US 20140101941A1

(19) **United States**

(12) **Patent Application Publication**

NUSSBAUMER et al.

(10) **Pub. No.: US 2014/0101941 A1**

(43) **Pub. Date: Apr. 17, 2014**

(54) **METHOD AND DEVICE FOR CONTINUOUSLY PRODUCING A MESH-TYPE SUPPORT**

(71) Applicant: **Progress Maschinen & Automation AG**, Brixen (IT)

(72) Inventors: **Erich NUSSBAUMER**, Nals (IT); **Karl Friedrich ENDERES**, Brixen (IT)

(73) Assignee: **Progress Maschinen & Automation AG**, Brixen (IT)

(21) Appl. No.: **14/134,193**

(22) Filed: **Dec. 19, 2013**

Related U.S. Application Data

(63) Continuation of application No. PCT/EP2012/002634, filed on Jun. 22, 2012.

(30) **Foreign Application Priority Data**

Jun. 30, 2011 (AT) 951/2011

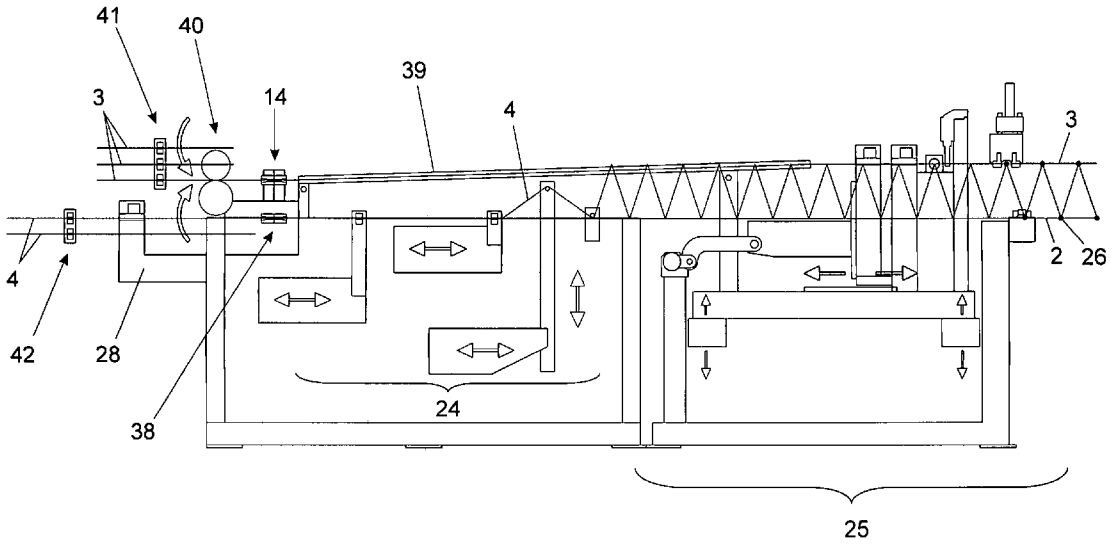
Publication Classification

(51) **Int. Cl.**
E04C 3/08 (2006.01)

(52) **U.S. Cl.**
CPC ***E04C 3/08*** (2013.01)
USPC **29/897.31**

(57) **ABSTRACT**

Method for continuously producing a mesh-type support by welding a lower member arrangement, which comprises at least one lower member, in particular two lower members, and an upper member, which is arranged at a specific height in relation to the lower member arrangement, and has at least one diagonal member running back and forth between the at least one lower member and the upper member, in particular in a zigzagging form, wherein the welding of the at least one lower member and the upper member to the at least one diagonal member is performed by means of a lower-member welding device and an upper-member welding device, wherein the height of the upper member in relation to the lower member arrangement is changed during the continuous production of the mesh-type support. The invention also relates to a device for carrying out the method.



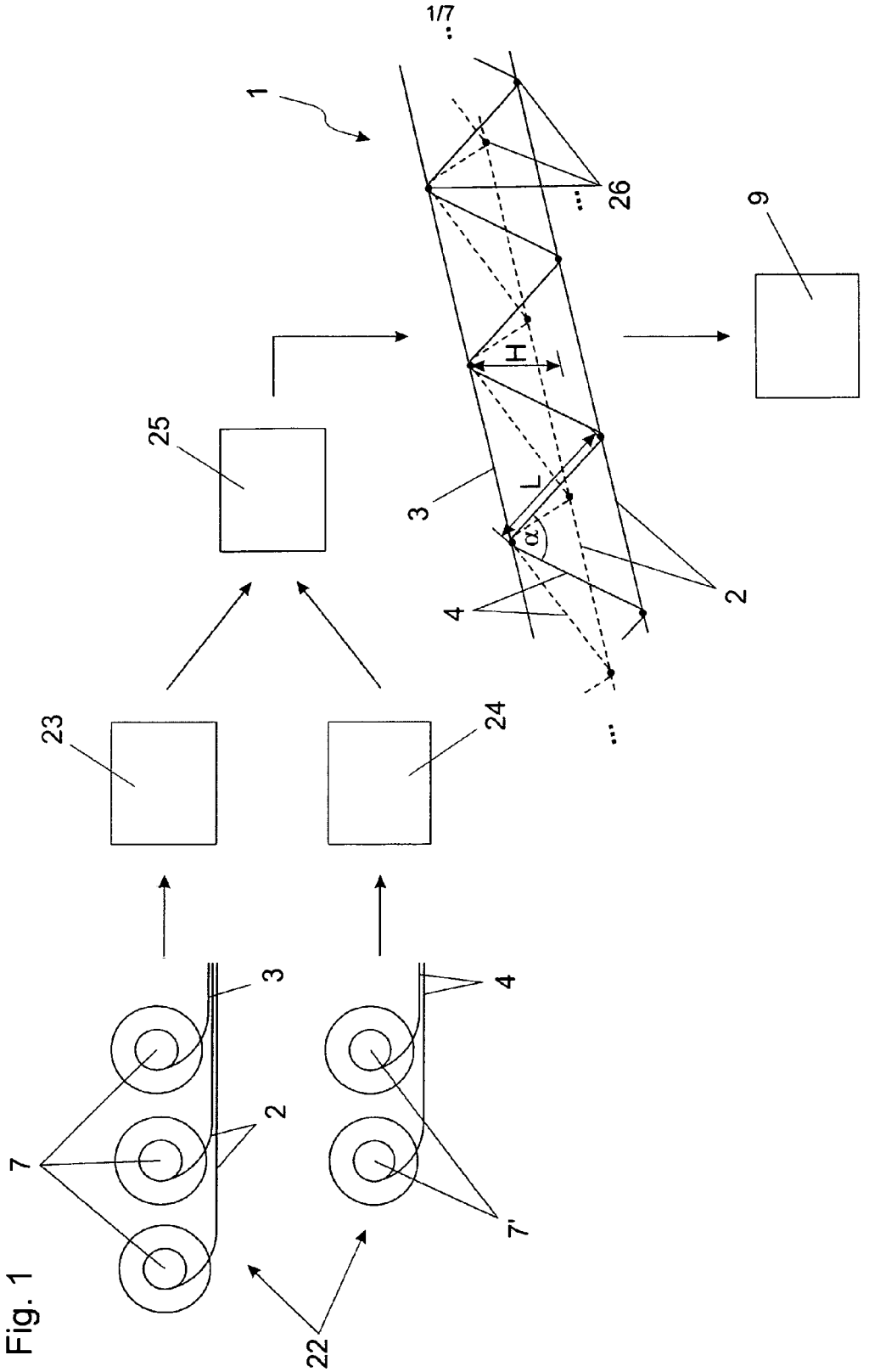


Fig. 1

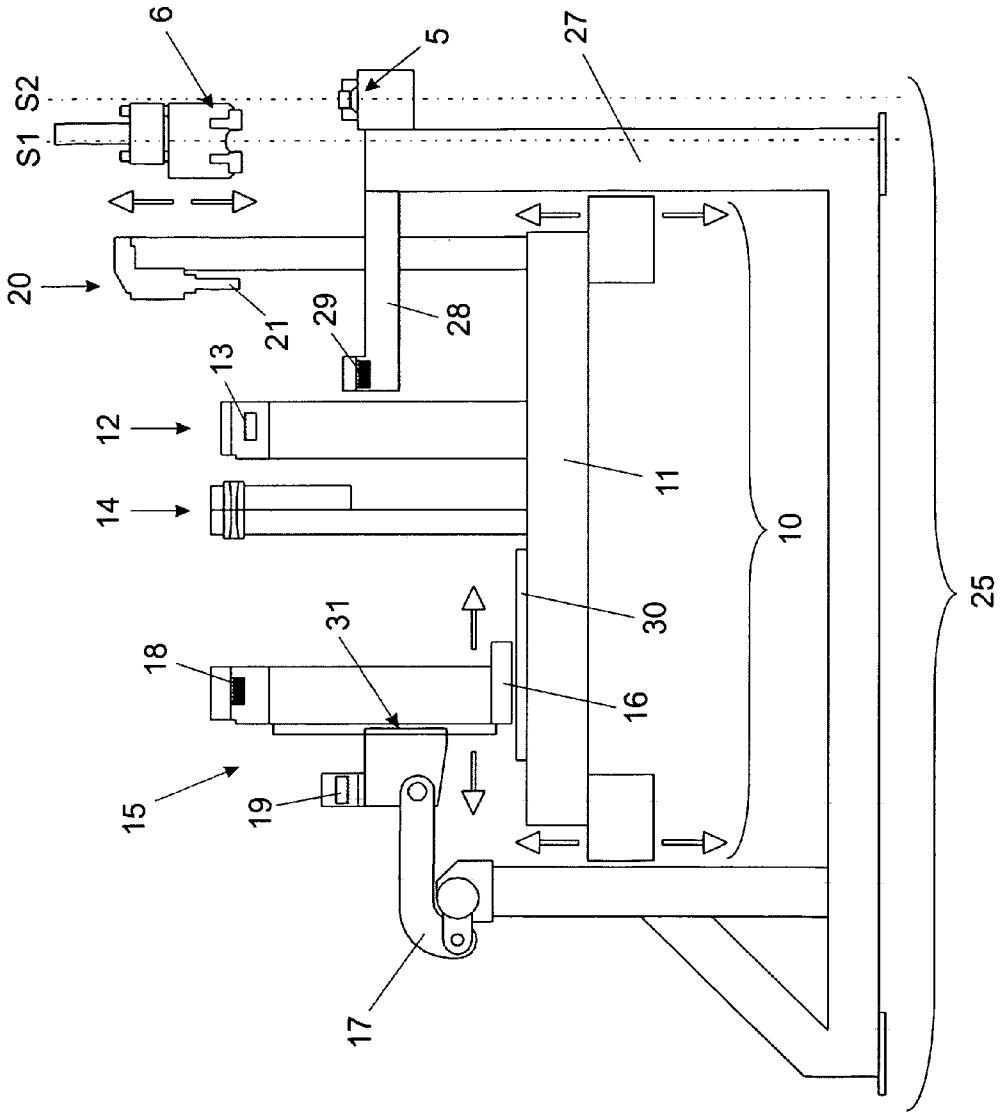


Fig. 2

Fig. 3a

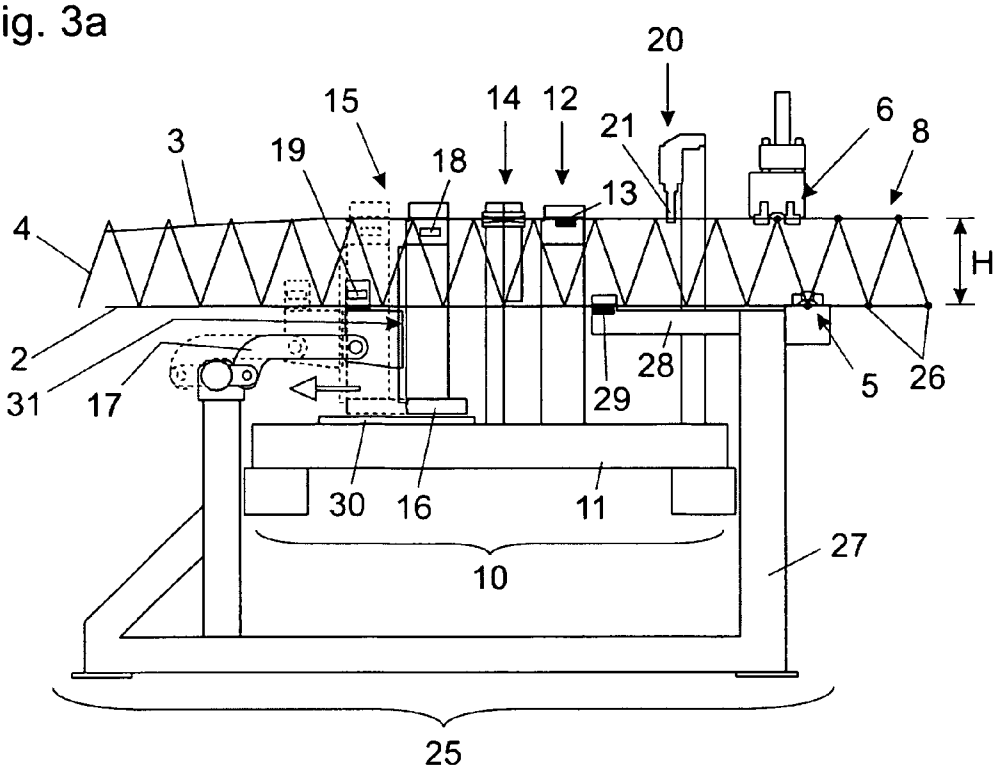

20
15
14
12
21
6
8
3
19
18
13
4
H
2
31
17
29
28
5
26
30
16
11
10
27
25

Fig. 3b

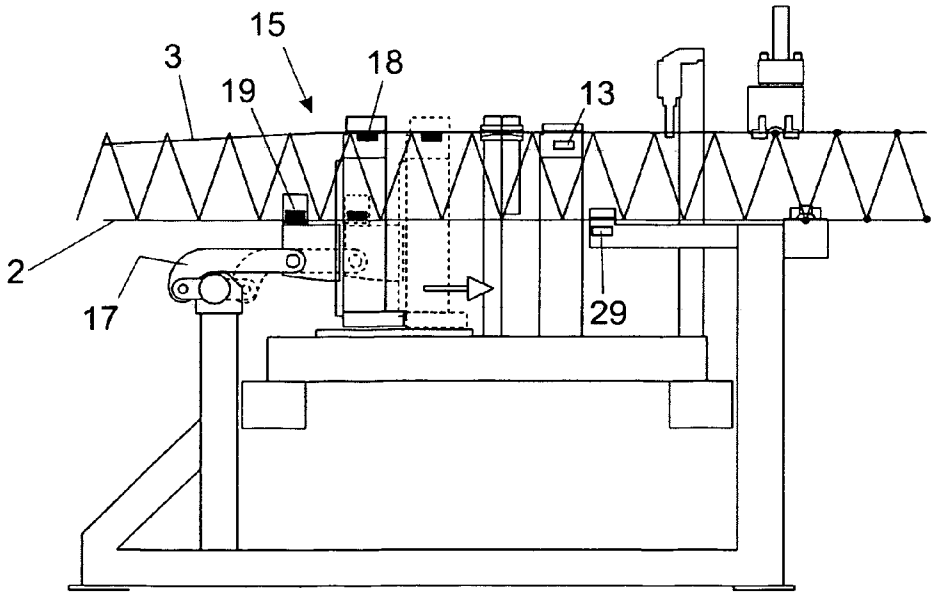

15
3
18
19
13
2
17
29

Fig. 4a

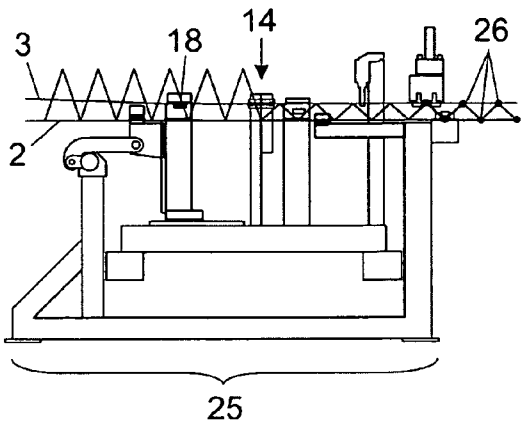


Fig. 4b

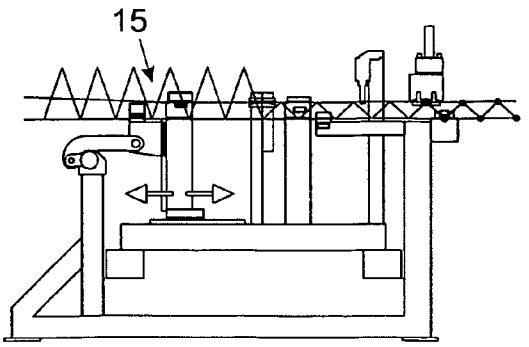


Fig. 4c

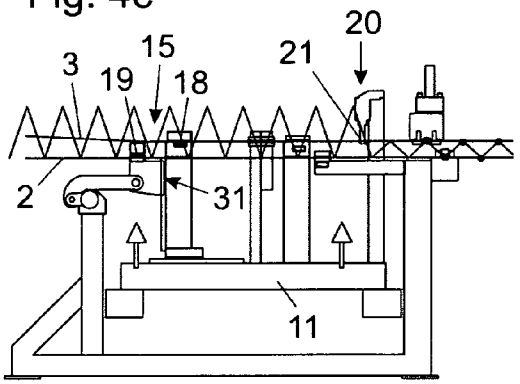


Fig. 4d

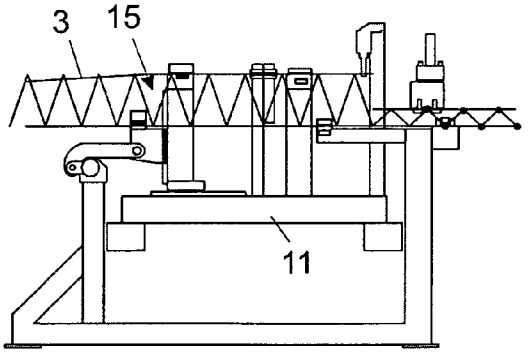


Fig. 4e

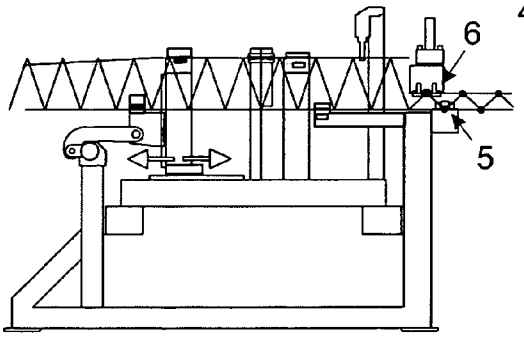


Fig. 4f

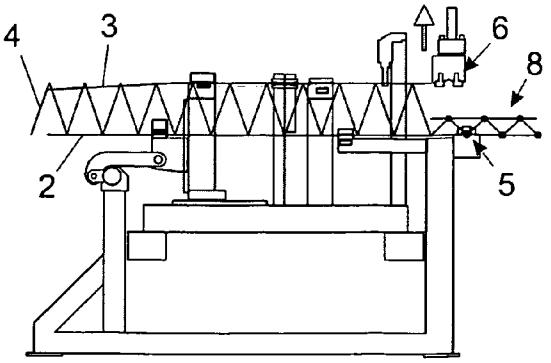


Fig. 5a

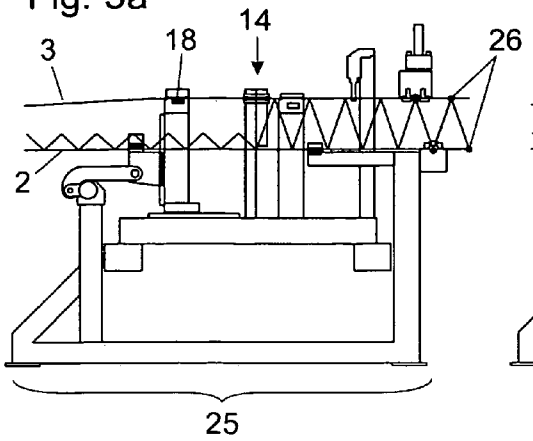


Fig. 5b

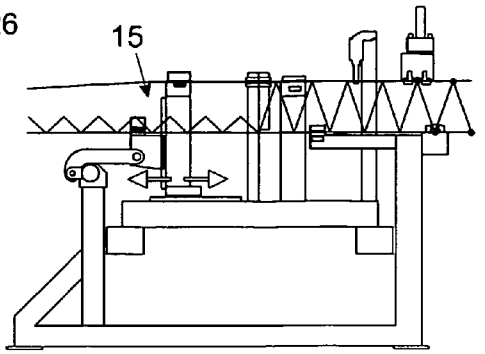


Fig. 5c

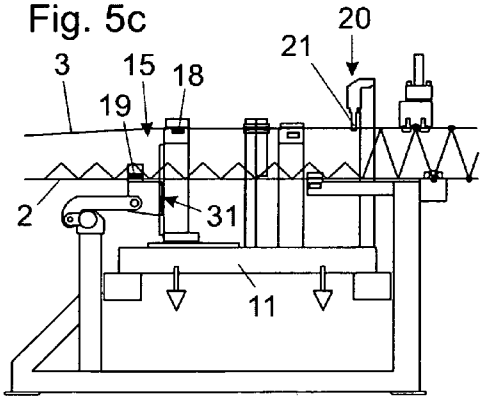


Fig. 5d

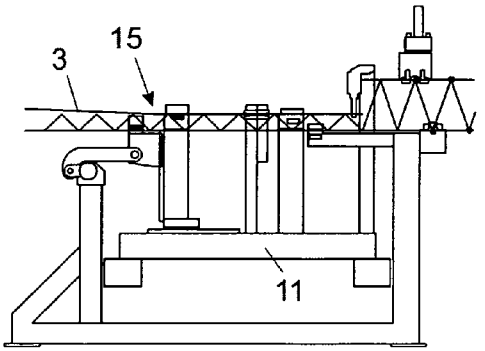


Fig. 5e

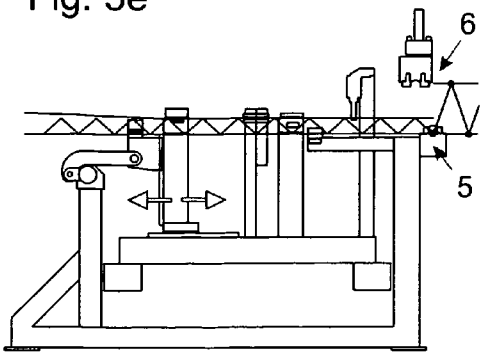


Fig. 5f

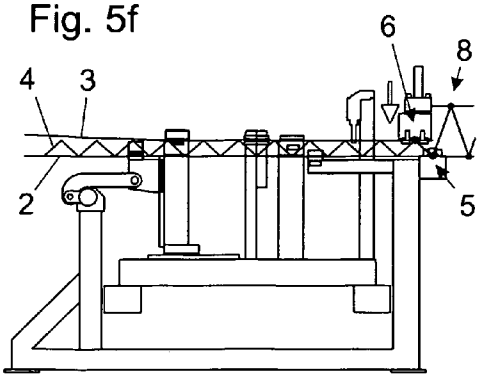


Fig. 6a

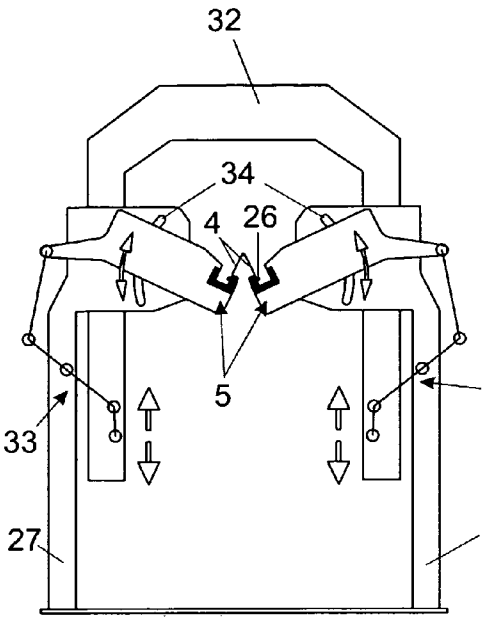


Fig. 6b

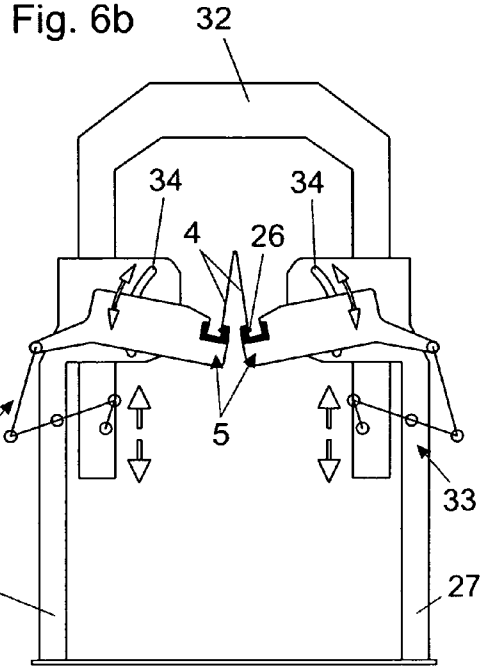


Fig. 7a

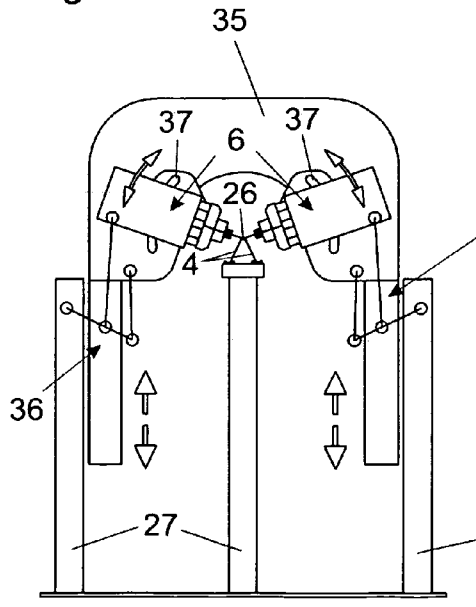
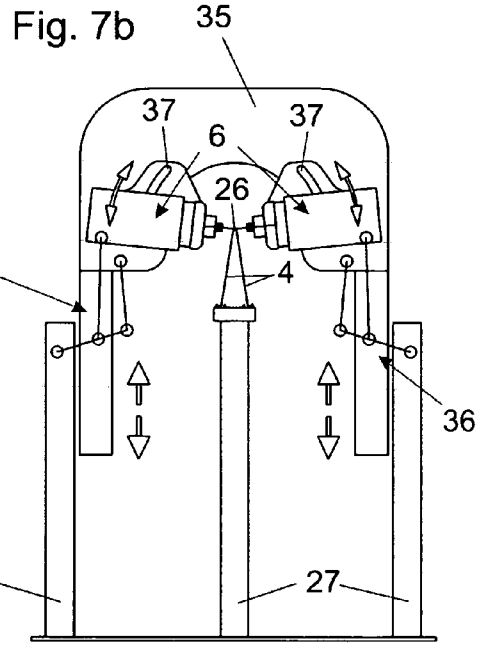


Fig. 7b



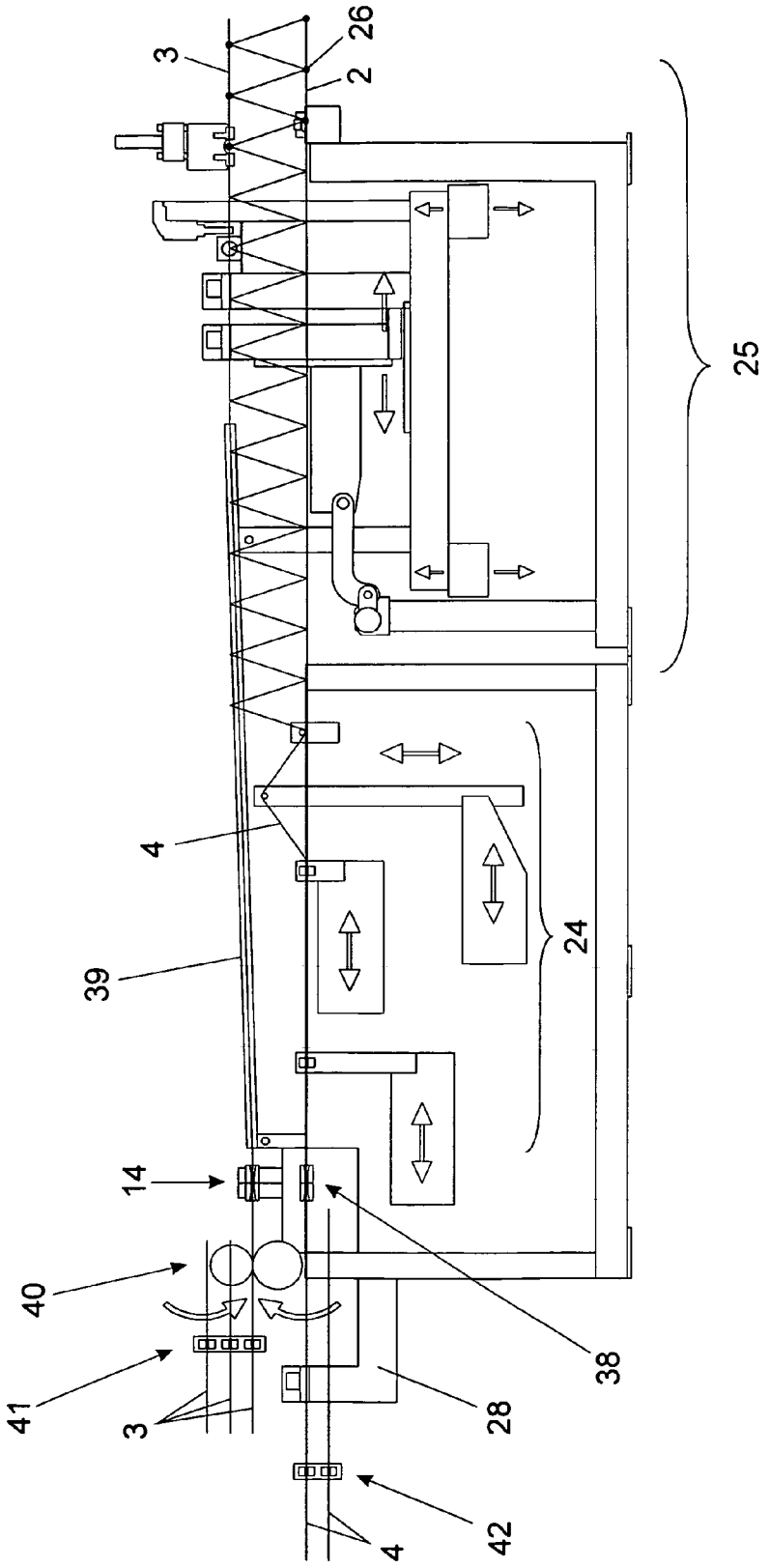


Fig. 8

METHOD AND DEVICE FOR CONTINUOUSLY PRODUCING A MESH-TYPE SUPPORT

[0001] The invention concerns a method of continuously producing a mesh-type support or lattice girder by welding a lower chord arrangement which includes at least one lower chord, in particular two lower chords, and an upper chord which is arranged at a specific height in relation to the lower chord arrangement to at least one diagonal member which extends back and forth between the at least one lower chord and the upper chord, in particular in a zig-zag form, wherein welding of the at least one lower chord and the upper chord to the at least one diagonal member is effected by means of a lower chord welding device and an upper chord welding device.

[0002] The invention further concerns an apparatus for continuously producing a lattice girder comprising a lower chord arrangement which includes at least one lower chord, in particular two lower chords, an upper chord arranged at a specific height relative to the lower chord arrangement and at least one diagonal member which extends back and forth between the at least one lower chord and the upper chord, in particular in a zig-zag form, wherein the at least one lower chord and the upper chord are welded to the at least one diagonal member and the apparatus for that welding operation includes a lower chord welding device and an upper chord welding device.

[0003] Lattice girders are reinforcement elements prefabricated in the factory for use by prefabrication plants. They are used in prefabrication plants in particular for the production of element slabs (floor slabs, semi-manufactured slabs, filigree floor slabs) and double-shell walls. Lattice girders usually comprise two lower chords comprising generally profiled or ribbed concrete reinforcing steels, two zig-zag-shaped diagonal members which are welded thereto and which comprise generally smooth concrete reinforcement steels and an upper chord which is welded to the diagonal members and which comprises generally smooth concrete reinforcement steels.

[0004] Lattice girders are generally available only in certain standard sizes. The characteristic sizes of a lattice girder include in particular the height at which the upper chord is arranged relative to the lower chord arrangement, the length of the lattice girder and the wire diameter of the chords and struts. Only few manufacturers of lattice girders are in a position to meet the specific demands of a customer who is subjecting the lattice girders to further processing. This means that the customer has to accept a series of disadvantages:

[0005] often the customer only needs a given number of items of a given type of lattice girder but frequently has to accept a minimum quantity. That is problematic in particular when many different types of lattice girders are necessary in a building construction. The customer has to put the lattice girders which are not needed into intermediate storage, in which case he has to provide not only the space required for that purpose but also suitable equipment for handling the bulky lattice girders. Taking a minimum amount of a given type of lattice girder is also problematic in particular in view of the background of greatly fluctuating steel costs;

[0006] if he has to rework a lattice girder which is of certain standard sizes for his specific purposes a great amount of waste is involved. Furthermore additional welding operations which are only rarely standardised are required. The modification operations further frequently give rise to weak locations which are susceptible to rusting; and

[0007] the above-described disadvantages involve overall increased costs.

[0008] There are initial approaches for making the production of lattice girders more flexible in order better to meet the specific needs of a customer who is subjecting the lattice girders to further processing. WO 2005/021181 A1 shows for example a method and an apparatus for producing lattice girders of any length. For that purpose the lattice girders are cut from the continuously produced line of material at predetermined cutting positions. It will be noted however that in this case changing the other dimensions of a lattice girder, in particular the height at which the upper chord is arranged relative to the lower chord arrangement, involves a comparatively high level of complication and expenditure in conversion. Usually production also has to be interrupted for that purpose.

[0009] The object of the present invention is to avoid the above-described disadvantages and to provide a method of the kind set forth in the introductory part of this specification, which is simplified and improved over the state of the art, as well as a corresponding apparatus.

[0010] According to the invention that object is attained by the features of the two independent claims **1** and **10**.

[0011] One of the basic ideas of the invention is therefore that the height of the upper chord relative to the lower chord arrangement is changed during the continuous production of the lattice girder. The apparatus according to the invention for which protection is also claimed besides the method according to the invention, for that purpose has a device for height adjustment of the upper chord during the continuous production of the lattice girder. The device for height adjustment of the upper chord can be for example a height-adjustable carrier on which is arranged a holding device for the upper chord. Advantageously that holding device includes a gripper, clamp or another technical solution which is usually employed by a man skilled in the art for that purpose, for releasably fixing the upper chord.

[0012] To avoid bending of the upper chord during the change in its height relative to the lower chord arrangement it can be provided that the upper chord is cut prior to such a change in height. For that purpose the apparatus according to the invention desirably includes a cutting device for cutting the upper chord. That cutting device can be arranged for example on the above-mentioned height-adjustable carrier.

[0013] A further substantial advantage arising out of the combination of the device according to the invention for height adjustment of the upper chord during the continuous production of the lattice girder and the presence of a cutting device for cutting the upper chord is that 'ad hoc' conversion to the production of a lattice girder involving an altered upper chord height is possible without any loss of material worth mentioning. In that case the change in height can be effected completely between two welding cycles (for welding the upper chord to the diagonal members). It is also possible in that way to implement a product-related 'just in time' manner of production: more specifically it is frequently the case that, for a given concrete mold, lattice girders of different upper chord heights are required, in differing numbers. It is possible to comply with that wish in timely fashion by the flexible capacity for conversion.

[0014] As already stated hereinbefore welding of the at least one lower chord and the upper chord to the at least one diagonal member is effected by means of a lower chord welding device and an upper chord welding device. If now the height of the upper chord relative to the lower chord arrangement is changed during the continuous production of the lattice girder it is advantageous for the angle position of the lower chord welding device and/or the height of the upper chord welding device and/or the angle position of the upper chord welding device to be changed in the course of the change in the height of the upper chord relative to the lower chord arrangement. It is possible in that way to ensure that the welding operation is always effected in the optimum fashion. The apparatus according to the invention, for carrying out those two welding steps, advantageously includes a device for adjusting the angle position of the lower chord welding device and/or a device for adjusting the height and/or the angle position of the upper chord welding device.

[0015] It has proven to be particularly desirable if the upper chord and/or the at least one lower chord is fed stepwise to the upper chord welding device or the lower chord welding device respectively. Ideally that stepwise feed is matched to the welding cycle of the two welding devices. For technical implementation of the stepwise feed of the upper chord and/or the at least one lower chord to the upper chord welding device and the lower chord welding device respectively the apparatus according to the invention can for example include an advance device. In the simplest case that advance device is arranged on a linear carriage and is preferably movable by way of an eccentric lever. For releasably fixing the upper chord and/or the at least one lower chord the advance device can include grippers, clamps or other technical solutions which are usually employed by a man skilled in the art for that purpose. If the device for height adjustment of the upper chord includes a height-adjustable carrier it is advantageous for the advance device also to be arranged on that height-adjustable carrier.

[0016] To ensure that the upper chord is fed to the upper chord welding device in the optimum fashion it can be provided that the upper chord is centered prior to welding thereof to the at least one diagonal member, in the course of the method according to the invention. For that purpose the corresponding device according to the invention ideally includes a centering device which is preferably equipped with a gripper, clamp or another technical solution usually employed by a man skilled in the art for that purpose, for releasably fixing the upper chord. From a structural point of view it is advantageous for that centering device for the upper chord also to be arranged on the height-adjustable carrier which has already been mentioned a number of times.

[0017] The method according to the invention can further be developed by one or more of the following steps and in that way can be categorised in a wider overall context:

[0018] the at least one lower chord and/or the upper chord and/or the at least one diagonal member are firstly unwound from drums prior to the welding operation to form a lattice girder and are then deformed in a predetermined fashion, wherein such deformation in respect of the at least one lower chord and/or the upper chord provides that those chords are deformed to form straight bars, whereas the at least one diagonal member acquires a predetermined zig-zag form in the course of this step in the method;

[0019] the lattice girder is separated from the continuously produced line of material at predetermined cutting positions; and

[0020] the lattice girder is then fed to at least one storage location.

[0021] To carry out those three method steps the corresponding apparatus according to the invention preferably includes:

[0022] an unwinding device for drums, on which the at least one lower chord and/or the upper chord and/or the at least one diagonal member are wound;

[0023] a straightening machine for the at least one lower chord and/or the upper chord and/or a bending machine for the at least one diagonal member;

[0024] a storage location for storage of the lattice girder; and

[0025] a robot device for transporting the lattice girder to said storage location.

[0026] Further details and advantages of this invention are described more fully hereinafter by means of the specific description with reference to the embodiments by way of example illustrated in the drawings in which:

[0027] FIG. **1** shows a greatly simplified diagrammatic overall view of a preferred embodiment of the method according to the invention and the apparatus according to the invention for the continuous production of a lattice girder,

[0028] FIG. **2** shows a diagrammatic side view of the welding machine,

[0029] FIGS. **3***a* and **3***b* show two diagrammatic side views of the welding machine to illustrate the stepwise advance of the upper chord and the two lower chords,

[0030] FIGS. **4***a* through **4***f* show a succession of six diagrammatic side views of the welding machine to illustrate the procedure for increasing the height of the upper chord relative to the lower chord arrangement during the continuous production of the lattice girder,

[0031] FIGS. **5***a* through **5***f* show a succession of six diagrammatic side views of the welding machine to illustrate the procedure for reducing the height of the upper chord relative to the lower chord arrangement during the continuous production of the lattice girder,

[0032] FIGS. **6***a* and **6***b* show two diagrammatic side views of the lower chord welding device to illustrate the change in the angle position of that welding device in the course of the change in the height of the upper chord relative to the lower chord arrangement,

[0033] FIGS. **7***a* and **7***b* show two diagrammatic side views of the upper chord welding device to illustrate the change in the height and the angle position of that welding device in the course of the change in the height of the upper chord relative to the lower chord arrangement, and

[0034] FIG. **8** shows a diagrammatic side view of a further preferred embodiment of an apparatus according to the invention for the production of a lattice girder.

[0035] FIG. **1** diagrammatically shows in greatly simplified form an overall view of a preferred embodiment of the method according to the invention and the apparatus according to the invention for the continuous production of a lattice girder **1**. In this case the lattice girder **1** comprises a lower chord arrangement which includes two lower chords **2**, an upper chord **3** arranged at a specific height H relative to the lower chord arrangement, and two diagonal members **4** which extend back and forth in a zig-zag form between the two lower chords **2** and the upper chord **3**, wherein the two lower chords

2 and the upper chord 3 are welded to the two diagonal members 4. The corresponding weld locations in spot form are denoted by reference 26.

[0036] To produce such a lattice girder 1 the upper chord 3, the two lower chords 2 and the two diagonal members 4 are firstly unwound from drums 7 and 7' in an unwinding device 22. The chords 2 and 3 and the struts 4 are delivered to the lattice girder manufacturer in the form of wound-on steel wires on those drums 7 and 7'. Depending on the respective nature of the lattice girder type to be produced the steel wires can be of different diameters and/or can involve different surface properties (profiled, ribbed or smooth).

[0037] Following the operation of unwinding from the drums 7 and 7' the lower chords 2 and the upper chord 3 are fed to a straightening machine 23 and the two diagonal members 4 are fed to a bending machine 24. In the straightening machine the lower chords 2 and the upper chord 3 are deformed substantially to form straight bars while the two diagonal members 4 receive a predetermined zig-zag form in the bending machine 24. In that case the lengths L of the individual limbs of that zig-zag form or the bending angle α between the limbs can be freely selected.

[0038] Following the straightening machine 23 and the bending machine 24 the lower chords 2 and the upper chord 3 and the two diagonal members 4 respectively are fed to the welding machine 25 in which actual production of the lattice girder 1 is effected by welding the two lower chords 2 and the upper chord 3 to the two diagonal members 4 by means of a lower chord welding device and an upper chord welding device (not visible in this drawing). After they are produced the lattice girders 1 are transported into a storage location 9 by means of a robot device and set down there.

[0039] FIG. 2 shows a diagrammatic side view of the welding machine 25. This Figure shows the components of the welding machine 25, that are required for substantial understanding of the mode of operation of the preferred embodiment. A central component part is a device 10 for height adjustment of the upper chord in the form of a height-adjustable carrier 11 on which is arranged a holding device 12 for the upper chord. That holding device 12 includes a gripper 13 for releasably fixing the upper chord. The gripper 13 has two operating conditions: an opened condition in which the upper chord is not held fast and a closed condition in which the upper chord is pressed against a counterpart surface and fixed in that way. Those two operating conditions are identified in this Figure and in the other drawings by the gripper 13 being filled out with a black color in the closed condition and having no filling in the opened condition. The mechanism for height adjustment of the height-adjustable carrier 11 is not shown in this drawing for the sake of clarity. This can be for example a chain drive mounted to the frame 27 of the welding machine 25.

[0040] In addition arranged on the height-adjustable carrier 11 is a cutting device 14 for cutting the upper chord and an advance device 15 for stepwise feed of the upper chord and the two lower chords to the upper chord welding device 6 and the lower chord welding device 5 respectively (which can be seen at top right in the drawing). That advance device can be moved towards the right and left by way of a linear carriage 16 and a corresponding guide rail 30 by means of an eccentric lever 17 fixed to the frame 27 of the welding machine 25. The advance device 15 includes a gripper 18 for releasably fixing the upper chord and two grippers 19 for releasably fixing the two lower chords, only one of the lower chord grippers 19 being visible in this drawing (because of the side view). As the height of the upper chord relative to the lower chord arrangement during continuous production of the lattice girder is to be variable the gripper 18 of the upper chord, which is fixed to the advance device 15, is not only displaceable in the horizontal plane but is also adjustable in height. In comparison therewith, it is not provided that the height of the two lower chords is changed. This means that a device 31 for height compensation must be provided between the component on which the two lower chord grippers 19 are arranged and the component on which the upper chord tong gripper 18 is arranged. In the embodiment illustrated here that height compensation is effected by means of rails. In general it should also be noted that the grippers 18 and 19 function just like the gripper 13 arranged on the holding device 12 for the upper chord. The two possible operating conditions are illustrated in the same manner.

[0041] Finally also arranged on the height-adjustable carrier 11 is a centering device 20, by means of which the upper chord can be centered, before it is fed to the upper chord welding device 6. That centering device 20 also has a gripper 21 for releasably fixing the upper chord. Stationarily connected to the frame 27 of the welding machine 25 is a holding device 28 for the two lower chords, on which two further grippers 29 are arranged (in relation thereto the same applies as for the other grippers 13, 18 and 19). It should also be pointed out that the upper chord welding device 6 is adjustable in height, as indicated by the two arrows. The precise operating principle of that height adjustment is described in detail precisely like the change in the angle position of the upper chord welding device 6 and the lower chord welding device 5 by reference to FIGS. 6*a* and 6*b* and FIGS. 7*a* and 7*b*.

[0042] FIGS. 3*a* and 3*b* serve to illustrate the mode of operation of the stepwise advance, by means of which the upper chord 3 and the two lower chords 2 are fed to the upper chord welding device 6 and the lower chord welding device 5 respectively. In principle this involves the same side view of the welding machine 25 as in FIG. 2. The lattice girder can also be seen. It should be noted that in FIG. 3*b* only the components of the welding machine 25, that are relevant for understanding thereof, are denoted by references. The references of the other components can be seen from FIG. 3*a*. The stepwise advance in the horizontal direction (in this embodiment with a stepping width of 200 m) takes place as follows: firstly the grippers 13 and 29 of the holding devices 12 and 28 for the upper chord 3 and the two lower chords 2 are closed. As a result those chords 2 and 3 are fixed in their position. Then the grippers 18 and 19 arranged on the advance device 15 are opened and the advance device 15 is moved towards the left by way of the eccentric lever 17. In a further step (shown in FIG. 3*b*) the grippers 13 and 29 are opened, the grippers 18 and 19 are closed and the advance device 15 is moved towards the right by way of the eccentric lever 17. Because the chords 2 and 3 are clamped fast at the grippers 18 and 19 and the chords 2 and 3 are welded together with the two diagonal members 4 behind the weld line the entire lattice girder moves towards the right.

[0043] The sequence of the views shown in FIGS. 4*a* through 4*b* serves to illustrate the increase in the height of the upper chord 3 relative to the lower chord arrangement during the continuous production of the lattice girder. In principle this involves the same diagrammatic side view of the welding machine 25, which is also to be seen in FIGS. 2, 3*a* and 3*b*. Therefore in those six views only the components relevant for

understanding are also provided with references. The references for the other components can be found in FIG. **2***a* or **3***a*. The change in the height of the upper chord **3** relative to the lower chord arrangement during the continuous production of the lattice girder from a small height to a larger height takes place in detail as follows: at a given moment in time during welding of the two lower chords **2** and the upper chord **3** to the two diagonal members **4** the upper chord **3** is cut by means of the cutting device **14** at a predetermined cutting position. The part of the cut upper chord **3**, that is at the right in FIG. **4***a*, is held in position by the welds **26** which have already been made while the part of the cut upper chord **3**, that is at the left in the Figure, is held fast by means of the closed gripper **18**.

[0044] Following the operation of cutting the upper chord **3** the lattice girder is transported stepwise towards the right, the advance being effected by means of the advance device **15** in the manner described with reference to FIGS. **3***a* and **3***b* (see FIG. **4***b*). That stepwise advance continues until the location at which the upper chord was cut has reached the centering device **20** for the upper chord (see FIG. **4***c*). That means that the gripper **21** of that centering device **40** can fix the end of the left-hand part of the cut upper chord **3**. In that way that part of the upper chord **3** is held fast stably between the two grippers **18** and **21** and can subsequently be moved upwardly by an upward movement of the height-adjustable carrier **11** (which is indicated by the two upwardly pointing arrows). The two lower chords **2** remain in the original position. Account can be taken of the altered spacing of the two grippers **18** and **19** on the advance device **15** by means of the height compensation device **31**.

[0045] The end position of the upward movement of the height-adjustable carrier **11** is shown in FIG. **4***d*. After that end position is reached the lattice girder is further moved stepwise towards the right (the stepwise advance again being effected by means of the advance device **15** in the above-described manner), more specifically until the end of the right-hand part of the cut upper chord **3** is completely welded, that is to say until the height change position has reached the lower chord welding device **5** and the upper chord welding device **6** respectively (see FIG. **4***e*).

[0046] In a last step (which is to be seen in FIG. **4***f*) the upper chord welding device **6** still has to be moved upwardly so that the weld of the left-hand part of the cut upper chord **3** to the diagonal members can be implemented at the new (greater) height.

[0047] Finally attention is also to be directed to the following points:

[0048] after reaching the new height of the upper chord **3** relative to the lower chord arrangement the angle position of the upper chord welding device **6** and the lower chord welding device **5** respectively is also optionally adapted,

[0049] the feed of the two diagonal members **4** is not effected stepwise but continuously, in contrast to the feed of the lower chords **2** and the upper chord **3**. The corresponding device for that continuous feed from the bending machine to the welding machine is not shown in the drawings. The length of the limbs of the zig-zag-shaped diagonal members **4** is automatically adapted to the new height during the height adjustment of the upper chord **3**, and

[0050] after the right-hand part of the cut upper chord **3** is completely welded the corresponding lattice girder involving the smaller height is severed at the height change position from the continuously produced line of material **8**. Provided for that purpose is a severing device which is not shown in the drawings.

[0051] The succession of the six images of the welding machine **25**, shown in FIGS. **5***a* through **5***f*, serve to illustrate the reversed procedure (in comparison with FIGS. **4***a* through **4***f*), that is to say a reduction in the height of the upper chord **3** relative to the lower chord arrangement during the continuous production of the lattice girder. It takes place in a similar manner and therefore does not have to be described in greater detail here.

[0052] FIGS. **6***a* and **6***b* and FIGS. **7***a* and **7***b* diagrammatically show a side view of the lower chord welding device **5** and the upper chord welding device **6** respectively. This involves a side view turned through 90° in comparison with FIGS. **2** through **5***f*. The corresponding sectional planes are denoted by references S**1** and S**2** in FIG. **2**. The comparison of two views, in both cases, shows how the angle position of the lower chord welding device **5** and the height and the angle position of the upper chord welding device **6** can be changed in the course of the change in the height relative to the lower chord arrangement. In both cases it is effected by means of a height-adjustable hoop **32** and **35** respectively, an especially shaped lever mechanism **33** and **36** respectively and a curved guide contour **34** and **37** respectively.

[0053] FIG. **8** shows a diagrammatic side view of a further preferred embodiment of the apparatus according to the invention for the production of a lattice girder. The right-hand part of the apparatus substantially corresponds to the welding machine **25**, the structure and mode of operation of which were described in connection with the preceding Figures. A difference however is that the welding machine **25** does not include the cutting device **14** for the upper chord **3**. That is now arranged in the left-hand part of the apparatus. More precisely it is disposed between a wire change device **41** and an advance device **40** for the upper chord **3** and a device **39** for wire guidance of the upper chord **3**. The advance device **40** substantially comprises two rollers which rotate in mutually opposite relationship and between which the upper chord **3** is clamped. The device **39** for wire guidance of the upper chord **3** substantially comprises a tube mounted at a first and a second location, wherein the height of the second support location is variable together with the height of the height-adjustable carrier **11** (see for example FIG. **2**). The cutting device **14** is arranged at a middle height in relation to the lower chords **2**. The upper chord **3** to be welded can be conveyed by means of the device **39** out of that height to any desired height in relation to the lower chords **2**.

[0054] The left-hand part of the apparatus further includes a wire change device **42**, a cutting device **48** and a bending machine **24**. They serve to process the diagonal members **4**. The diagonal members **4** and the lower chords **2** are fed to the production process at the same height so that they appear to be in superposed relationship as FIG. **8** is a side view. That is not the case in reality.

[0055] Upper chords and diagonal members respectively involving different wire diameters can be stored in the wire change devices **41** and **42**. In that way it is possible to flexibly vary during the production process not only the height of the upper chord relative to the lower chord arrangement but also the wire diameter of the upper chord **3** and the diagonal members **4** respectively.

LIST OF REFERENCES

[0056] **1** lattice girder
[0057] **2** lower chords
[0058] **3** upper chord
[0059] **4** diagonal members
[0060] **5** lower chord welding device
[0061] **6** upper chord welding device
[0062] **7** drums (lower chords and upper chord)
[0063] **7'** drums (diagonal members)
[0064] **8** line of material
[0065] **9** storage location
[0066] **10** height adjustment device (upper chord)
[0067] **11** height-adjustable carrier
[0068] **12** holding device (upper chord)
[0069] **13** gripper (upper chord)
[0070] **14** cutting device (upper chord)
[0071] **15** advance device (lower chords and upper chord)
[0072] **16** linear carriage
[0073] **17** eccentric lever
[0074] **18** gripper (upper chord)
[0075] **19** gripper (lower chord)
[0076] **20** centering device (upper chord)
[0077] **21** gripper (upper chord)
[0078] **22** unwinding device
[0079] **23** straightening machine
[0080] **24** bending machine
[0081] **25** welding machine
[0082] **26** weld locations
[0083] **27** frame
[0084] **28** holding device (lower chord)
[0085] **29** gripper (lower chord)
[0086] **30** guide rail
[0087] **31** height compensation device
[0088] **32** height-adjustable hoop
[0089] **33** lever mechanism
[0090] **34** guide contour
[0091] **35** height-adjustable hoop
[0092] **36** lever mechanism
[0093] **37** guide contour
[0094] **38** cutting device (diagonal members)
[0095] **39** wire guide device (upper chord)
[0096] **40** advance device (upper chord
[0097] **41** wire change device (upper chord)
[0098] **42** wire change device (diagonal members)
[0099] H height of the upper chord relative to the lower chord arrangement
[0100] L lengths of the limbs of the zig-zag form of the diagonal members
[0101] α a bending angle between the limbs of the zig-zag form of the diagonal members
[0102] S**1** cross-sectional plane **1**
[0103] S**2** cross-sectional plane **2**

1. A method of continuously producing a lattice girder by welding a lower chord arrangement which includes at least one lower chord, in particular two lower chords, and an upper chord which is arranged at a specific height in relation to the lower chord arrangement to at least one diagonal member which extends back and forth between the at least one lower chord and the upper chord, in particular in a zig-zag form, wherein welding of the at least one lower chord and the upper chord to the at least one diagonal member is effected by means of a lower chord welding device and an upper chord welding device, characterised in that the height of the upper chord relative to the lower chord arrangement is changed during the continuous production of the lattice girder.

2. A method as set forth in claim **1** characterised in that the upper chord is cut prior to a change in its height relative to the lower chord arrangement.

3. A method as set forth in claim **1** characterised in that the angle position of the lower chord welding device is changed in the course of the change in the height of the upper chord relative to the lower chord arrangement.

4. A method as set forth in one of claim **1** characterised in that the height and/or the angle position of the upper chord welding device is changed in the course of the change in the height of the upper chord relative to the lower chord arrangement.

5. A method as set forth in claim **1** characterised in that the upper chord and/or the at least one lower chord is fed stepwise to the upper chord welding device and the lower chord welding device respectively.

6. A method as set forth in claim **1** characterised in that the upper chord is centered before it is fed to the upper chord welding device.

7. A method as set forth in claim **1** characterised in that the at least one lower chord and/or the upper chord and/or the at least one diagonal member is firstly unwound from drums before the welding operation to form a lattice girder and is then deformed in a predetermined fashion.

8. A method as set forth in claim **1** characterised in that the lattice girder is separated at predetermined cutting positions from the continuously produced line of material.

9. A method as set forth in claim **8** characterised in that the lattice girder is then fed to at least one storage location.

10. Apparatus for continuously producing a lattice girder comprising a lower chord arrangement which includes at least one lower chord, in particular two lower chords, an upper chord arranged at a specific height relative to the lower chord arrangement and at least one diagonal member which extends back and forth between the at least one lower chord and the upper chord, in particular in a zig-zag form, wherein the at least one lower chord and the upper chord are welded to the at least one diagonal member and the apparatus for that welding operation includes a lower chord welding device and an upper chord welding device, characterised in that the apparatus further includes a device for height adjustment of the upper chord during the continuous production of the lattice girder.

11. Apparatus as set forth in claim **10** characterised in that the device for height adjustment of the upper chord involves a height-adjustable carrier on which is arranged a holding device for the upper chord.

12. Apparatus as set forth in claim **11** characterised in that the holding device includes a gripper for releasably fixing the upper chord.

13. Apparatus as set forth in claim **10** characterised in that the apparatus further includes a cutting device for cutting the upper chord.

14. Apparatus as set forth in claim **13** wherein the device for height adjustment of the upper chord involves a height-adjustable carrier, characterised in that the cutting device is arranged on the height-adjustable carrier.

15. Apparatus as set forth in claim **10** characterised in that the apparatus further includes a device for adjusting the angle position of the lower chord welding device.

16. Apparatus as set forth in claim **10** characterised in that the apparatus further includes a device for adjusting the height and/or the angle position of the upper chord welding device.

17. Apparatus as set forth in claim **10** characterised in that the apparatus further includes an advance device for stepwise feed of the upper chord and/or the at least one lower chord to the upper chord welding device and the lower chord welding device respectively.

18. Apparatus as set forth in claim **17** characterised in that the advance device is arranged on a linear carriage.

19. Apparatus as set forth in claim **17** characterised in that the advance device is movable by way of an eccentric lever.

20. Apparatus as set forth in claim **17** characterised in that the advance device includes a gripper for releasably fixing the upper chord and/or a gripper for releasably fixing the at least one lower chord.

21. Apparatus as set forth in claim **17** wherein the device for height adjustment of the upper chord involves a height-adjustable carrier, characterised in that the advance device is arranged on the height-adjustable carrier.

22. Apparatus as set forth in claim **10** characterised in that the apparatus further includes a centering device for the upper chord.

23. Apparatus as set forth in claim **22** characterised in that the centering device has a gripper for releasably fixing the upper chord.

24. Apparatus as set forth in claim **22** wherein the device for height adjustment of the upper chord involves a height-adjustable carrier, characterised in that the centering device is arranged on the height-adjustable carrier.

25. Apparatus as set forth in claim **10** characterised in that the apparatus includes an unwinding device for drums on which the at least one lower chord and/or the upper chord and/or the at least one diagonal member are wound.

26. Apparatus as set forth in claim **25** characterised in that the apparatus further includes a straightening machine for the at least one lower chord and/or the upper chord and/or a bending machine for the at least one diagonal member.

27. Apparatus as set forth in claim **10** characterised in that the apparatus includes a separating device for separating the lattice girder from the continuously produced line of material.

28. Apparatus as set forth in claim **10** characterised in that the apparatus includes at least one storage location for storage of the lattice girder.

29. Apparatus as set forth in claim **28** characterised in that the apparatus includes a robot device for transporting the lattice girder to the storage location.

* * * * *