(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 3 031 542 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
15.06.2016 Bulletin 2016/24

(21) Application number: **15201261.3**

(22) Date of filing: **17.11.2010**

(51) Int Cl.:
B21D 7/025 *(2006.01)* ***B21D 9/07*** *(2006.01)*
B21D 9/01 *(2006.01)* ***B21D 43/28*** *(2006.01)*

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR

(30) Priority: **18.11.2009 IT UD20090205**

(62) Document number(s) of the earlier application(s) in accordance with Art. 76 EPC:
10805630.0 / 2 501 503

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Remarks:
This application was filed on 18-12-2015 as a divisional application to the application mentioned under INID code 62.

(54) **MACHINE FOR BENDING TUBULAR PRODUCTS AND RELATIVE BENDING METHOD**

(57) Machine to bend tubular elements (11) comprising bending means (12) provided with a bending arm (17) and a bend core (16) disposed, when in use, inside said tubular element (11). The bend core (16) comprises a support bar (19), a contrasting ogive (20) and a possible bend-follower element (21) disposed articulated at the head of the contrasting ogive (20). The machine also comprises movement means to move said tubular element (11) in a direction (F) toward said bending means (12) and cutting means (22, 122) to cut a segment of tube. The machine comprises holding means (15, 115) disposed on the perimeter around said tubular element (11) and configured to maintain said bend core (16) in a condition of suspension inside said tubular element (11).

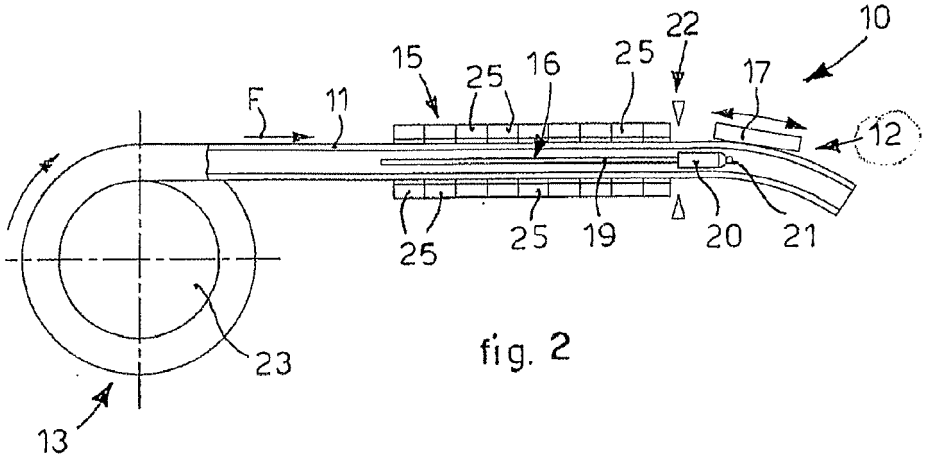

fig. 2

EP 3 031 542 A1

Description

FIELD OF THE INVENTION

[0001] Embodiments of the present disclosure relate to a machine to bend tubular products, for example metal tubes to make fluid dynamic tubes, pipes, plants or other. In particular, the machine according to the present disclosure allows to bend such tubular products in an automated way and feed them substantially continuously onto a bend core.

[0002] Embodiments of the present disclosure also relate to a bending method for the tubular elements.

[0003] Here and in the following description and claims, by the term continuous feed we mean a feed of the tubular product starting from a product in a roll or in a bar, but which in any case has a starting length higher in multiples than the length of the segment which is the finished product.

BACKGROUND OF THE INVENTION

[0004] Machines are known for the automatic or substantially automated bending of tubular elements, which allow to make parts of pipes, plants, tubing, fluidic connections or other, according to different design bends.

[0005] The known bending machines for this type of product can be distinguished into substantially two groups, that is, bending machines with a core and bending machines without a core.

[0006] In particular, in bending machines with a core the tubular elements are pre-cut to size into segments and then loaded onto the machine to feed them onto the core.

[0007] This type of known machine, although it guarantees a high bending quality of large-size tubular elements with limited radiuses for each bending operation, needs different auxiliary equipment both for the preliminary cutting into segments and also for loading the segments onto the core, prior to the bending steps.

[0008] This causes an increase in the costs of managing the machine and an increased operating complexity and automation.

[0009] Moreover, very often, this type of known machine has a mainly manual use, with consequent operating delays, the need for specialized personnel and an increase in production costs.

[0010] Moreover, known bending machines with a core, due to their conformation and operating conception, carry out a tail bending, that is, starting from the opposite end of the tube with respect to the end that is fed.

[0011] Tail bending, for many products, needs to provide that the length of the segment is suitably longer than the length of the actual development of the tubular element once it is bent, since it is necessary that the segment is still gripped by the part not bent during the execution of the last bend.

[0012] Some types of known bending machines are also characterized by the formation of high quantities of waste caused by short rectilinear sections of the end of the bent tubes.

[0013] The formation of waste has two main reasons. On the one hand, the traditional machines with core, because of their operating conception, need the tube to be supported at one end, so that the section of tube which acts as a support causes waste to be eliminated at the end. On the other hand, waste is caused because, starting from the segment in the bending step, the external material stretches and creates a deforming effect on the end of the cut tube, which obliges one section to be eliminated.

[0014] Coreless bending machines, on the contrary, are applied in particular for bending tubular elements of reduced diameter with high radiuses, and fed from a roll.

[0015] These known machines, which provide a bending system with a matrix and clamp, and not a core, can entail, in the case where reduced radiuses of curvature are required, an ovalization of the usable section for the passage of the tubular element, and the fluidic characteristics of the tubular element itself may vary.

[0016] In some conditions, a partial occlusion of the tubular element can occur at the bent point, with consequent lack of performance of the final product.

[0017] There is therefore a need to improve a machine for bending tubular products and a relative bending method, which overcome at least one of the drawbacks in the art.

[0018] In particular, one purpose of the present disclosure is to produce a machine for bending tubular elements which allows an efficient bending both of tubular elements with an ample diameter with reduced radiuses of curvature, and tubular elements of a limited diameter with ample bending radiuses.

[0019] A further purpose of the present disclosure is to make a machine for bending tubular elements which is simple and economic, which allows great operating automation, which uses a bend core and can be fed substantially continuously.

[0020] Another purpose of the present disclosure is to perfect a method for bending tubular elements which overcomes the shortcomings of the state of the art.

[0021] The Applicant has devised, tested and embodied the present invention to overcome the shortcomings of the state of the art and to obtain these and other purposes and advantages.

SUMMARY OF THE INVENTION

[0022] The present invention is set forth and characterized in the independent claims, while the dependent claims describe other characteristics of the invention or variants to the main inventive idea.

[0023] In accordance with the above purposes and with embodiments described herein, a machine for bending tubular elements is provided. In one embodiment, the machine comprises bending means provided with at least

one bending arm able to act on an external surface of the tubular element in order to make a bend, and with a bend core able to be disposed inside the tubular element to contrast from the inside the action of the bending arm, and to conform, in a desired way, the bend of the tubular element.

[0024] The machine according to embodiments described herein also comprises movement means able to move the tubular element in a linear manner, both in the first feed step toward the bending means and also during the bending steps.

[0025] According to embodiments, the bending machine also comprises holding means selectively connected to the bend core in order to keep the latter in a condition of substantial suspension inside the tubular element.

[0026] The condition of suspension defined by the holding means is such that the movement means feed the tubular element toward the bending means in a direction and sense concordant with a work direction of the bending means on the tubular element.

[0027] In this way, the tubular element is worked head-wise, that is, starting from the same end as that with which the tubular element is fed.

[0028] This work condition allows to feed the tubular element substantially continually, exploiting the advantages of automation of known coreless machines. Unlike these known machines, the machine according to the present disclosure, also exploits the advantageous characteristics of using the core to carry out the bending.

[0029] In this way, it is possible to provide a machine for bending tubular elements which is substantially automated, or can be automated, more or less completely, which allows to bend with both large and reduced radiuses, substantially of the whole dimensional range of tubular elements.

[0030] With the embodiments of the present disclosure there is a reduction in operating and management costs of the machine, optimizing the yield.

[0031] According to a variant, the holding means are of the magnetic type, that is, they provide at least a magnetic element disposed on the perimeter around the zone where the tubular element is disposed in the operating condition. By magnetic element, here and in the following description and claims, we mean any element suitable to exert a magnetic force of attraction on an element, which is also magnetic, magnetized or has magnetic means (in this case the bend core), therefore including permanent magnets, electromagnets, elements which can be magnetized and any other element suitable for the purpose.

[0032] The at least one magnetic element, or the plurality of magnetic elements, is/are disposed around the tubular element in order to generate a magnetic field which keeps the core in a condition of suspension inside the tubular element.

[0033] The position of the magnetic element or elements is lateral, that is, not interfering with the axis of feed of the tubular element, and this determines a considerable operating advantage, promoting the automation of the advance and feed movements of the tubular element toward the bending means.

[0034] The bending core is disposed axially in correspondence to the central zone of magnetic balance, thus staying in a condition of substantial suspension inside the space defined by the magnetic elements.

[0035] The tubular element is thus fed by the movement means in the direction of feed, inserting itself into the interspace defined between the magnetic elements and the bend core, without any interference by any possible supports of the bend core or the tubular element itself. In this disposition, the tubular element is further fed by the movement means in the same direction and the same sense, in a manner coordinated with the drive of the bending means in order to carry out the bends required.

[0036] In this solution, it is obvious that no working waste at all is produced, in that once a first portion of tubular element has been bent according to the desired pattern, the tubular element can be cut exactly to size, separating only the bent portion. In this condition, the tail end of the remaining tubular element coincides with the leading end of the new portion to be bent, and so on.

[0037] According to a variant, the magnetic elements can be conformed so as to command an axial recovery movement of the core after the bending steps.

[0038] According to another variant, the holding means comprise a first gripping member disposed in cooperation with a first end, or tail end, of the bend core, and able to maintain the bend core in the suspended condition during the feed steps of the tubular element in the direction of feed.

[0039] In this variant solution, the holding means also comprise a second gripping member disposed in cooperation with a second end, or tail end, of the bend core, and able to maintain the bend core in the suspended condition during the bending steps of the tubular element.

[0040] In this solution too, as in the previous one, the holding means are disposed and act laterally with respect to the position of the tubular element, so that there is no interference by the holding means with respect to the axis of feed of the tubular element.

[0041] In this variant solution, the tubular element is initially fed head-wise by the movement means. Then the tubular element is cut or sheared in order to define a segment of desired length.

[0042] Subsequently the segment is fed along the direction of feed so as to free the tail end of the bend core.

[0043] In this condition the second gripping member is activated and the first gripping member is de-activated, so that the movement means can feed the segment in the same direction and sense in order to bring it into cooperation with the bending means and carry out the bends required.

[0044] The suspended condition of the bend core is guaranteed at the rear by the second gripping member.

[0045] With this variant, the bending occurs only on a

segment coinciding with the dimension of the development of the portion to be bent, so as to facilitate the operations to move the segment, and to further improve the quality results of the bend carried out.

[0046] According to a further variant, the holding means comprise a support member, for example made of flexible material, articulated meshes or other, which support and feed the core inside a tubular bar, from which a plurality of bent portions are made.

[0047] In this variant solution, the core is moved by the movement means, axially to the tubular bar by a tail end of the latter, until the leading end is reached, and then positioned in cooperation with the bending arm of the bending means.

[0048] The movement of the tubular bar to bend its portions is, however, carried out head-wise.

[0049] These and other features, aspects and advantages of the present disclosure will become better understood with reference to the following description, the drawings and appended claims. The drawings, which are incorporated in and constitute a part of this specification, illustrate embodiments of the present subject matter and, together with the description, serve to explain the principles of the disclosure.

[0050] The various aspects and features described in the present disclosure can be applied, individually, wherever possible. These individual aspects, for instance the aspects and features described in the attached dependent claims, can be made subject of divisional patent applications.

[0051] It is noted that anything found to be already known during the patenting process is understood not to be claimed and to be the subject of a disclaimer.

BRIEF DESCRIPTION OF THE DRAWINGS

[0052] These and other characteristics of the present invention will become apparent from the following description of some preferential forms of embodiment, given as a non-restrictive example with reference to the attached drawings wherein:

- fig. 1 is a schematized view, lateral and partially sectioned, of a first form of embodiment of a machine for bending tubular elements according to embodiments of the present disclosure, in a first operating step;
- fig. 2 is a schematized view, lateral and partially sectioned, of the bending machine in fig. 1, in a second operating step;
- fig. 3 is a schematized view, lateral and partially sectioned, of the bending machine in fig. 1, in a third operating step;
- fig. 4 is a schematized view, lateral and partially sectioned, of a second form of embodiment of a machine for bending tubular elements according to the present disclosure, in a first operating step;
- fig. 5 is a schematized view, lateral and partially sectioned, of the bending machine in fig. 4, in a second operating step;
- fig. 6 is a schematized view, lateral and partially sectioned, of the bending machine in fig. 4, in a third operating step;
- fig. 7 is a schematized view, lateral and partially sectioned, of a third form of embodiment of a machine for bending tubular elements according to the present disclosure, in a first operating step;
- fig. 8 is a schematized view, lateral and partially sectioned, of the bending machine in fig. 7, in a second operating step;
- fig. 9 is a schematized view, lateral and partially sectioned, of the bending machine in fig. 7, in a third operating step.

[0053] In order to facilitate comprehension, the same reference numbers have been used, where possible, to identify common elements in the drawings that are substantially identical. It is understood that elements and characteristics of one form of embodiment can conveniently be incorporated into other forms of embodiment without further clarifications.

DETAILED DESCRIPTION OF THR EMBODIMENT

[0054] Reference will now be made in detail to the various embodiments of the invention, one or more examples of which are illustrated in the figures. Within the following description of the drawings, the same reference numbers refer to the same components. Generally, only the differences with respect to individual embodiments are described. Each example is provided by way of explanation of the invention and is not meant as a limitation of the invention. For example, features illustrated or described as part of one embodiment can be used on or in conjunction with other embodiments to yield yet a further embodiment. It is intended that the present invention includes such modifications and variations.

[0055] With reference to figs. 1, 2 and 3, a first form of embodiment of a machine 10 used for the bending of tubular elements, or tubes 11 is shown.

[0056] Both for this form of embodiment described and for the forms of embodiment described hereafter, the relative representations are deliberately schematic, in order to better understand the characteristics of the machine according to the present disclosure.

[0057] Operating details such as, for example, the diameters of the tubes, the radiuses of curvature achieved, the sizes of the core and others, have been deliberately chosen randomly so as not to constrain the individual forms of embodiment to specific operating solutions, also considering the fact that one of the main advantages of the present disclosure is the excellent operating applicability of the bending machine substantially for any type of tube with any radius of curvature.

[0058] In this case, the machine 10 comprises a bend-

ing member 12 and a movement member 13, in this case represented by an unwinding reel 23. The movement of the tube 11, in a manner known in the state of the art, is achieved by means of a motorized roller-way or with other systems of an alternative type, such as a gripper, or similar means, not shown here in detail, which carry out both the first feed of the tubes 11 toward the bending member 12 and the advance of the tubes 11 during the work steps.

[0059] In the following description, the reference numbers 13, 113, 213 are used to indicate in general the member which moves the tube 11 linearly in the direction of feed which, being known, is not shown in detail in the drawings.

[0060] The machine 10 according to embodiments of the present disclosure also comprises a holding member 15, the function of which will be described in detail hereafter.

[0061] The bending member 12 comprises a bend core 16 and a bending arm 17, which is mobile with respect to the bend core 16 in order to bend the tubes 11 fed.

[0062] In particular the bend core 16 is disposed inside the tubes 11 so as to function as contrast, inside the tube 11, to the bending action exerted externally by the bending arm 17.

[0063] The bend core 16 comprises, in its turn, a polarized support bar 19, a contrasting ogive 20 and, in the case shown in the drawings, at least a bend-follower element 21 disposed articulated at the head of the contrasting ogive 20.

[0064] There may be only one bend-follower element 21, as in the drawings, or of the multiple type, or it may not be there at all, if the type of bending and/or machine does not require it.

[0065] The bending arm 17 is of the substantially known type and is only shown schematized in the drawings. The bending arm 17 acts externally to the tube 11 to be bent in order to confer on the latter, in coordination with the advance imparted by the movement member 13, the bending radius envisaged. The bending arm 17 can be selectively positioned on different planes transverse to the direction F, in order to bend the tubes 11 on different planes.

[0066] The machine 10 also comprises a cutting tool 22, for example a milling cutter or other, in this case, disposed downstream of the holding member 15 and upstream of the bending member 12, which allows to cut to size one segment of tube 11, at the end of the bending steps.

[0067] Within the framework of the present disclosure, here and in the variant solutions shown hereafter, it is understood that the cutting tool 22 could also be disposed downstream of the bending member 12, or there could be one or more cutting members 22 upstream and one or more cutting tools downstream of the bending member 12.

[0068] The tube 11 is fed in the same direction of feed "F", and in the same sense, both in the feed step of the tube 11 to the bending member 12, and also during the bending steps. The direction and sense of feed define a head-wise feed and a head-wise working of the tube 11.

[0069] The holding member 15 comprises at least a magnetic element 25; by this term we mean permanent magnets, electro-magnets or other similar or comparable element. The magnetic element or elements 25 are disposed annularly around a zone in which the tube 11 is fed, in proximity to the bending member 12, defining an interspace between it and the bend core 16 in which the tube 11 can be inserted.

[0070] The permanent magnets 25 thus disposed define, with their magnetic fields, a median zone, axial to the direction of feed "F", of magnetic balance. The bend core 16 is disposed with its support bar 19 in this median zone of magnetic balance. The support bar 19, being polarized, remains substantially suspended in correspondence to this zone, also absorbing, among other things, the axial forces which they generate during bending.

[0071] Therefore, the whole bend core 16 is maintained suspended by the action of the magnetic fields generated by the permanent magnet or magnets 25, so as to allow the feed in the direction "F" required, without risk of interference with possible structures for the support of the bend core 16 in its operating position.

[0072] As shown in sequence in figs. 1, 2 and 3, in this form of embodiment of the machine 10, the tube 11 is fed from a roll by the action of the unwinding reel 23 in the direction of feed "F", and directed head-wise toward the bending member 12.

[0073] Before reaching the bending arm 17, the leading end of the tube 11 is made to pass inside the holding member in the interspace defined between the permanent magnet or magnets 25 and the bend core 16, so that the latter is disposed in suspension inside the tube 11.

[0074] In the form of embodiment shown in figs. 4, 5 and 6, a second form of embodiment of the machine 110 according to the present disclosure is shown schematically.

[0075] In this case the machine 110 comprises a bending member 12, a movement member 113, and a holding member 115, the latter two being of a different conformation than has so far been described.

[0076] The bending member 12 is the same as that described for the solution in figs. 1, 2 and 3, and comprises the bend core 16 and the bending arm 17, for bending the tubes 11 fed.

[0077] The movement member 113, in this case, comprises a motorized unwinding reel 23 able to unwind from a roll the tube 11 to be bent, and a movement pincers 123 disposed downstream of the unwinding reel 23 and upstream of the bending member 12, with respect to the direction of feed "F".

[0078] In this case too there can be other feed members present, but not shown here, such as a roller-way, etc.

[0079] In this variant solution too, the tube 11 is fed

head-wise in the same direction of feed "F", and in the same sense, both by means of the unwinding reel 23 and also by means of the movement pincers 123.

[0080] The holding member 115 comprises a first gripping pincers 26 and a second gripping pincers 27 disposed in cooperation with the bend core 16, in order to keep it in a suspended condition, acting on one side of the tube 11.

[0081] In particular the first gripping pincers 26 is suitable to cooperate with a tail end of the support bar 19 of the bend core 16; while the second gripping pincers 27 is suitable to cooperate with the contrasting ogive 20 of the bend core 16. The operating sequence of the two gripping pincers 26 and 27 will be described in detail hereafter.

[0082] The machine 110 in this case also comprises a cutting tool 122, for example a milling cutter or other, in this case disposed upstream of the first gripping pincers 26, and able to cut to size a segment of tube 11 before bending.

[0083] As shown in sequence in figs. 4, 5 and 6, in this form of embodiment of the machine 110, the tube 11 is initially unwound from a roll by the action of the unwinding reel 23, and moved in the direction of feed "F" by the feed member 113, and directed head-wise toward the bending member 12.

[0084] During the feed of the tube 11, the bend core 16 is kept in a suspended condition by the action of the second gripping pincers 27.

[0085] Before reaching the second gripping pincers with the leading end of the tube 11, the unwinding reel 23 stops the feed of the tube 11 and the cutting tool 122 cuts to size the segment of tube 11 to be bent. Before the definitive cut of the segment of tube 11, the segment is associated to the movement pincers 123. In a variant of this solution two cutting units can be provided, in which a first cuts one segment made from multiples of the product, and a second is positioned after the bending member 12 and cuts to size the bent tube.

[0086] Once the cutting to size has been carried out, the unwinding reel 23 partly recovers the tube 11, separating from the cut segment, and freeing a back section of the support bar 19 of the bend core 16.

[0087] In this condition, the first gripping pincers 26 is brought into cooperation with this back section of the support bar 19, and subsequently the second gripping pincers 27 is discharged, releasing the contrasting ogive 20.

[0088] At this point the movement pincers 123 feed the segment head-wise in the direction F in the same sense of feed executed with the unwinding reel 23, so as to bring it into cooperation with the bending member 12 and perform the required bends.

[0089] In the form of embodiment shown in figs. 7, 8 and 9, the bending machine according to the present disclosure is shown in its entirety with the reference number 210.

[0090] In this case the machine 210 comprises a bending member 12, a movement member 213, and a holding member 215, the latter two having a conformation different from both the solutions so far described.

[0091] The bending member 12 is the same as that described for the previous solutions and comprises the bend core 16 and the bending arm 17.

[0092] In this case the tube, rather than being fed from a roll, is fed in bars 211 of a length substantially multiple to the length of the individual segments to be bent.

[0093] In this case, the movement member 213 comprises movement pincers 223 disposed in cooperation with a back end of the bar 211, in order to determine a movement thereof toward the bending member 12 in the direction of feed F.

[0094] The holding member 215 comprises a support bar 219 directly connected to the back part of the contrasting ogive 20 of the bend core 16.

[0095] The support bar 219 is made of flexible material, with articulated meshes or other, so as to be able to feed the contrasting ogive 20 from the back surface of the tubular bar 211, with a curvilinear path, and in any case guarantee sufficient rigidity in the operating position of the contrasting ogive 20.

[0096] The machine 210 in this case also comprises a cutting tool 222, for example a milling cutter or other, in this case disposed upstream of the bending arm 17, and able to cut to size a segment of tube 11 after bending.

[0097] As shown in sequence in figs. 7, 8 and 9, in this form of embodiment of the machine 210, the tubular bar 211 is initially fed from a store and disposed in the direction of feed F. From here the movement pincers 223 feed the bar 211 head-wise toward the bending member 12.

[0098] Once the bar 211 is disposed in cooperation with the bending member 12, the bend core 16 is inserted axially to the bar 211 from a back end of the latter, until it reaches the position of cooperation, inside the bar 211, with the bending arm 17.

[0099] The bar 211 is then progressively fed by the movement pincers 233 to carry out the desired bends.

[0100] At the end of bending, the cutting tool 222 cuts the segment to size, in order to resume the bending cycle of a new section of the bar 211, always fed head-wise.

[0101] It is clear that modifications and/or additions of parts or steps may be made to the machine 10 and the cutting method as described heretofore, without departing from the field and scope of the present disclosure.

[0102] For example, it comes within the scope of the present disclosure to provide that cutting tools 22, 122, 222 are disposed downstream of the bending member 12, or in another position with respect to the bending member 12, depending on the different operating conditions.

[0103] According to another variant, the support bar 19 is polarized by means of a magnetic core, or an electric current or other known polarization system, able to generate a magnetic field contrasting the action of the field generated by the permanent magnets 25, or by the electro-magnets.

[0104] It is also clear that, although the present disclo-

sure has been described with reference to some specific examples, a person of skill in the art shall certainly be able to achieve many other equivalent forms of machine for bending tubular products and relative cutting method, having the characteristics as set forth in the claims and hence all coming within the field of protection defined thereby.

Claims

1. Machine to bend tubular elements (211) in the form of a bar, from which a plurality of bent portions are made, said machine comprising bending means (12) provided with at least one bending arm (17) and a bend core (16) disposed, when in use, inside a tubular element (211), the bend core (16) comprising a contrasting ogive (20) and a possible bend-follower element (21) disposed articulated at the head of the contrasting ogive (20), the machine also comprising movement means (213), configured to move said tubular element (211) in a direction (F) toward said bending means (12), and cutting means (222) to cut a segment of tube, **characterized in that** said machine also comprises holding means (215) configured to maintain said bend core (16) in a condition of suspension inside said tubular element (211),
wherein said holding means (215) comprise a support member (219) made of flexible or articulated components or materials, said support member (219) being configured to support and feed, in said condition of suspension, at least the contrasting ogive (20) and the possible bend-follower element (21) of the bend core (16) inside the tubular element (211).

2. Machine as in claim 1, **characterized in that** said support member (219) made of flexible or articulated components or materials is configured to feed the contrasting ogive (20) from the back surface of the tubular element (211) with a curvilinear path and guarantee rigidity in the operating position of the contrasting ogive (20

3. Machine as in claim 1 or 2, **characterized in that** said machine also comprises a cutting member (222) configured to divide the tubular element (211) in bar into segments of the desired length.

4. Machine as in claim 3, **characterized in that** said cutting member (222) is disposed upstream of the bending means (12) with respect to the direction of feed (F).

5. Machine as in claim 4, **characterized in that** said cutting member (222) is disposed upstream of the bending arm (17).

6. Machine as in claim 3, **characterized in that** said cutting member (222) is disposed downstream of the bending means (12) with respect to the direction of feed (F).

7. Machine as in any claims from 3 to 6, **characterized in that** said cutting member (222) is configured to cut to size a segment of tube (211) after bending.

8. Machine as in any claims from 3 to 7, **characterized in that** said cutting member (222) is a milling cutter.

9. Machine as in any claims hereinbefore, **characterized in that** the movement means (213) comprise movement pincers (223) disposed in cooperation with a tail end of the tubular element (211) in order to feed said tubular element (211) toward the bending means (12) in the direction of feed (F).

10. Method to bend tubular elements (211) in the form of a bar, from which a plurality of bent portions are made, said method comprising at least one bending step, in which bending means (12) provided with at least one bending arm (17) act on an external surface of a tubular element (211), and a bend core (16) disposed inside said tubular element (211) contrasts the action of said bending arm (17) from the inside, by means of a contrasting ogive (20) and a possible bend-follower element (21) disposed articulated at the head of the contrasting ogive (20), and conforms the bend of said tubular element (211) in a desired manner, and at least one movement step in which movement means (213) move said tubular element (211) both to feed it toward said bending means (12) and also during the bending step, **characterized in that**, both in said bending step and also in said movement step, said method provides that said bend core (16) is maintained in a condition of suspension inside said tubular element (211) by means of holding means (215),
wherein said method provides to activate a support member (219) of the holding means (215) which is made of flexible or articulated components or materials, and supports and feeds in said condition of suspension at least the contrasting ogive (20) and the possible bend-follower element (21) of the bend core (16) inside said tubular element (211).

11. Method as in claim 10, **characterized in that** said method provides to use said support member (219) to feed the contrasting ogive (20) from the back surface of the tubular element (211) with a curvilinear path and guarantee rigidity in the operating position of the contrasting ogive (20).

12. Method as in claim 11, **characterized in that** the bend core (16) is moved axially to the tubular element (211) by a tail end of the tubular element (211), until

the leading end is reached, and then positioned in cooperation with the bending means (12) and **in that** the movement of the tubular element (211) to bend its portions is carried out head-wise.

13. Method as in any claims from 10 to 12, **characterized in that** the tubular element (211) is initially fed from a store and disposed in the direction of feed (F).

14. Method as in claim 13, **characterized in that**, from said store, movement pincers (223) feed the tubular element (211) head-wise toward the bending means (12) and once the tubular element (211) is disposed in cooperation with the bending means (12), the bend core (16) is inserted axially to the tubular element (211) from a back end of the tubular element (211), until the bend core (16) reaches the position of co-operation, inside the tubular element (211), with the bending arm (17).

15. Method as in claim 14, **characterized in that** the tubular element (211) is then progressively fed by the movement pincers (223) to carry out the desired bends and, at the end of bending, a cutting member (222) cuts the segment to size, in order to resume the bending cycle of a new section of the tubular element (211), always fed head-wise.

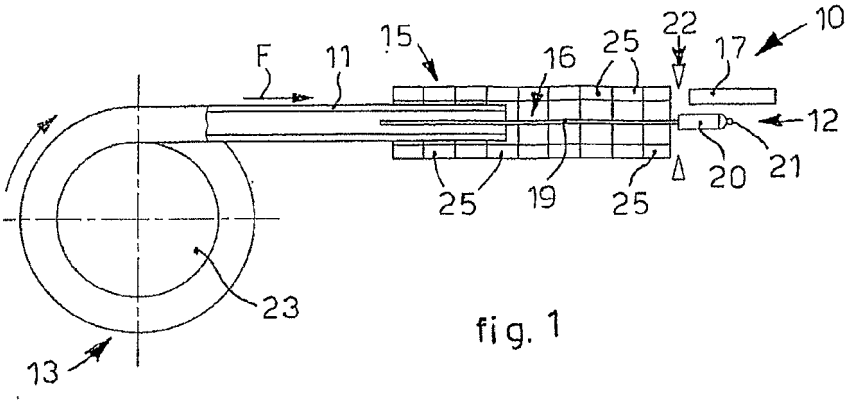

fig. 1

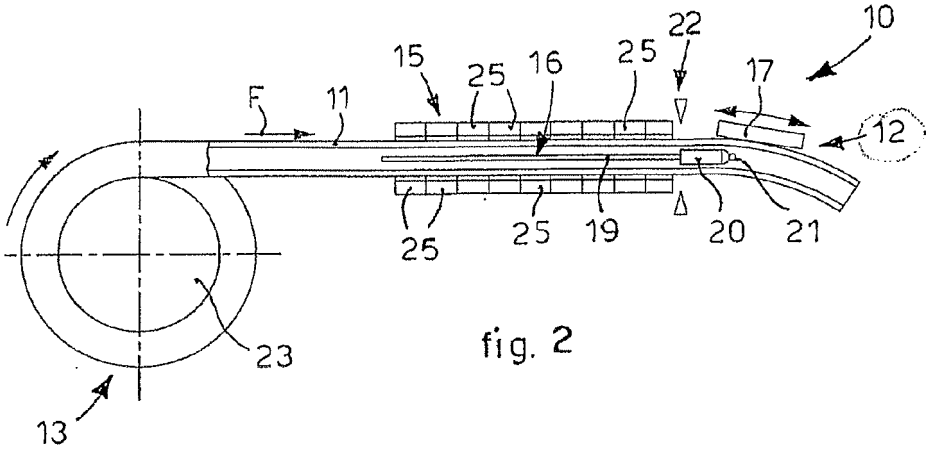

fig. 2

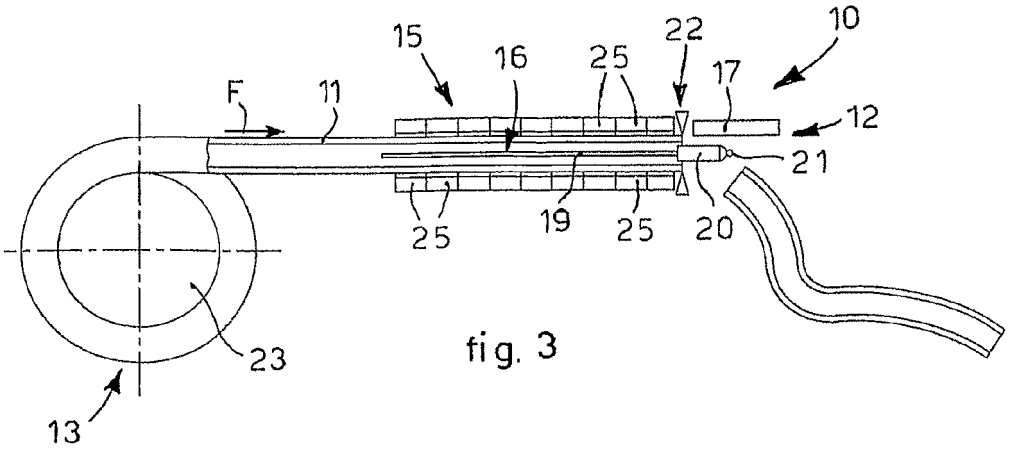

fig. 3

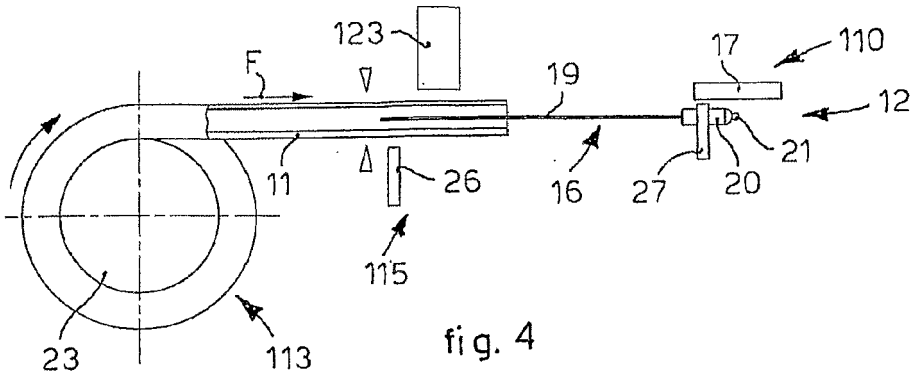

fig. 4

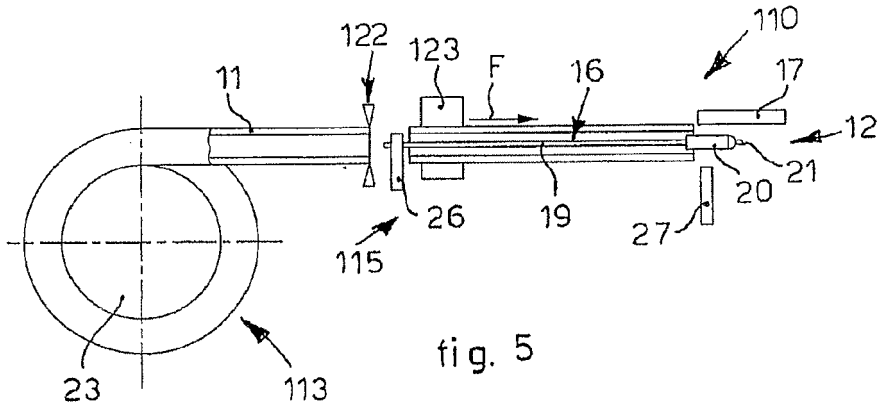

fig. 5

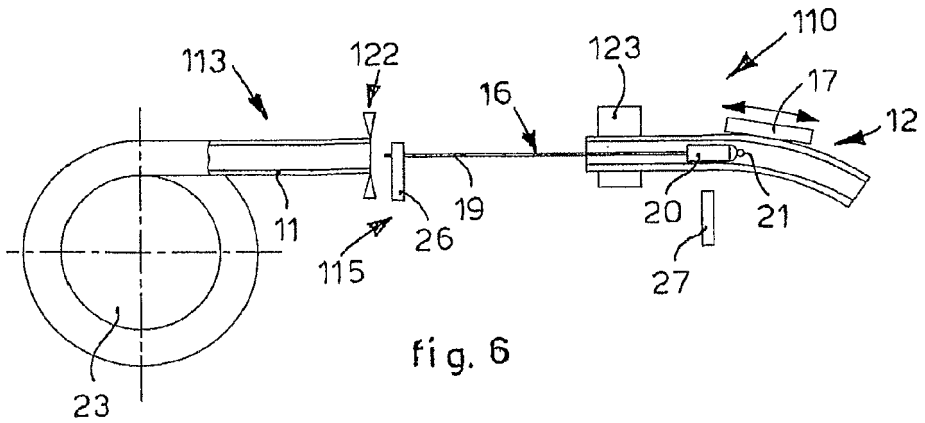

fig. 6

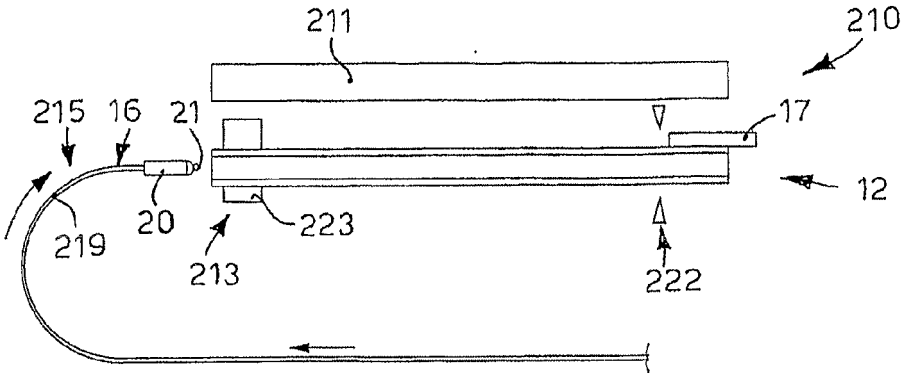

fig. 7

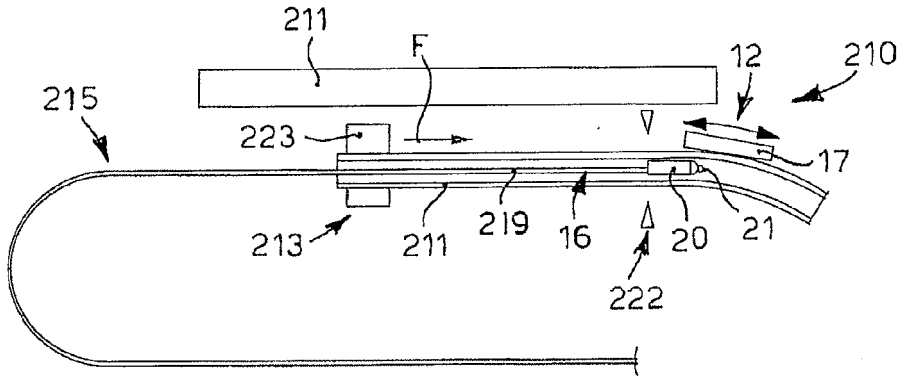

fig. 8

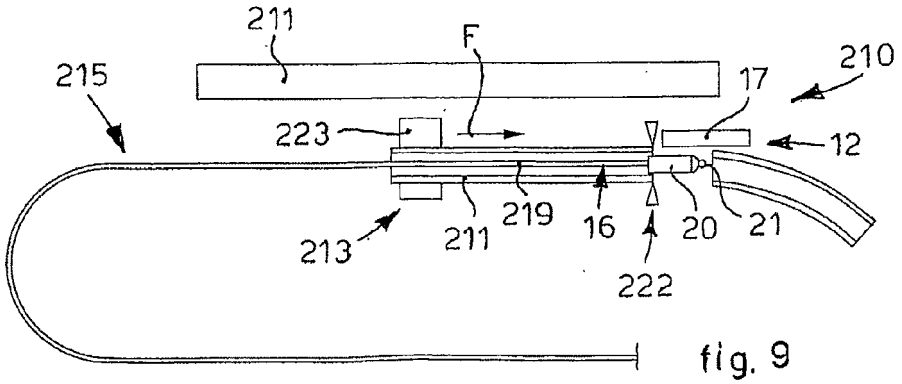

fig. 9

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EUROPEAN SEARCH REPORT

Application Number
EP 15 20 1261

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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
Munich	28 April 2016	Cano Palmero, A

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