quelconque des revendications 6 ou 7, en outre **caractérisé par** l'étape suivante :

blocage de la branche d'étrier libre (5) avec un crochet (17) ou un grappin disposé sur ledit bras (16).

9. Procédé pour la production d'étriers tridimensionnels (1a, 1b, 1c, 1d, 1e) selon l'une quelconque des revendications 6, 7 ou 8, en outre **caractérisé par** l'étape suivante :

réception simultanée de plusieurs étriers bidimensionnels (9), dans plusieurs emplacements de réception respectifs, par des mécanismes (25) appropriés respectifs, de sorte que lesdits plusieurs étriers bidimensionnels (9) sont soumis à un traitement supplémentaire pour la formation des produits finaux.

10. Procédé pour la production d'étriers tridimensionnels (1a, 1b, 1c, 1d, 1e) selon la revendication 6, en outre **caractérisé par** l'étape suivante :

production simultanée d'une pluralité d'étriers tridimensionnels (1a, 1b, 1c, 1d, 1e), par application du procédé de fabrication à une pluralité d'emplacements correspondantes.

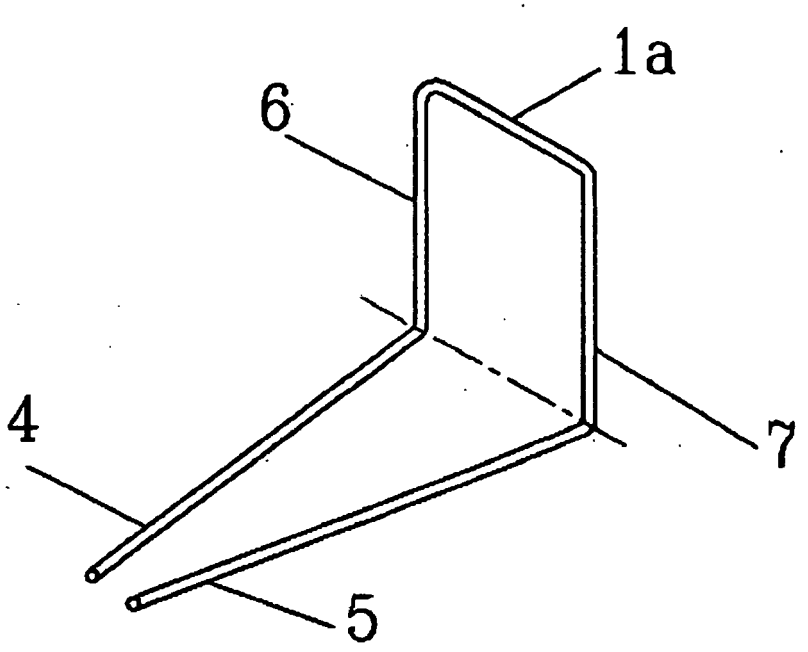

Fig. 1

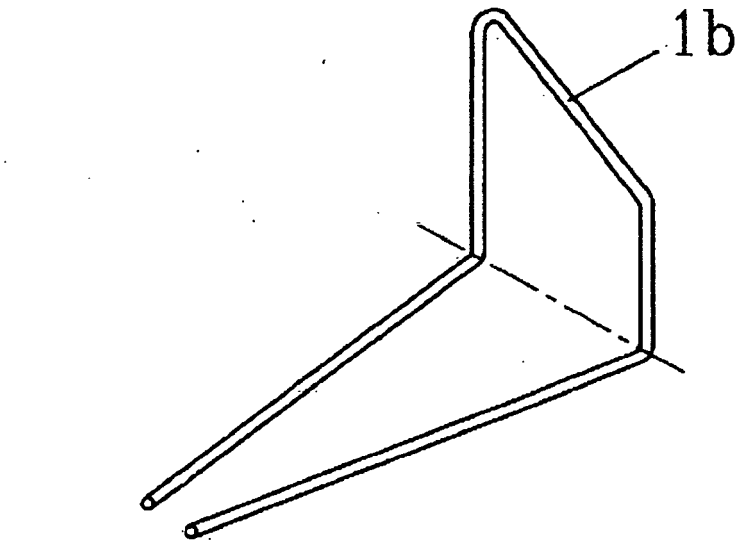

Fig. 2

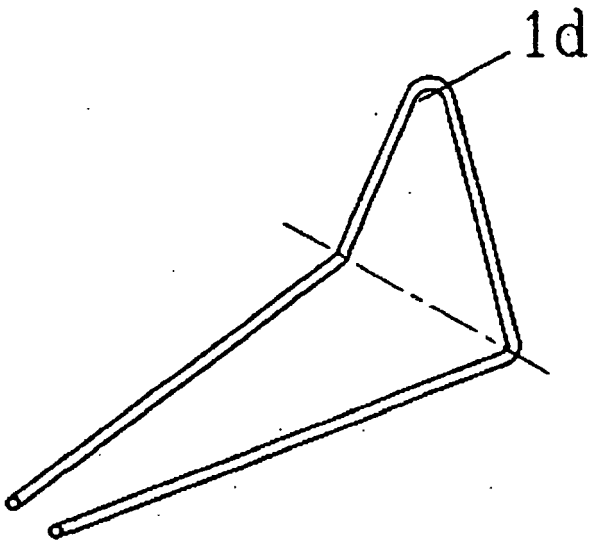

Fig. 3

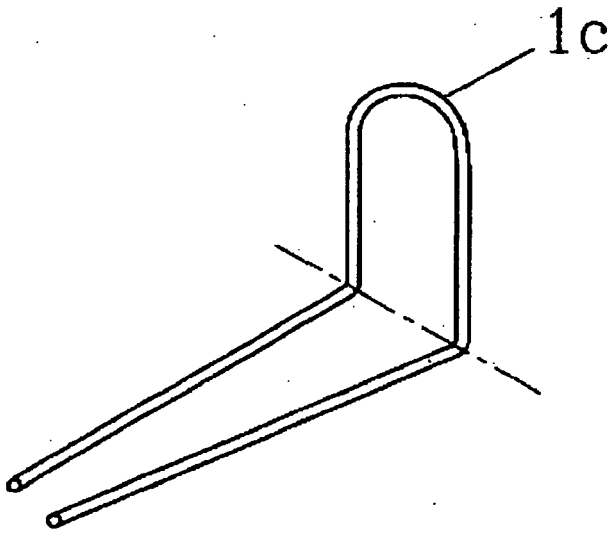

Fig. 4

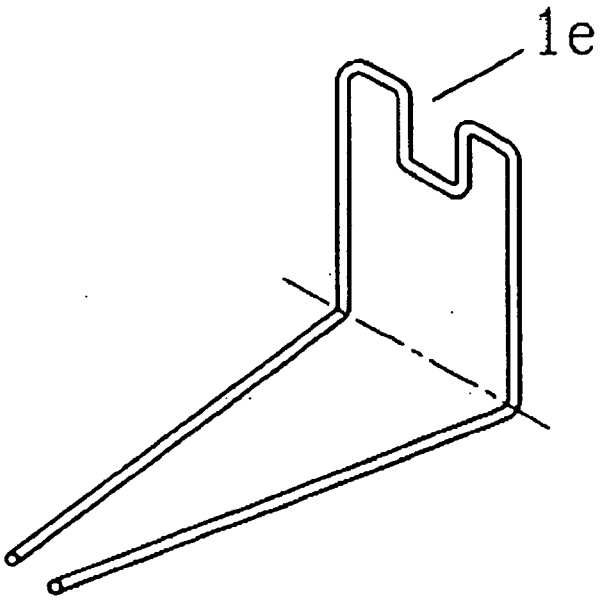

Fig. 5

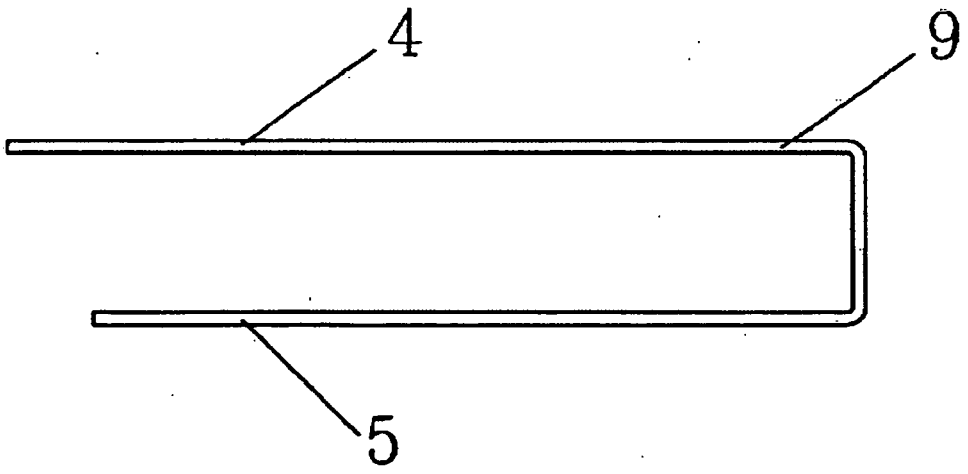

Fig. 6

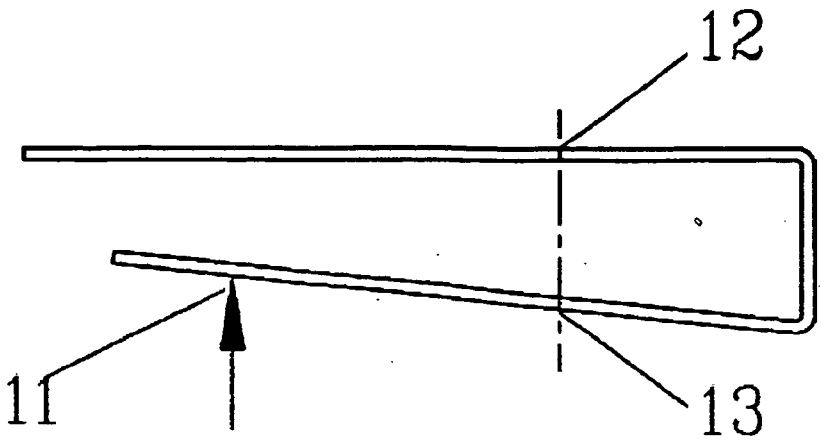

Fig. 7

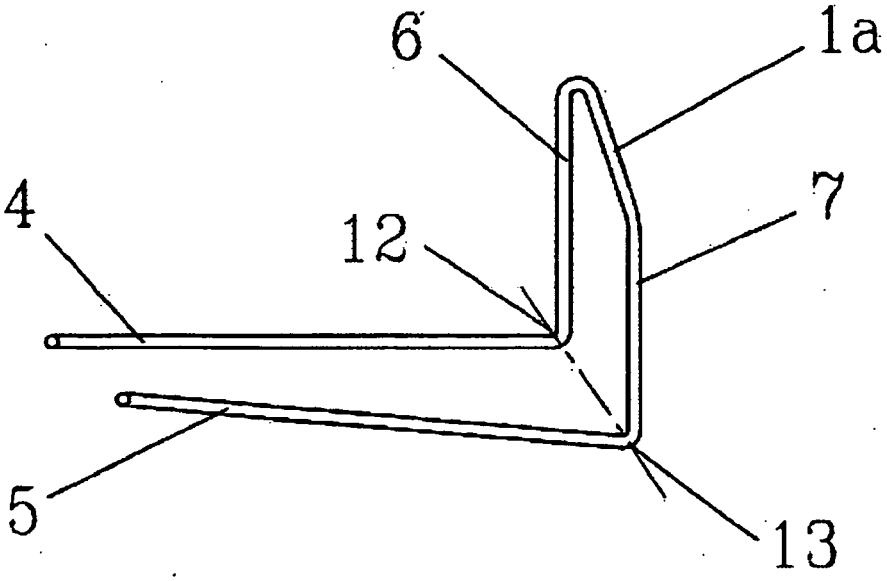

Fig. 8

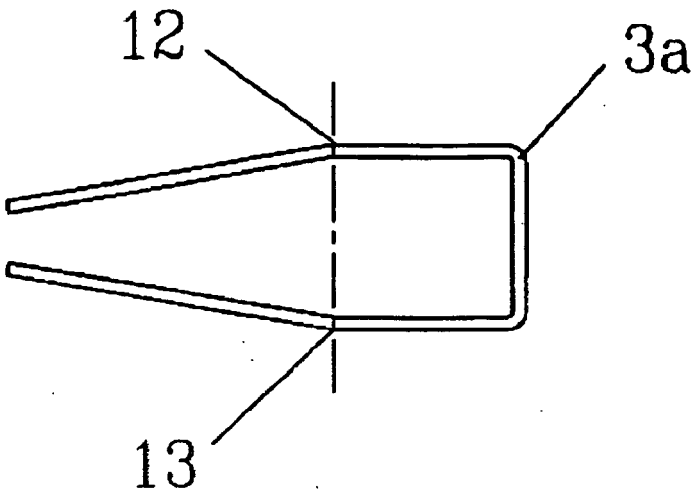

Fig. 9

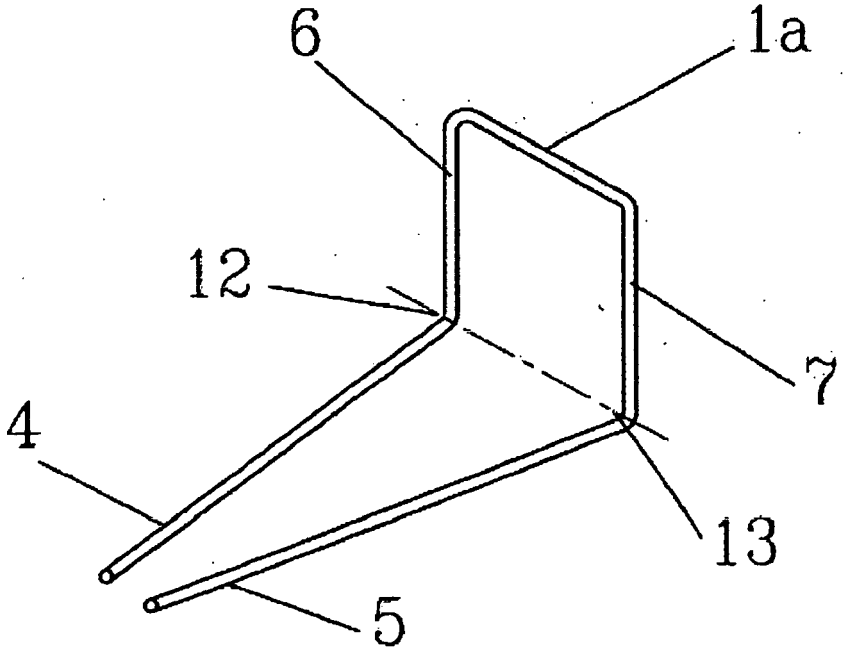

Fig. 10

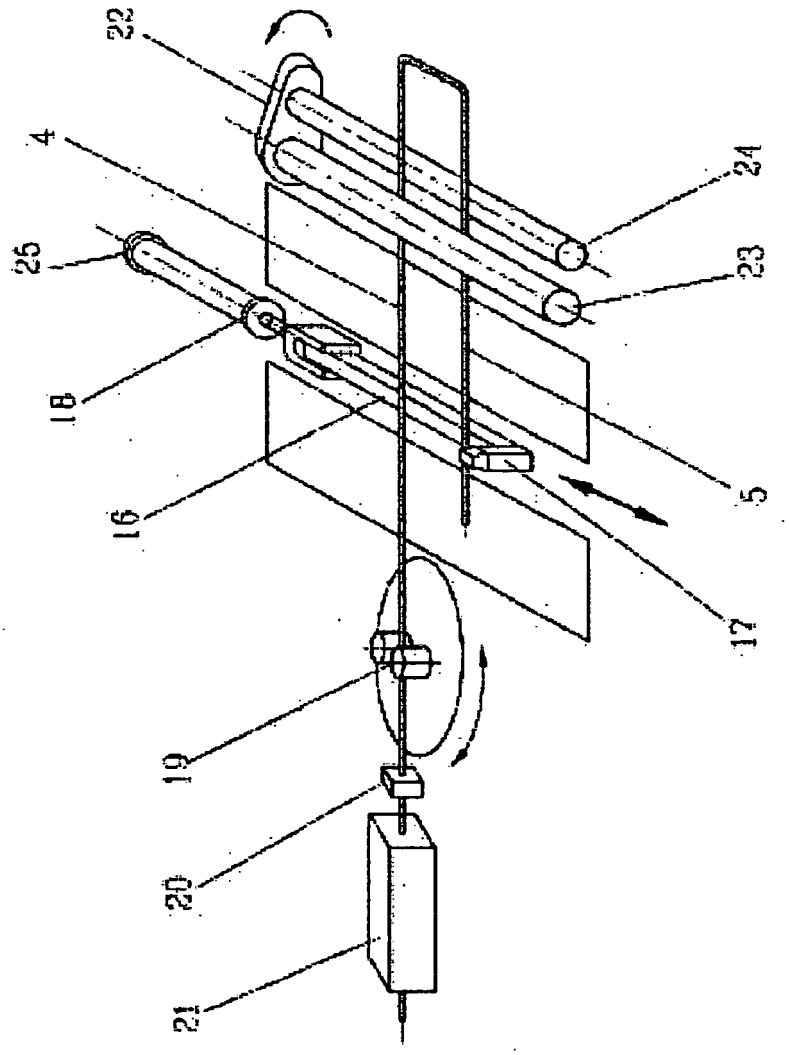

Fig. 11

REFERENCES CITED IN THE DESCRIPTION

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