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(54) MACHINE FOR BENDING TUBULAR PRODUCTS AND TUBE BENDING METHOD

MASCHINE ZUM BIEGEN VON ROHRFÖRMIGEN PRODUKTEN UND ROHRBIEGEVERFAHREN
CINTREUSE POUR PRODUITS TUBULAIRES, ET PROCÉDÉ DE CINTRAGE DE TUBES

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Description

FIELD OF THE INVENTION

[0001] The present invention concerns 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 invention allows to bend such tubular products in an automated way and feed them substantially continuously onto a bend core.

[0002] The present invention also concerns the 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] Document US-A-2,996,100 discloses a method and apparatus for bending pipe and tubing comprising a rotating forming die, a clamping die, support shoe and pressure die. The pipe to be bent is fed and received within the rotating forming die along a feed direction and then is advanced, by means of rolls, towards the support shoe and pressure die along another working direction, contrary to said feed direction. Within the pipe may be mounted a mandrel having a head portion, a stem portion and an end portion, used for bending thin wall sections of pipes and tubing and usually is not necessary for heavier walled pipes and tubing. The mandrel may be substituted for or combined with heating means to heat the pipe before bending.

[0018] Document WO-A-03/045603 discloses a bending machine to obtain shaped elements from pre-cut profiles, equipped with a drawing assembly which draws the profiles, first shearing means, bending means and second shearing means downstream of the bending means.

[0019] Document NL-A-7.512.602 discloses a bending machine to bend tubular elements that includes compressing means, configured as a wire rope, a chain, or a chain made of L-shaped links with protrusions to be inserted along the tubular element to act as contrast for the bending operation. The compressing means disclosed in NL-A-7.512.602 exert a compressive stress from the inside throughout the whole length of the tubular element and, in particular, in the case of the chain, contact, contrast and push at least along the whole surface inside wall of the tubular element, exerting a force perpendicular to the axis of the tubular element.

[0020] One purpose of the present invention 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.

[0021] A further purpose of the present invention 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.

[0022] Another purpose of the present invention is to perfect a method for bending tubular elements which overcomes the shortcomings of the state of the art.

[0023] 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

[0024] 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.

[0025] In accordance with the above purposes, a machine for bending tubular elements according to the present invention comprises bending means provided with at least a 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.

[0026] The machine according to the present invention 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.

[0027] According to a characteristic feature of the present invention, 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.

[0028] 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.

[0029] In this way, the tubular element is worked headwise, that is, starting from the same end as that with which the tubular element is fed.

[0030] 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 invention, also exploits the advantageous characteristics of using the core to carry out the bending.

[0031] 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.

[0032] With the present invention there is a reduction in operating and management costs of the machine, optimizing the yield.

[0033] According to the invention, 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.

[0034] 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.

[0035] 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.

[0036] 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.

[0037] 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.

[0038] 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.

[0039] 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.

[0040] 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.

[0041] 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.

[0042] 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.

[0043] 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.

[0044] Subsequently the segment is fed along the direction of feed so as to free the tail end of the bend core.

[0045] 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.

[0046] The suspended condition of the bend core is guaranteed at the rear by the second gripping member.

[0047] 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.

[0048] 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.

[0049] 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.

[0050] The movement of the tubular bar to bend its portions is, however, carried out head-wise.

BRIEF DESCRIPTION OF THE DRAWINGS

[0051] 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 the present invention, 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, 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, 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.

[0052] 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 SOME FORMS OF EMBODIMENT

[0053] 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.

[0054] 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 invention.

[0055] 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 invention is the excellent operating applicability of the bending machine substantially for any type of tube with any radius of curvature.

[0056] In this case, the machine 10 comprises a bending 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.

[0057] 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.

[0058] The machine 10 according to the present invention also comprises a holding member 15, the function of which will be described in detail hereafter.

[0059] 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.

[0060] 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.

[0061] 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.

[0062] 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.

[0063] 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.

[0064] 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.

[0065] Within the framework of the present invention, 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.

[0066] 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.

[0067] 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.

[0068] 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.

[0069] 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.

[0070] 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.

[0071] 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.

[0072] In the form of embodiment shown in figs. 4, 5 and 6, a second form of embodiment of the machine 110 is shown schematically.

[0073] 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.

[0074] 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.

[0075] 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".

[0076] In this case too there can be other feed members present, but not shown here, such as a roller-way, etc.

[0077] 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.

[0078] 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.

[0079] In particular the first gripping pincers 26 is suit-

able 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.

[0080] 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.

[0081] 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.

[0082] 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.

[0083] 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.

[0084] 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.

[0085] 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.

[0086] 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.

[0087] In the form of embodiment shown in figs. 7, 8 and 9, the bending machine is shown in its entirety with the reference number 210.

[0088] 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.

[0089] 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.

[0090] 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.

[0091] 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.

[0092] 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.

[0093] 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.

[0094] 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.

[0095] 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.

[0096] 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.

[0097] The bar 211 is then progressively fed by the movement pincers 233 to carry out the desired bends.

[0098] 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.

[0099] 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 invention.

[0100] For example, it comes within the scope of the present invention 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.

[0101] 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.

[0102] It is also clear that, although the present invention 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, without departing from the scope of the claims.

Claims

1. Machine to bend tubular elements (11, 211) com-

- prising bending means (12) provided with at least a bending arm (17) and a bend core (16) disposed, when in use, inside said tubular element (11, 211), the bend core (16) comprising 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 comprising movement means (13, 113), to move said tubular element (11, 211) in a direction (F) toward said bending means (12), and cutting means (22, 122) to cut a segment of tube, **characterized in that** it also comprises holding means (15, 115) disposed on the perimeter around said tubular element (11, 211) and configured to maintain said bend core (16) in a condition of substantial suspension inside said tubular element (11, 211) and **in that** the movement means (13) are of the type with an unwinding reel (23) and the holding means (15) are of the magnetic type and comprise at least a magnetic element (25) disposed downstream of said unwinding reel (23) in the direction (F) and outside and around the tubular element (11), so as to generate a magnetic field cooperating with said support bar (19) and to keep the bend core (16) in magnetic suspension inside said tubular element (11).
2. Machine as in claim 1, **characterized in that** said support bar (19) is provided with a magnetic polarization.
 3. Machine as in claim 1, **characterized in that** said magnetic elements (25) and said bend core (16) define between them an interspace into which the tubular element (11) is inserted around said bend core (16).
 4. Machine as in claim 1, **characterized in that** the feed means (13) are of the combined type, with an unwinding reel (113) and a movement gripper (123), and the holding means (115) comprise a first gripping member (26), disposed on one side of the perimeter of the tubular element (11) in cooperation with a first end (19) of the bend core (16), in order to selectively keep said bend core (16) in the suspended condition inside the tubular element (11) during the feed steps of said tubular element (11) in the direction of feed (F) and toward said bending means (12), and a second gripping member (27), distanced longitudinally from said first gripping member (26), and disposed in cooperation with a second end (20) of the bend core (16), and able to keep the bend core (16) in the suspended condition inside the tubular element (11) during the bending steps of said tubular element (11), in which the tubular element (11) is moved by said grippers (123).
 5. Machine as in claim 1 or 4, **characterized in that** it comprises at least a cutting member (22, 122) disposed upstream and/or downstream of the gripping member with respect to the direction of feed (F), and able to divide the tubular element (11) into segments of the desired length.
 6. Method to bend tubular elements (11) comprising at least a bending step, in which bending means (12) provided with at least a bending arm (17) act on an external surface of said tubular element (11, 211), and a bend core (16) disposed inside said tubular element (11, 211) contrasts the action of said bending arm (17) from the inside and conforms the bend of said tubular element (11) in a desired manner, and at least a movement step in which movement means (13, 113) move said tubular element (11, 211) both to feed it toward said bending means (12) and also during the bending step, wherein both in said bending step and also in said movement step, said bend core (16) is maintained in a condition of substantial suspension inside said tubular element (11) by means of holding means (15, 115), disposed on the perimeter around said tubular element (11), **characterized in that** said method provides to activate holding means (15) of the magnetic type comprising at least a magnetic element (25) cooperating with a support bar (19) of the bend core (16) and disposed on the perimeter around the tubular element (11, 211) in an operating condition, to generate respective magnetic fields, defining a central zone of magnetic balance in which the bend core (16) is disposed axially resulting in magnetic substantial suspension, to allow a substantially continuous feed by the movement means (13, 113).
 7. Method according to claim 6, **characterized in that** the bend core (16) is moved axially to the tubular element (11, 211) by a tail end of the tubular element (11, 211), until the leading end is reached, and then positioned in cooperation with the bending means (12) and the movement of the tubular element (11, 211) to bend its portions is carried out head-wise.

Patentansprüche

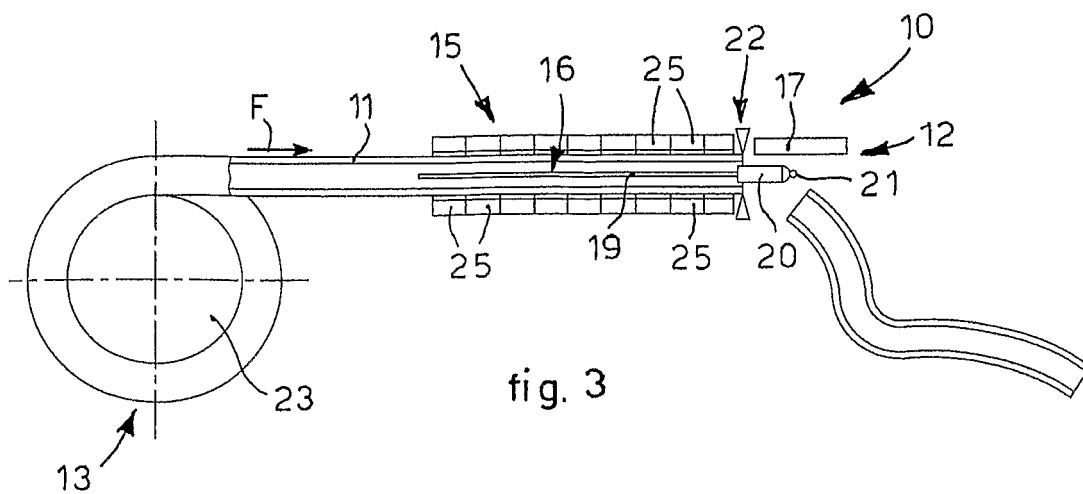
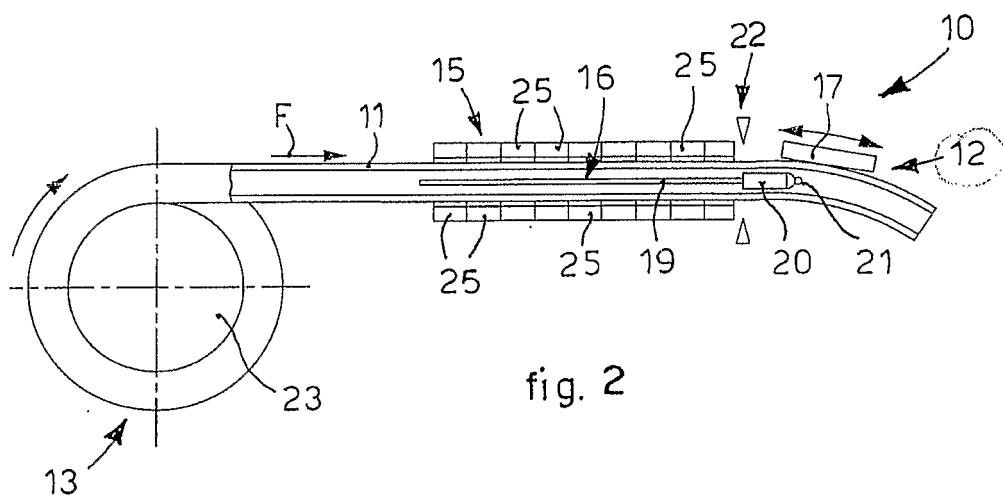
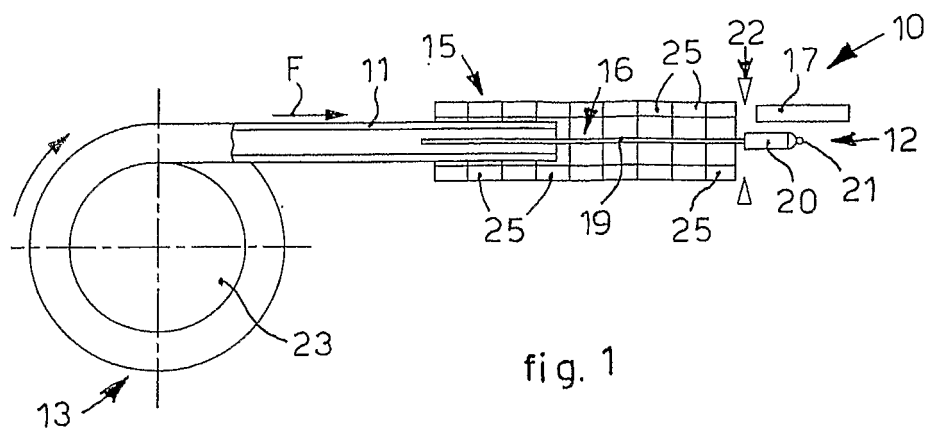
1. Maschine zum Biegen rohrförmiger Elemente (11, 211), aufweisend eine Biegeeinrichtung (12), versehen mit zumindest einem Biegearm (17) und einem Biegekern (16), angeordnet, wenn verwendet, innerhalb des rohrförmigen Elements (11, 211), wobei der Biegekern (16) aufweist eine Haltestange (19), eine Absetzogive (20) und ein mögliches Biege-Folgeelement (21), angeordnet beweglich an der Spitze der Absetzogive (20), wobei die Maschine zudem aufweist eine Bewegungseinrichtung (13, 113), um das rohrförmige Element (11, 211) in einer Richtung (F) zu der Biegeeinrichtung (12) zu bewegen, sowie eine Schneideinrichtung (22, 122), um ein Segment des

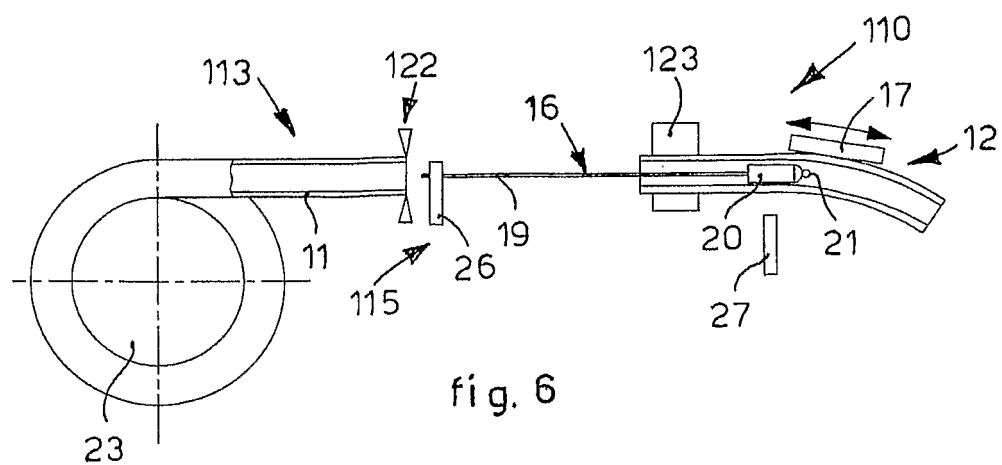
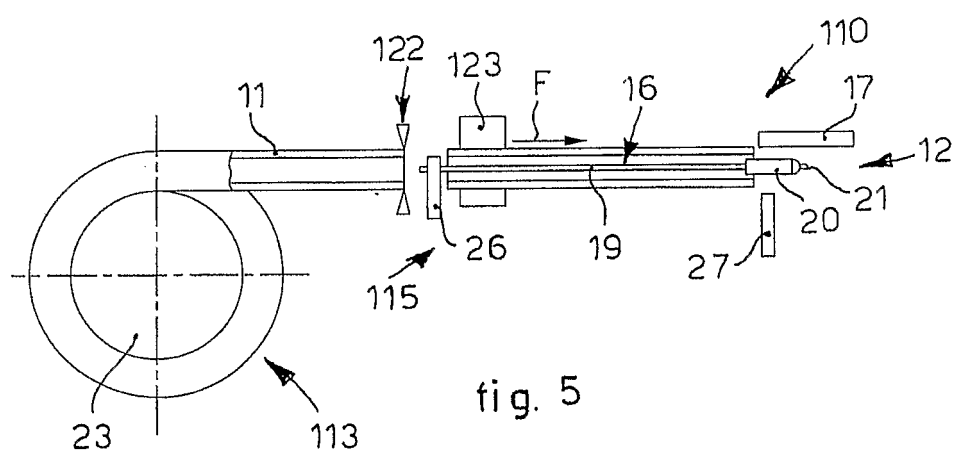
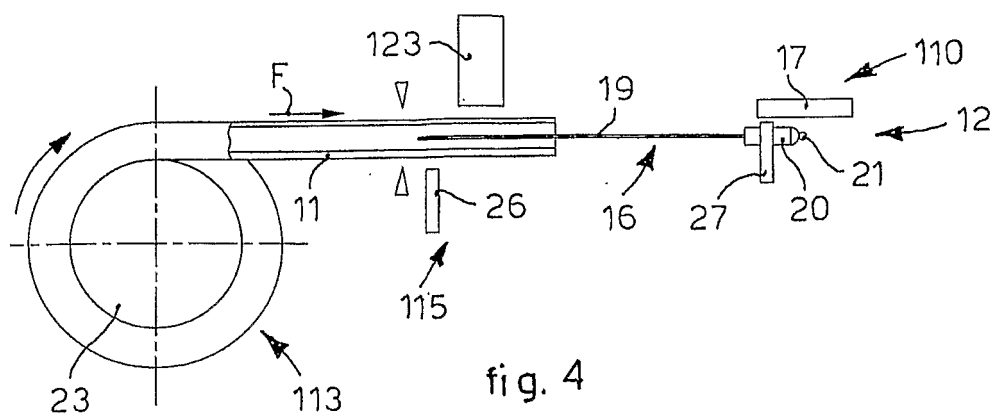
- Rohres zu schneiden, **dadurch gekennzeichnet, dass** sie zudem aufweist eine Halteeinrichtung (15, 115), angeordnet auf dem Umfang um das rohrförmige Element (11, 211) und dahingehend konfiguriert, den Biegekern (16) in einem Zustand von im Wesentlichen gehalten in dem rohrförmigen Element (11, 211) zu halten, und dass die Bewegungseinrichtung (13) von der Art ist einer Abwickelrolle (23) und die Halteeinrichtung (15) von magnetischer Bauart ist und umfasst zumindest ein Magnetikelement (25), angeordnet stromab der Abwickelrolle (23) in der Richtung (F) und außerhalb und um das rohrförmige Element (11), um so ein magnetisches Feld zu erzeugen, das zusammenwirkt mit der Haltestange (19), und um den Biegekern (16) magnetisch gehalten innerhalb des rohrförmigen Elements (11) zu halten.
2. Maschine nach Anspruch 1, **dadurch gekennzeichnet, dass** die Haltestange (19) mit einer magnetischen Polarisation versehen ist.
3. Maschine nach Anspruch 1, **dadurch gekennzeichnet, dass** Magnetikelemente (25) und der Biegekern (16) zwischen sich einen Zwischenraum festlegen, in den das rohrförmige Element (11) um den Biegekern (16) eingeführt ist.
4. Maschine nach Anspruch 1, **dadurch gekennzeichnet, dass** die Zuführeinrichtung (13) von der kombinierten Art ist mit einer Abwickelrolle (113) und einer Bewegungsgreifeinrichtung (123) und dass die Halteeinrichtung (115) umfasst ein erstes Greifelement (26), angeordnet auf einer Seite des Umfangs des rohrförmigen Elements (11) im Zusammenwirken mit einem ersten Ende (19) des Biegekerns (16), um selektiv den Biegekern (16) in dem gehaltenen Zustand innerhalb des rohrförmigen Elements (11) zu halten während der Zuführschritte des rohrförmigen Elements (11) in der Zuführrichtung (F) und zu der Biegeeinrichtung (12), und ein zweites Greifelement (27), längs beabstandet von dem ersten Greifelement (26) und angeordnet im Zusammenwirken mit einem zweiten Ende (20) des Biegekerns (16) und dazu ausgelegt, den Biegekern (16) in dem gehaltenen Zustand zu halten innerhalb des rohrförmigen Elements (11) während der Biegeschritte des rohrförmigen Elements (11), in denen das rohrförmige Element (11) von den Greifeinrichtungen (123) bewegt wird.
5. Maschine nach Anspruch 1 oder 4, **dadurch gekennzeichnet, dass** es zumindest ein Schneidelement (22, 122) aufweist stromauf und/oder stromab des Greifelements in Bezug auf die Zuführrichtung (F) und dazu in der Lage ist, das rohrförmige Element (11) in Segmente der gewünschten Länge zu unterteilen.
6. Verfahren zum Biegen rohrförmiger Elemente (11), umfassend zumindest einen Biegeschritt, in dem eine Biegeeinrichtung (12), versehen mit zumindest einem Biegearm (17), auf eine Außenfläche des rohrförmigen Elements (11, 211) wirkt, und einem Biegekern (16), angeordnet innerhalb des rohrförmigen Elements (11, 211), die Wirkung des Biegearms (17) kontrastiert von innen und das Biegen des rohrförmigen Elements (11) in einer gewünschten Weise erfüllt, und zumindest einen Bewegungsschritt, in dem eine Bewegungseinrichtung (13, 113) das rohrförmige Element (11, 211) bewegt, um es sowohl zu der Biegeeinrichtung (12) zuzuführen und ebenfalls während des Biegeschrittes, wobei sowohl in dem Biegeschritt als auch in dem Bewegungsschritt der Biegekern (16) gehalten wird in einem Zustand von im Wesentlichen gehalten sein innerhalb des rohrförmigen Elements (11) durch eine Halteeinrichtung (15, 115), angeordnet auf dem Umfang um das rohrförmige Element (11), **dadurch gekennzeichnet, dass** das Verfahren vorsieht, eine Halteeinrichtung (15) der magnetischen Art, umfassend zumindest ein Magnetikelement (25), zusammenwirkend mit einer Haltestange (19) des Biegekerns (16) und angeordnet auf dem Umfang um das rohrförmige Element (11, 211) in einem Betriebszustand, zu aktivieren, entsprechende magnetische Felder zu erzeugen, die eine Zentralzone eines magnetischen Gleichgewichts definieren, in der der Biegekern (16) axial angeordnet ist, zu magnetischer substantieller Haltung führend, um eine substantiell kontinuierliche Zuführung durch die Bewegungseinrichtung (13, 113) zu ermöglichen.
7. Verfahren nach Anspruch 6, **dadurch gekennzeichnet, dass** der Biegekern (16) axial bewegt wird zu dem rohrförmigen Element (11, 211) durch ein hinteres Ende des rohrförmigen Elements (11, 211), bis das vordere Ende erreicht ist, und dann positioniert wird im Zusammenwirken mit der Biegeeinrichtung (12) und der Bewegung des rohrförmigen Elements (11, 211), um seine Teile zu biegen, kopfseitig ausgeführt ist.

Revendications

1. Cintreuse pour éléments tubulaires (11, 211) comprenant des moyens de cintrage (12) pourvus d'au moins un bras de cintrage (17) et un noyau de cintrage (16) disposé, lors de l'utilisation, à l'intérieur dudit élément tubulaire (11, 211), le noyau de cintrage (16) comprenant une barre de support (19), une ogive opposée (20) et un éventuel élément de suivi de cintrage (21) disposé de manière articulée à la tête de l'ogive opposée (20), la machine comprenant également des moyens de déplacement (13, 113), pour déplacer ledit élément tubulaire (11,

- 211) dans un sens (F) vers lesdits moyens de cintrage (12), et des moyens de coupe (22, 122) pour couper un segment de tube, **caractérisée en ce qu'elle** comprend également des moyens de maintien (15, 115) disposés sur le périmètre autour dudit élément tubulaire (11, 211) et configurés pour maintenir ledit noyau de cintrage (16) dans un état de suspension substantielle à l'intérieur dudit élément tubulaire (11, 211) et **en ce que** les moyens de déplacement (13) sont du type ayant un dévidoir (23) et les moyens de maintien (15) sont du type magnétique et comprennent au moins un élément magnétique (25) disposé en aval dudit dévidoir (23) dans le sens (F) et à l'extérieur et autour de l'élément tubulaire (11), de manière à générer un champ magnétique coopérant avec ladite barre de support (19) et à maintenir le noyau de cintrage (16) en suspension magnétique à l'intérieur dudit élément tubulaire (11).
2. Machine selon la revendication 1, **caractérisée en ce que** ladite barre de support (19) est dotée d'une polarisation magnétique.
3. Machine selon la revendication 1, **caractérisée en ce que** lesdits éléments magnétiques (25) et ledit noyau de cintrage (16) forment entre eux un espace dans lequel l'élément tubulaire (11) est inséré autour dudit noyau de cintrage (16).
4. Machine selon la revendication 1, **caractérisée en ce que** les moyens d'alimentation (13) sont du type combiné, avec un dévidoir (113) et une pince de déplacement (123), et les moyens de maintien (115) comprennent un premier organe de pincement (26), disposé sur un côté du périmètre de l'élément tubulaire (11) en coopération avec une première extrémité (19) du noyau de cintrage (16), afin de maintenir sélectivement ledit noyau de cintrage (16) à l'état suspendu à l'intérieur de l'élément tubulaire (11) durant les étapes d'alimentation dudit élément tubulaire (11) dans le sens d'alimentation (F) et vers lesdits moyens de cintrage (12), et un second organe de pincement (27), espacé longitudinalement dudit premier organe de pincement (26), et disposé en coopération avec une seconde extrémité (20) du noyau de cintrage (16), et apte à maintenir le noyau de cintrage (16) à l'état suspendu à l'intérieur de l'élément tubulaire (11) durant les étapes de centrage dudit élément tubulaire (11), dans lequel l'élément tubulaire (11) est déplacé par lesdites pinces (123).
5. Machine selon la revendication 1 ou 4, **caractérisée en ce qu'elle** comprend au moins un organe de coupe (22, 122) disposé en amont et/ou en aval de l'organe de pincement par rapport au sens d'alimentation (F) et apte à diviser l'élément tubulaire (11) en segments de longueur désirée.
6. Procédé de cintrage d'élément tubulaires (11) comprenant au moins une étape de cintrage, dans laquelle des moyens de cintrage (12) pourvus d'au moins un bras de cintrage (17) agissent sur une surface externe dudit élément tubulaire (11, 211), et un noyau de cintrage (16) disposé à l'intérieur dudit élément tubulaire (11, 211) s'oppose à l'action dudit bras de cintrage (17) depuis l'intérieur et conforme le cintrage dudit élément tubulaire (11) d'une manière désirée, et au moins une étape de déplacement dans laquelle des moyens de déplacement (13, 113) déplacent ledit élément tubulaire (11, 121) à la fois pour l'amener vers lesdits moyens de cintrage (12) et également durant l'étape de cintrage, dans lequel à la fois dans ladite étape de cintrage et aussi dans ladite étape de déplacement, ledit noyau de cintrage (16) est maintenu dans un état de suspension substantielle à l'intérieur dudit élément tubulaire (11) à l'aide de moyens de maintien (15, 115), disposés sur le périmètre autour dudit élément tubulaire (11), **caractérisé en ce que** ledit procédé prévoit d'activer les moyens de maintien (15) du type magnétique comprenant au moins un élément magnétique (25) coopérant avec une barre de support (19) du noyau de cintrage (16) et disposé sur le périmètre autour de l'élément tubulaire (11, 211) et dans un état opérationnel, pour générer des champs magnétiques respectifs, formant une zone centrale d'équilibre magnétique dans laquelle le noyau de cintrage (16) est disposé axialement créant une suspension substantielle magnétique, pour permettre une alimentation substantiellement continue par les moyens de déplacement (13, 113).
7. Procédé selon la revendication 6, **caractérisé en ce que** le noyau de cintrage (16) est déplacé axialement par rapport à l'élément tubulaire (11, 211) par une extrémité arrière de l'élément tubulaire (11, 211), jusqu'à ce que l'extrémité avant soit atteinte, et ensuite positionnée en coopération avec les moyens de cintrage (12) et le mouvement de l'élément tubulaire (11, 211) pour cintrer ses parties est réalisé par l'avant.





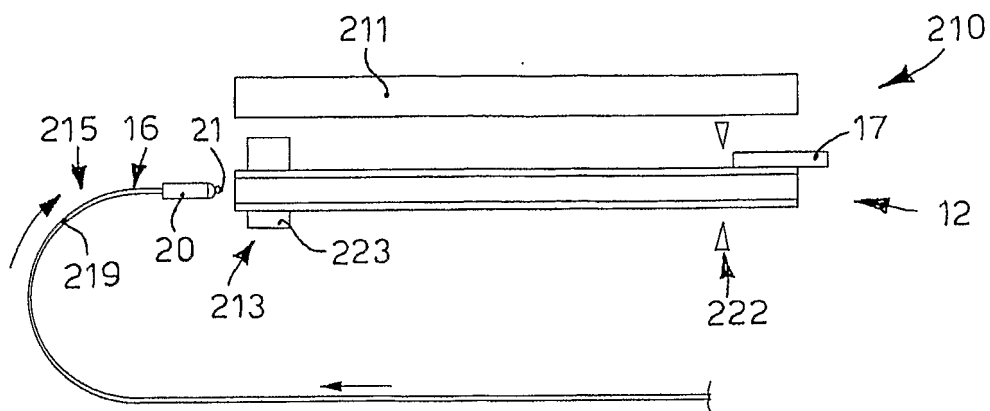


fig. 7

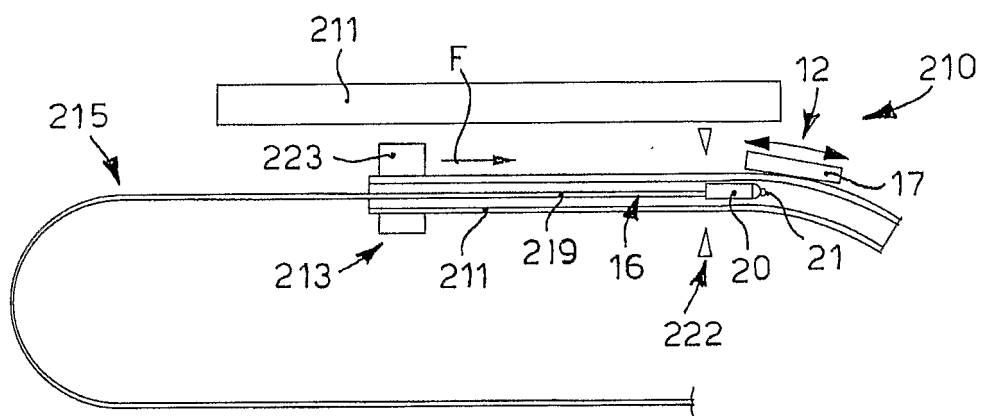


fig. 8

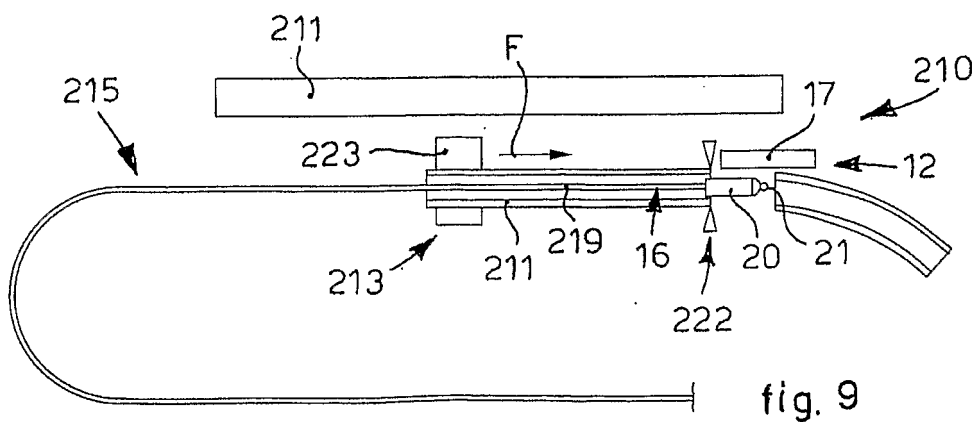


fig. 9

REFERENCES CITED IN THE DESCRIPTION

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