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(54) A method for manufacturing a spatial trusslike module and a spatial trusslike module

(57) A method for manufacturing a space truss-like module, wherein reinforcing elements are connected to longitudinal closing rods. The reinforcing elements (100) have a plurality of bends (101, 102), which constitute sections (103) forming a pattern recurring along the reinforcing element, the pattern comprising at least two bends (101, 102), and wherein the reinforcing elements are manufactured by shaping successive sections (103) with the recurring pattern in a bending station (402) by movable bending elements (141-146) in a single bending operation, during which all the bends of the section (103) are shaped simultaneously, such that the already-shaped section (103) of the element moves within a bed (148) of a constant width, not larger than twice the length (L) of the rod (130) necessary to shape the single section (103) of the reinforcing element (100).

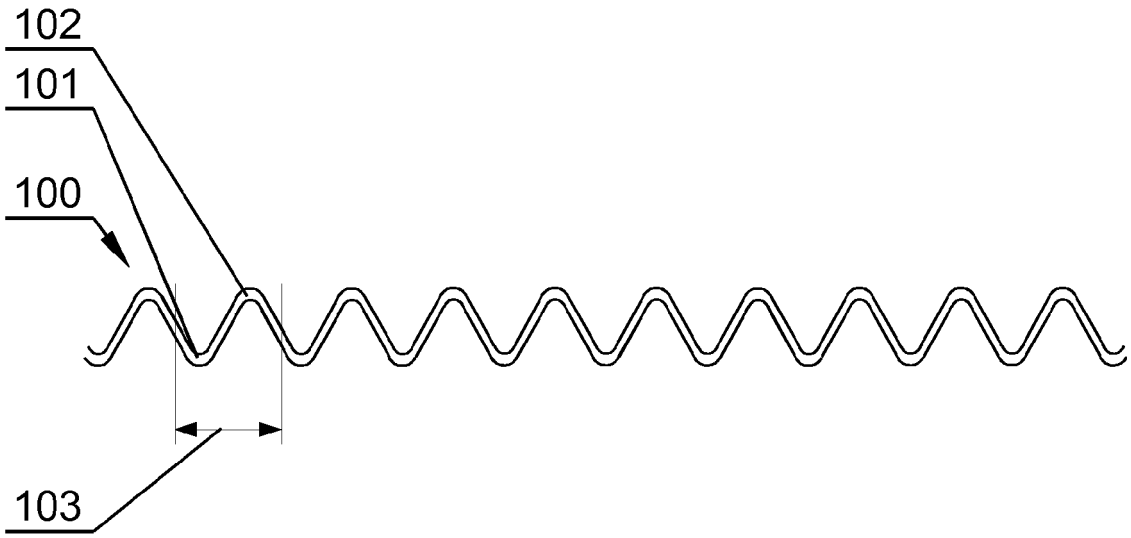

Fig. 1

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Description

DESCRIPTION

[0001] The present invention relates to space truss-like modules.

[0002] Standard structural trusses are constructions comprising straight rods connected together at truss nodes. The known space trusses usually have a triangular or square cross section and comprise longitudinal closing rods extending through the corners of the figure which constitutes the cross section. Between the closing rods there are mounted reinforcing bracing elements.

[0003] A US patent US5711131 presents a metal truss having a square cross-section, which is made of four longitudinal closing rods running through the corners of a square and straight reinforcing bracing rods inclined with respect to each other and extending in a zig-zag manner between the longitudinal closing rods, and welded thereto.

[0004] A US patent US5390463 presents a modular truss-like structure, comprising longitudinal closing rods in the form of hollow tubes and V-shaped reinforcing elements positioned between them.

[0005] In the known truss structures, the reinforcing (bracing) elements have a form of straight rods, V-shaped elements or zig-zag elements with a small number of bends. In the known processes for bending the reinforcing rods for trusses, the end of a straight rod is subject to subsequent operations of bending in opposite directions, thereby forming a zig-zag shape. In such process, the end of the bent rod moves along a curve of an increasing radius, which requires a lot of space and generates tension in the shaped end of the rod, which leads to unacceptable deformations. Consequently, the known reinforcing rods having a zig-zag form have only a few bends.

[0006] In order to manufacture a truss module which is longer than a few dozen of one of its cross-section dimensions, at least a few dozen of straight reinforcing elements should be used, or at least a few or a dozen of zig-zag elements.

[0007] Mounting of a straight reinforcing rod or the end of the zig-zag element to the closing rods requires to use hard soldered or welded joints, which hamper the strength of the construction. Moreover, making of each joint is time- and cost- consuming.

[0008] The object of the invention is a method for manufacturing a space truss-like module, wherein reinforcing elements are connected to longitudinal closing rods. The reinforcing elements have a plurality of bends, which constitute sections forming a pattern recurring along the reinforcing element, the pattern comprising at least two bends, and wherein the reinforcing elements are manufactured by shaping successive sections with the recurring pattern in a bending station by movable bending elements in a single bending operation, during which all the bends of the section are shaped simultaneously, such that the already-shaped section of the element moves within a bed of a constant width, not larger than twice the length of the rod necessary to shape the single section of the reinforcing element.

[0009] The object of the invention is also a space truss-like module, comprising longitudinal closing rods, to which reinforcing elements are connected. The reinforcing elements have a plurality of bends, which constitute sections forming pattern recurring along the reinforcing element, the pattern comprising at least two bends and wherein the reinforcing elements are manufactured by the method according to the invention.

[0010] The method according to the invention allows shaping the reinforcing elements in such a way, that the shaped section of the element, during the shaping process, moves in a limited, narrow space, and therefore is not subject to large forces leading to large deformations. Therefore, reinforcing elements with a few dozen or a few hundred of bends can be shaped. Such elements can be used for construction of long space truss-like modules, wherein the length of the reinforcing element is equal to the length of the closing rod. Moreover, the method according to the invention provides high dimensional accuracy of the module, in the order of 1 mm at the length of a few dozen meters.

[0011] The object of the invention is shown by means of exemplary embodiments on a drawing, in which:

Fig. 1 shows an exemplary reinforcing element,
Fig. 2 shows an exemplary space truss-like module,
Fig. 3A-3H show the stages of bending of the reinforcing element,
Fig. 4 shows schematically a process line for manufacturing the space truss-like module,
Fig. 5 shows an exemplary construction made by joining individual truss-like modules.

[0012] Fig. 1 shows an exemplary flat reinforcing element 100, the bends of which form a recurring pattern A, comprising two bends 101, 102 having the same radius, but different directions in the same plane. The reinforcing elements may have different shapes as well, including more than two bends in the pattern or the reinforcing elements can have a spatial form, wherein the bends are formed in different planes, and wherein the pattern comprises two or more bends in different planes.

[0013] Fig. 2 shows an exemplary space truss-like module, comprising four longitudinal closing rods 111-114, to which there are connected, for example by welding, six reinforcing elements 121-126 having a length equal to the length of the closing rods 111-114. The closing rods 11-114 have a diameter from 6 to 12 mm, the reinforcing rods 121-126 have a diameter from 6 to 12 mm. The presented technology allows manufacturing space truss-like modules of a length up to a few dozen meters, which is practically limited by the ability of transporting the rods to the assembly site, where the truss construction is to be assembled.

[0014] Figs. 3A-3H show the stages of bending of the reinforcing element. In the starting phase of the bending operation, as shown in Fig. 3A, a straight rod 130 is secured between movable bending elements 141-146, and its tip 131, defining the edge of the recurring pattern A, is pressed towards the limiting element 147. Next, as shown in Figs. 3B-3D, the bending elements 141-146 move along predefined trajectories, shaping the bends of the recurring pattern A. After the bending operation is finished, as shown in Fig. 3D, the shaped section of the element is removed from between the bending elements, for example by slightly separating the bending elements and moving the rod upwards. Then, the bending elements are moved to their initial position and a successive section of the rod 100 is placed therebetween, as shown in fig. 3E. The end of the previously shaped pattern A, which is also the beginning of the following pattern A to be shaped, is pressed towards the limiting element 147, which guarantees the dimensional stability of successively shaped patterns. Bending of the successive pattern A, as shown in Figs. 3E-3H, is carried out in a manner similar to the banding process shown in Figs. 3A-3D. During the bending process, the end of the element which has been shaped in the previous operations, moves within the limits of a bed 148 having a constant width W, not larger than two lengths L of the rod necessary to make a single section of the reinforcing element. Therefore, during the bending process, the rod is subject only to small movements. The range of its movement is independent of the length of the element shaped so far. Therefore, the presented method allows to shape reinforcing elements having considerable length, covering a dozen, a few dozen or even a few hundred of sections 103 of the recurring pattern.

[0015] Fig. 4 shows a schematic of a process line for manufacturing space truss-like elements by the method according to the invention. On a straightening and cutting station 401, longitudinal closing elements are formed. On a bending station 402, reinforcing elements are shaped according to the process shown in Figs. 3A-3H. Next, the reinforcing elements are initially coupled with the closing elements on station 403. On station 403, the elements are placed in a positioning machine, in which the elements are coupled together by means of pneumatic clamps and rollers, with a high accuracy, in the order of 1 mm. The elements are joined together by solder or weld points. The high temperature emitted during the joining may cause deformation of the welded element, therefore it is simultaneously straightened by means of pneumatic clamps and rollers used to hold it. The welding is carried out by robots equipped with welding heads. Next, the preliminarily joined modules are welded on a welding station 404 by means of welding robots, by which individual modules can be also joined to larger constructions, such as the construction shown in Fig. 5. The welding is carried out in the atmosphere of active or neutral gases. The elements are positioned by means of a crane. Next, the welded modules are moved to a cleaning station 405 in the form of a shot blasting chamber, wherein the elements are shot blasted. The cleaned elements are moved to a station 406 for applying anticorrosion coatings, wherein the modules are coated by coatings appropriate for a prescribed application of the module.

[0016] The space truss-like modules according to the invention can therefore form basic construction cells for a wide range of building, bridge, road constructions, industrial machines and other, which are characterized by significantly higher parameters related to strength, load capacity, rigidity, by simultaneously significantly lower mass and time to construct as compared to standard constructions.

Claims

1. A method for manufacturing a space truss-like module, wherein reinforcing elements are connected to longitudinal closing rods, **characterized in that** the reinforcing elements (100) have a plurality of bends (101, 102), which constitute sections (103) forming a pattern recurring along the reinforcing element, the pattern comprising at least two bends (101, 102), and wherein the reinforcing elements are manufactured by shaping successive sections (103) with the recurring pattern in a bending station (402) by movable bending elements (141-146) in a single bending operation, during which all the bends of the section (103) are shaped simultaneously, such that the already-shaped section (103) of the element moves within a bed (148) of a constant width, not larger than twice the length (L) of the rod (130) necessary to shape the single section (103) of the reinforcing element (100).

2. A space truss-like module, comprising longitudinal closing rods, to which reinforcing elements are connected, **characterized in that** the reinforcing elements (100) have a plurality of bends (101, 102), which constitute sections (103) forming pattern recurring along the reinforcing element, the pattern comprising at least two bends (101, 102) and wherein the reinforcing elements (100) are manufactured by the method according to claim 1.

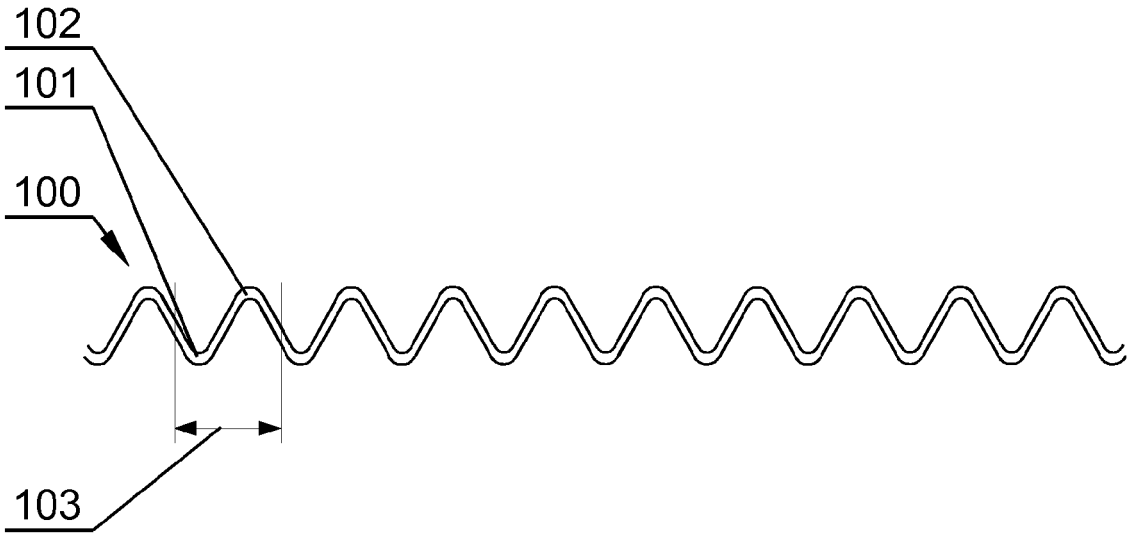

Fig. 1

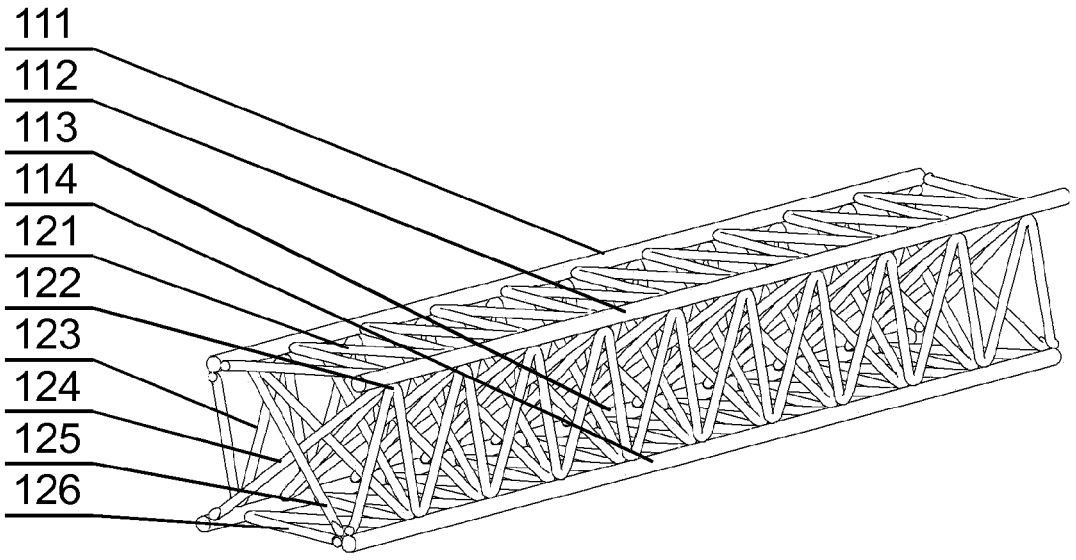

Fig. 2

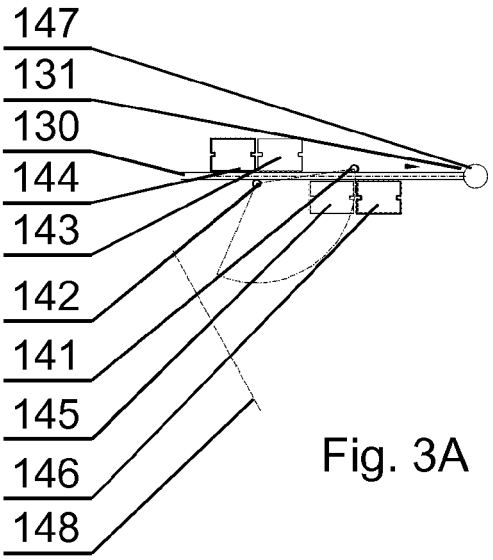

Fig. 3A

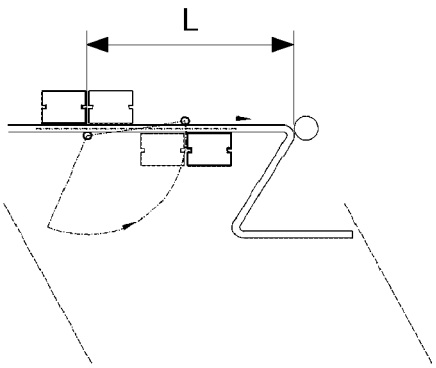

Fig. 3E

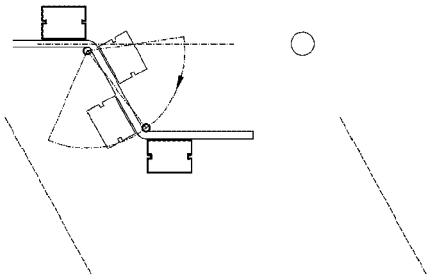

Fig. 3B

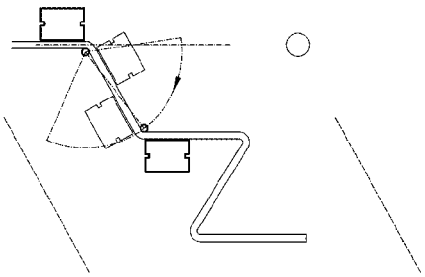

Fig. 3F

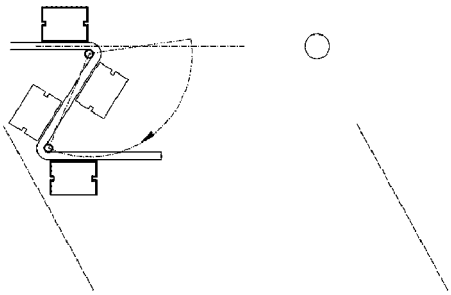

Fig. 3C

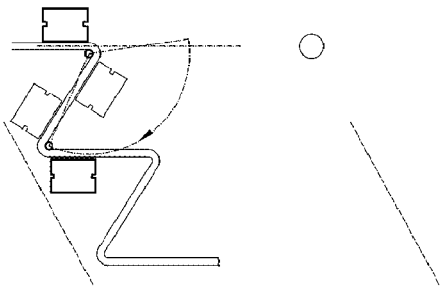

Fig. 3G

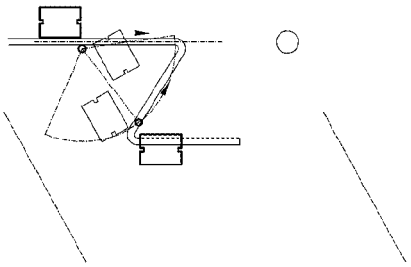

Fig. 3D

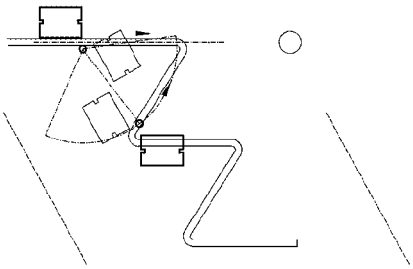

Fig. 3H

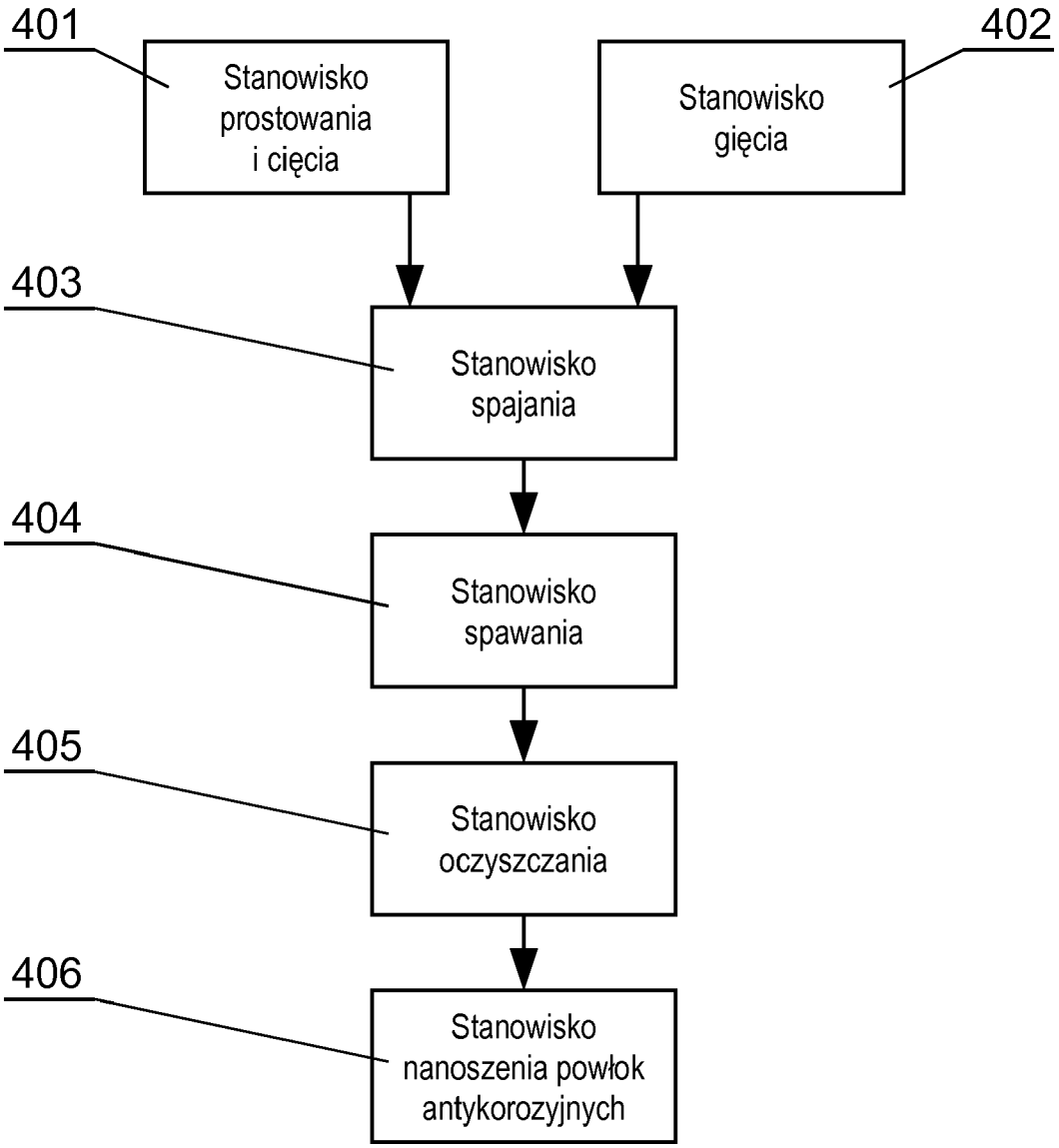
401
Stanowisko prostowania i cięcia
402
Stanowisko gięcia
403
Stanowisko spajania
404
Stanowisko spawania
405
Stanowisko oczyszczania
406
Stanowisko nanoszenia powłok antykorozyjnych

Fig. 4

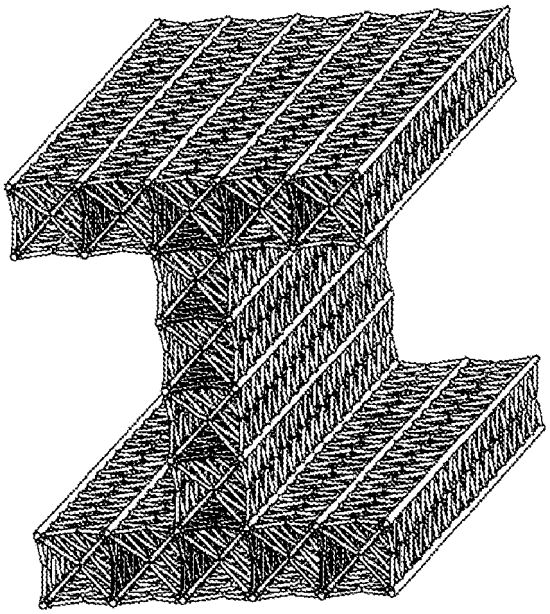

Fig. 5

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EUROPEAN SEARCH REPORT

Application Number
EP 11 17 0261

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	18 November 2011	Bauer, Josef

CATEGORY OF CITED DOCUMENTS

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