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(54) **Method and device for the manufacture of metal tubes with oval or elliptical section**

(57) Method and device for the fabrication of tubes (5,6) with an oval or elliptical section that comprises a tube (5,6) with a circular section placed along a path defined by a plurality of rollers (3 and 4, 7 and 8, 9 and 10, 11 and 12, 13 and 14). The plurality of rollers comprises couple of rollers (3 and 4, 7 and 8, 9 and 10, 11 and 12, 13 and 14) placed diametrically opposed to each other and defining the path. The passage through the path forces, therefore, the tube (5,6) against the throats (30,40) of the rollers (3 and 4, 7 and 8, 9 and 10, 11 and 12, 13 and 14) causing its deformation for its entire length.

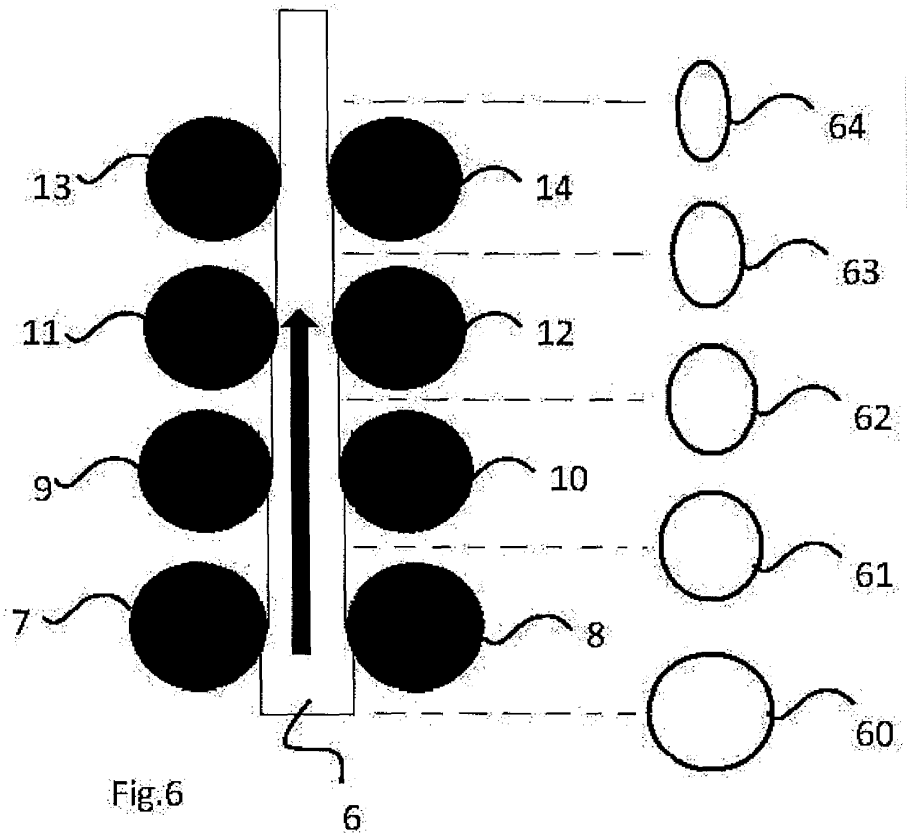

Fig.6

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Description

Technical Field

[0001] The present invention refers to the field relative to the production of tubes. In particular the invention refers to a method for the production of metal tubes with oval, elliptical or similar section.

[0002] Moreover it is described a device that uses such method.

State of the Art

[0003] In the building field, the request of supplies of metal tubes with structural function and with a transversal section that is different from the common circular section is growing fast. In particular are very much requested the tubes with transversal section of oval, elliptical or similar type.

[0004] The metal tubes with a structural function are tubes that usually have diameters that range approximately from 100m to 800mm with variable depth from 6mm to 30mm. The dimensions, in any case, can vary according to the needs.

[0005] The tubes with elliptical or oval section (or anyway not with a circular section) adapt better to the dimension's need of the structure within which they will fit in, having indeed a greater dimension compared to the other one. For this reason they are easily used for different applications and are requested everyday more in the building field. Obviously, the lengths of the tubes with oval or elliptical transversal section, as the common tubes, are variable according to the needs and follow the market request, driven by the recent slants of the modern architecture. In any case are increasingly requested tubes with sizeable lengths, even over 4 meters. This could indeed cause further problems in the realization of these particular tubes.

[0006] Nowadays the tubes with oval or elliptical or similar section are produced or fabricated mainly in two ways: or by roller levelling and subsequent welding of a plate, or through press of a tube with a circular section.

[0007] The production or manufacture through roller levelling implies to predispose a plane plate, which is deformed through the known process of roller levelling (or rather it is bent) and then welded in order to obtain a tube with an oval or elliptical o similar section. This method presents a main inconvenient of having to make one or more runs of welding on the plate, with a further cost relative to the realization of the run or bead and a consequent elevated time of production. Moreover the welding must undergo to structural controls, to see if there are points that are not well done. Indeed, the tube having to accomplish structural tasks and being prone to elevated stress, must be carefully dimensioned.

[0008] For this aim, therefore, a particular dimensioning attention shall be given to the bead as it presents a possible point of structural weakness. Moreover, the welding generates on the tube a number of problems related to the shrinkage of the metal, and therefore to eventual deformation of the tube, and problems related to the thermal treatment that the metal stands to, as a result of the same welding, that entails a distribution of the tube's stress not always optimal in order to structurally use it as it has been produces.

[0009] The production or manufacture through press, on the other hand, comprises a tube with circular section, which is inserted between two castings applied on the press and therefore deformed until the desired shape of the oval or elliptical or similar section is reached. It is clear how this procedure requires powerful, and therefore expensive, machineries. The power required for the press to deform the tube, is directly proportional to different factors, between which are found the thickness of the tube, the length of the tube, the diameter of the tube, the deviation of the oval or elliptical or similar profile from the initial circular profile of the tube.

[0010] The deformation that the tube undergoes during the process according to the present method of the prior art, is applied by the press on the entire length of the tube, which is produced in a single processing phase in the press.

[0011] The press, having to deform the tube contextually on its entire length, requires to have a lot of power. All these turn to require presses that are structurally big and expensive both from the point of view of their maintenance and their operation.

[0012] For this reason, being the thickness of the tubes relevant as they are structural tubes, we are forced to work on tubes that have, not only lengths that are limited and often contained within four meters, but also with reduced diameters and thickness. If it would be necessary to fabricate tubes with a greater length respect to the maximum length obtainable from the press, according to this method, then it should be produced more tubes, welded to each other until the desired length is reached, the whole with additional elevated costs and moreover with a final quality of the product that is not acceptable.

[0013] In conclusion to the actual state of the prior art, until some lengths, typically under four meters and with certain thickness and diameters, the tubes are produced through press, roller levelling and welding, despite this implies strong weakening along the same tube.

Disclosure of invention

[0014] It is therefore the aim of the present invention to give a method and a device for the production of tubes with oval or elliptical or similar section that resolves the above mentioned inconvenient.

[0015] In particular it is the aim of the present invention to give a method and a device for the production of tubes with oval or elliptical section that allows to realize supporting tubes with lengths greater than four meters in an economic way without having to weld different portions of tubes to each other.

[0016] These and other aims are obtained with the present method for the production of tubes with oval or elliptical or similar section and characterized by the fact that it includes at least the operations of:

- prearrangement of a tube with circular section along a path;
- Deformation of the tube along its entire longitudinal length through a deformation applied in different temporal instants for each section of the tube along said path.

[0017] Advantageously, thus, the operation of deformation is obtained by passing the tube between at least two rotating rollers placed in a manner that they are diametrically opposed to each other and each have at least a deformation throat, the rollers defining the path.

[0018] According to this method, thus, the deformation of the section is obtained by passing the tube between two or more rollers that define a compulsory path determining a deformation of the transversal section of the same tube.

[0019] The deformation is therefore not applied to the entire length of the tube instantaneously, but only to the part found between the rollers. The feed of the tube along the path will the allow the deformation of the tube along its entire length. This method allow to overcome the inconvenient of the production through press according to the prior art. Indeed, it is not anymore required the elevated power of the presses requested in order to deform the tube in one time. Moreover such method allow the production of the tube with elliptical section without having to recur to the roller levelling, which presents the above mentioned welding inconvenient.

[0020] In particular, the deformation is obtained by passing the tube (5) between the rollers (3,4),and the deformation happens in correspondence to the transversal section found between the two rollers (3,4). Each two rollers (3,4) have a corresponding deformation throat (30,40), being said deformation throats substantially complementary to the final shape and dimensions of the tube's section.

[0021] Advantageously the deformation of the transversal section of the tube (5) happens in a single passage of the tube (5) between the two rollers (3,4).

[0022] In a first solution, or so called alternative method, the tube is therefore produced comprising in a first phase a tube with a round section along the path and making it pass through the two rollers specially shaped. The tube while passing through the rollers gets deformed, in particular the deformation happens in correspondence to the transversal section found between the two rollers.

[0023] After a single, or more passes of the tube in process through the rollers, the same tube adopts the desired elliptical or egg-shaped section.

[0024] Advantageously the deformation of the transversal section of the tube (5) happens in different passes of the tube (5) between the two rollers (3,4), being said two rollers (3,4) moved toward each other between the first and last passage of the tube (5) through said two rollers (3,4).

[0025] In the case of a process comprising more passes, thus, the two rollers are movable toward or apart from each other in order to obtain gradually the degree of ovalization requested. Substantially in each pass the tube is deformed gradually into the requested shape of the elliptical or egg-shaped section.

[0026] According to another solution of the invention, the deformation is obtained by passing the tube (6) between at least two or more couples of rollers (7 and 8, 9 and 10, 11 and 12, 13 and 14) where each have a deformation throat and are defining such path, said deformation making the tube from a circular transversal section (60) of the tube (6) into an elliptical transversal section (64) obtained gradually, through a number of intermediate deformation (61, 61, 62, 63).

[0027] According to this method, thus, there are different couples of rollers, with the distance between the centres gradually closer to each other, in a way that the tube with a round section reach the first couple of rollers and start the deformation of a first section of the tube. Afterwards the tube proceeds toward the second couple of rollers that have a smaller distance between centres compare to the first couple of rollers, and while the first section of the tube is deformed by the second couple of rollers, a second section of the tube is deformed by the first couple of rollers.

[0028] This way the power required to make the deformation of the tube is considerably reduced respect to the method of production according to the prior art that comprises the deformation of the tube substantially along the entire length in a sole pressing operation. In the prior art, indeed, the deformation happened along the entire length of the tube, while according to the teaching of the present invention the deformation happens on the sections that go sequentially between the processing rollers.

[0029] Moreover the tube so produced, does not need any welding, as in the case of the production through roller levelling, and thus it is exempted from the above disadvantages.

[0030] On the tube are visible signs left from the processing according to the present invention, and thus the tube produced through the method of the present invention is immediately recognizable. The passage of the tube during the processing between a couple of rollers or more couple of rollers, leaves a trace that longitudinally extends along the tube, in particular in correspondence of the points of the elliptical section that are placed in the zone where the two opposed rollers of each couple interface. The trace is given by the fact that the rollers, being reverse-rolling, act in the opposite direction on the material of the tube during the processing, and therefore leaving a trace that is easily identifiable. Moreover, the passage along the rollers, helps the orientation of the fibres of the tube according to the direction of great pressure and thus improve the technical features of strength

to combined bending and compressive stress.

[0031] It is also described a device for the production of tubes with oval or elliptical or similar sections and characterized by the fact that it comprises at least two rollers placed diametrically opposed to each other and each supplied with at least a deformation throat, said rollers defining a path.

[0032] Advantageously each two rollers (3,4) have a corresponding deformation throat (30,40), being said deformation throats substantially complementary to the final shape and dimensions of the section (51) of the tube (5) at the end of the processing.

[0033] Alternatively the present device comprises two or more couple of rollers (7 and 8, 9 and 10, 11 and 12, 13 and 14)aligned and where each subsequent couple of rollers present within the rollers constituting the same couple a shorter distance respect the preceding couple.

[0034] Moreover the shape of the throats of the couples of rollers (7 and 8, 9 and 10, 11 and 12, 13 and 14) have such a dimension to correspond to the deformation of the transversal section that we want to obtained, and in particular each subsequent couple of rollers present deformation throats with shape and dimensions different from the shape and dimensions of the preceding couple.

[0035] In order to allow the insertion of the tube along the path without causing deflections of the same, at least one of said rollers is motorized, or rather supplied with an engine able to transmit the rotational motion to the same roller.

[0036] Advantageously all the rollers are motorized, or rather supplied with an engine, for example an electric motor, able to transmit the rotational motion to the same roller.

[0037] Moreover are comprised supporting means, constituted by idle and/or motorized supporting cylinders on which the tube leans on. This way it is possible to bring and maintain the tube into the insertion position.

[0038] The motorized rollers will provide then to pull, during the process, automatically the tube without causing deflections on it.

[0039] Alternatively the tube is sustained and/or moved between said rollers through a cable or a chain or similar that goes through the tube and is supported by an overhead crane, and/or by means of an overhead crane or similar able to grab the tube at the extremities.

Brief description of drawings

[0040] Further features and advantages of this method and device, according to the invention, will be clearer with the description that of one of its pattern realization that follows, made to illustrate but not limit, with reference to the annexed drawings, in which:

- Figure 1 shows a transversal section of a tube before the processing;
- Figure 2 shows a transversal section of a tube before the processing; 1 after the processing according to the present invention;
- Figure 3 shows a transversal section of two rollers for the processing according to the present invention;
- Figure 4 shows an exploded view of fig. 3;
- Figure 5 shows a simplified top view of a first executive solution of the method and device according to the present invention;
- Figure 6 shows a simplified top view of a second executive solution of the method and device according to the present invention;

Description of a preferred pattern realization

[0041] In figure 1 it is represented a transversal solution 1 of a metallic tube for structural use. Such tube has typically diameters that range from 100mm to 800mm and thickness that range from 6mm to 30mm. The tubes to which the present invention is aimed at, are prevalently for structural use, or rather they constitute the supporting elements for constructions, as for example buildings or similar.

[0042] The tube's section is therefore deformed from a circular section 1 as fig. 1 to an elliptical or more generally round section, as section 2 shown in fig. 2.

[0043] The rounding of the tube's section happens through a continuous and progressive deformation along a predefined transversal section of said tube.

[0044] By continuous and progressive deformation along a predefined transversal section of the tube, it is intended that the tube is deformed in a continuous manner for its entire longitudinal length, but such deformation is applied in different time-slots for each transversal section of the same tube.

[0045] The method and the device for the realization of the above method present two alternative and preferred executive solutions, the first shown in a simplified way in fig. 5 and the second shown in fig. 6.

[0046] In particular, referring to the first solution, and with reference to fig. 5, are illustrated a tube 5 and two rollers 3 and 4. The rollers, placed diametrically opposed to each other, define indeed a route of passage and deformation forced to the tube.

[0047] In particular, the tube during the processing passes through the two rollers 3 and 4 that supplied with deformation throats 30 and 40 shown in fig. 4 and complementary to the final shape and dimensions that shall approach the tube at the end of the processing. In particular the deformation throats 30 and 40 are realized in such a way that each throat realizes half of the ellipse.

[0048] The throats 30 and 40 present therefore an elliptical profile, and in particular in the first executive solution present an elliptical profile with shape and dimensions equal to the ones requested at the end of the processing, therefore, since the tube 5 in process from a circular section 50 will have to go through an elliptical or round section 52, the deformation throats 30 and 40 will have an inner profile that is complementary to the elliptical section 52 of the tube.

[0049] The throats 30, 40 of the rollers 3 and 4 are placed at a shorter distance than the diameter of the tube 50, in particular can be placed, in the case of a single run of the tube through the rollers, to a distance that is substantially equal to the shorter semiaxis of the ellipsis 51 (look also at figure 3).

[0050] The double direction arrow indicates that the tube can be realized in the first solution both with one run, and more runs.

[0051] In the case of tubes with big dimensions or with higher thickness, this last one could be indeed necessary, in order to split the deformation of the tube during the processing into a multiplicity of little deformations, that are realized by passing the tube many times in an alternated way through the rollers 3 and 4 approaching them at each passage of the tube. The rollers 3 and 4 in this case are reciprocally movable toward each other, for example through means of pneumatic movement, not illustrated.

[0052] In this case the tube 5 is inserted between the rollers and during a first run between them, undergoes to a partial deformation. The rollers 3 and 4 are then drawn up and the tube 5 goes again through the rollers 3 and 4 undergoing to a second deformation. The process can be repeated a number of times, until the rollers 3 and 4 are placed at a minimum distance, corresponding to the realization of the deformation of the transversal section of the tube into an elliptical shape 51.

[0053] With reference to Fig. 6 it is shown an executive solution, where it can be seen a first number of rollers 7 and 8, a second set of rollers 9 and 10, a third set of rollers 11 and 12, a forth set of rollers 13 and 14, the tube during the processing 6 and the deformation 60, 61, 62, 63, 64 of the transversal section of the tube 6 in correspondence of each couple of rollers, starting from the circular section 60 until the elliptical section 64.

[0054] The proportions are only to be taken as examples.

[0055] In this executive solution the tube goes through each couple of rollers 7 and 8, 9 and 10, 11 and 12, 13 and 14, where these rollers are placed at different distances from each other.

[0056] In particular each subsequent couple of rollers presents between the rollers, constituting the same couple, a shorter distance comparing to the preceding couple. The terms preceding and subsequent are to be intended with reference to the direction of the tube between the rollers during the processing.

[0057] In this manner the deformation from the transversal circular section 60 of the tube 6 to the transversal elliptical section 64 happens gradually, through a number of intermediate deformations 61, 61, 62, 63.

[0058] There could be a preferred number of couples of rollers, that make the intermediate deformations. The shape of the throats of the couples of rollers 7 and 8, 9 and 10, 11 and 12, 13 and 14 have such a dimension to correspond to the deformation of the transversal section that we want to obtained, and in particular each subsequent couple of rollers present deformation throats with shape and dimensions different from the shape and dimensions of the preceding couple.

[0059] In both the solutions the tube during the processing is leant on supporting means, not illustrated comprising for example idle or motorized supporting cylinders on which the tube leans on.

[0060] In both the executive solutions, moreover, it is possible to have at least one roller, preferably all the rollers, motorized, or rather supplied with an engine, for example an electric motor, able to transmit the rotational motion to the same roller. This way it is not necessary to push the tube between the rollers causing possible dangerous deflections of it but it will be automatically "pulled" from the same reverse-rotating rollers.

[0061] Alternatively or in combination the tube can be sustained and/or moved between said rollers through a cable or a chain or similar that goes through the tube and is supported by an overhead crane, or by means of an overhead crane or similar able to grab the tube at the extremities.

[0062] The method and device according to the present invention could also be used to obtain tubes with any section, in particular with a different shape from the elliptical section shown here as an example, simply by changing the shape of the throats 30 and 40, and comprising a throat's shape that is complementary to the requested shape, provided that the same does not present back drafts.

Claims

1. Method for the production of tubes with oval or elliptical or similar section and **characterized by the fact that** it includes at least the operations of:

   - prearrangement of a tube with circular section along a path;
   - Deformation of said tube along its entire longitudinal length through a deformation applied in different temporal instants for each section of the tube along said path.

2. Method according to claim 1 **characterized by** the fact that said operation of deformation is obtained through the passage of said tube between at least two reverse-rotating rollers placed diametrically opposed to each other and each supplied with at least a deformation throat, said rollers defining said path.

3. Method according to one or more of the previous claims **characterized by** the fact that said operation of deformation is obtained through the passage of said tube (5) between two reverse-rotating rollers (3,4), and where said deformation happens in correspondence of the transversal section comprised between said two rollers (3,4), being each of said

two rollers (3,4) supplied with a corresponding deformation throat (30,40) being said deformation throats substantially complementary to the final shape and dimensions of the tube's section at the end of the processing.

4. Method according to claim 3 **characterized by** the fact that said operation of deformation of said transversal section of said tube (5) happens with a single run of said tube (5) between said two rollers (3,4).

5. Method according to claim 3 **characterized by** the fact that said operation of deformation of said transversal section of said tube (5) happens in different runs of the tube (5) between the two rollers (3,4), being said two rollers (3,4) moved toward each other between the first and last run of the tube (5) through said two rollers (3,4).

6. Method according to claim 2 **characterized by** the fact that said deformation is obtained by passing said tube (6) between at least two or more couples of rollers (7 and 8, 9 and 10, 11 and 12, 13 and 14) where each have a deformation throat and are defining such path, said deformation making the tube from a circular transversal section (60) of the tube (6) into an elliptical transversal section (64) obtained gradually, through a number of intermediate deformation (61, 61, 62, 63).

7. Device for the production of tubes with oval or elliptical or similar sections and **characterized by the fact that** it comprises at least two rollers placed diametrically opposed to each other and each supplied with at least a deformation throat, said rollers defining a path.

8. Device according to claim 7 **characterized by** the fact that said two rollers (3,4) have a corresponding deformation throat (30,40), being said deformation throats substantially complementary to the final shape and dimensions of the section (51) of the tube (5) at the end of the processing.

9. Device according to claim 7 **characterized by** the fact that comprises two or more couple of rollers (7 and 8, 9 and 10, 11 and 12, 13 and 14) aligned and where each subsequent couple of rollers present within the rollers constituting the same couple a shorter distance respect the preceding couple.

10. Device according to claim 9 **characterized by** the fact that the shape of the throats of the couples of rollers (7 and 8, 9 and 10, 11 and 12, 13 and 14) have such a dimension to correspond to the deformation of the transversal section that we want to obtained, and in particular each subsequent couple of rollers present deformation throats with shape and dimensions different from the shape and dimensions of the preceding couple.

11. Device according to one or more of claims from 7 to 10 **characterized by** the fact that at least one of said rollers is motorized, or rather supplied with a engine able to transmit the rotational motion to the same roller.

12. Device according to one or more of claims from 7 to 11 **characterized by** the fact that all rollers are motorized, or rather supplied with an engine, for example an electric motor, able to transmit the rotational motion to the same roller.

13. Device according to one or more of claims from 7 to 12 **characterized by** the fact that it comprises also means of support, constituted by idle and/or motorized supporting cylinders on which the tube leans on.

14. Device according to one or more of claims from 7 to 13 **characterized by** the fact that said tube is sustained and/or moved between said rollers through a cable or a chain or similar that goes through the tube and is supported by an overhead crane, and/or by means of an overhead crane or similar able to grab the tube at the extremities.

15. Device according to one or more of claims from 7 to 14 **characterized by** the fact that it realizes the method according to one or more of claims from 1 to 6.

16. Tube with elliptical, oval or similar section realized through the method according to one or more of claims from 1 to 6 and/or through a device according to one or more of claims from 7 to 15.

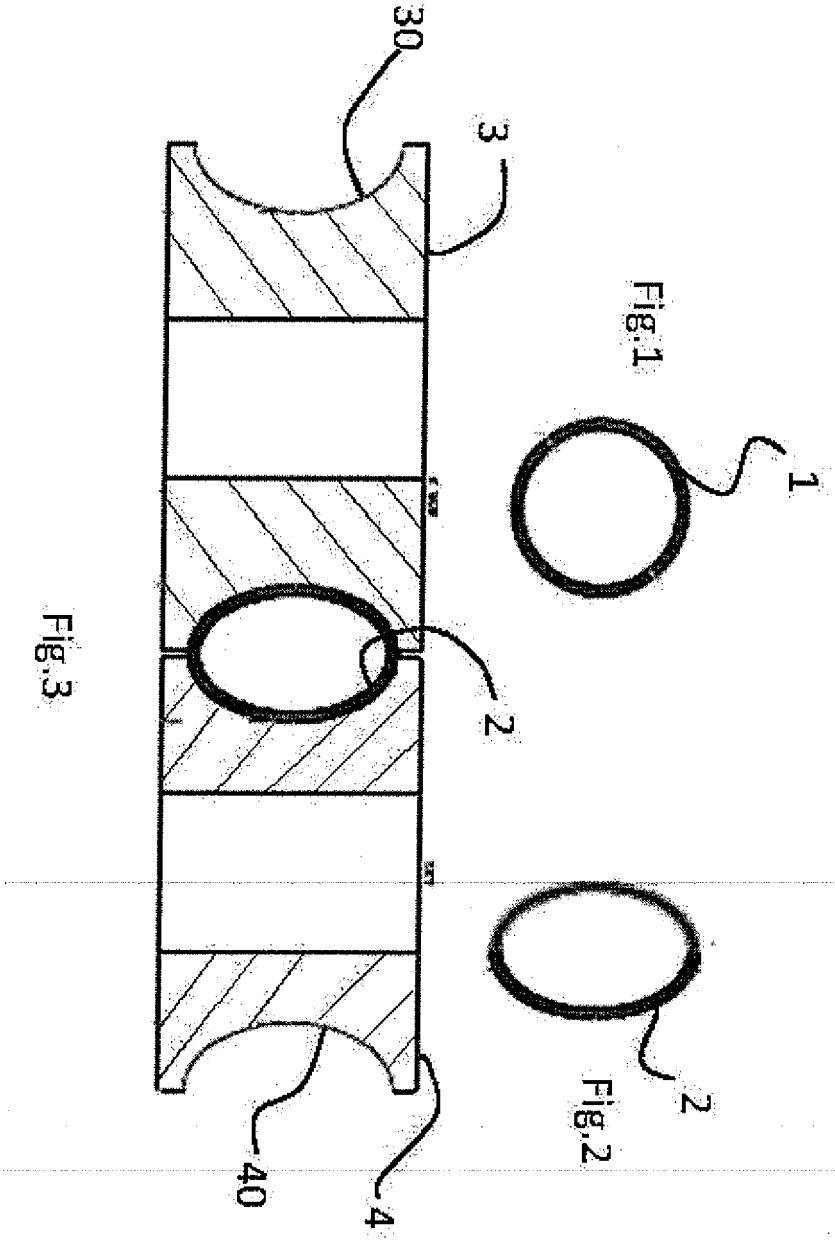


Fig.3

Fig.1

Fig.2

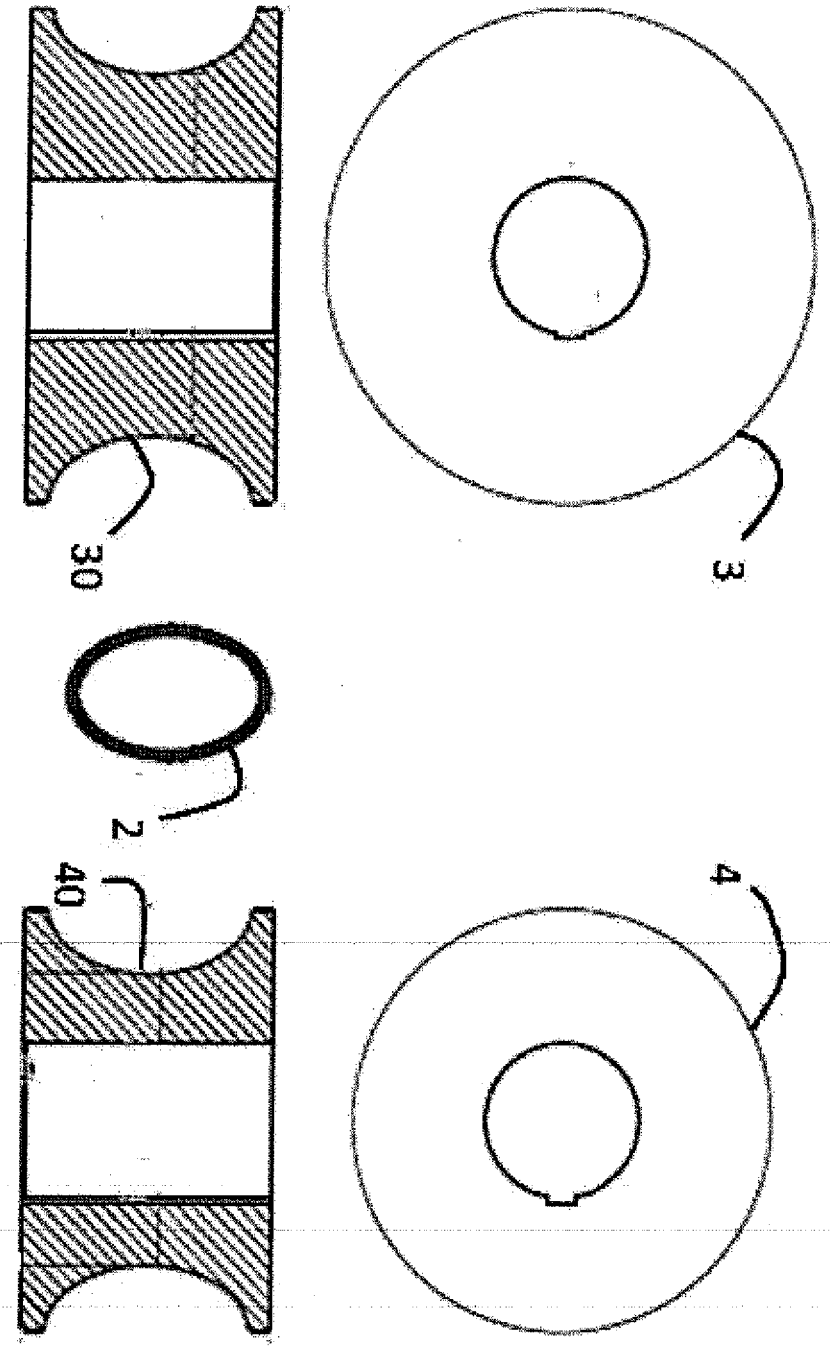
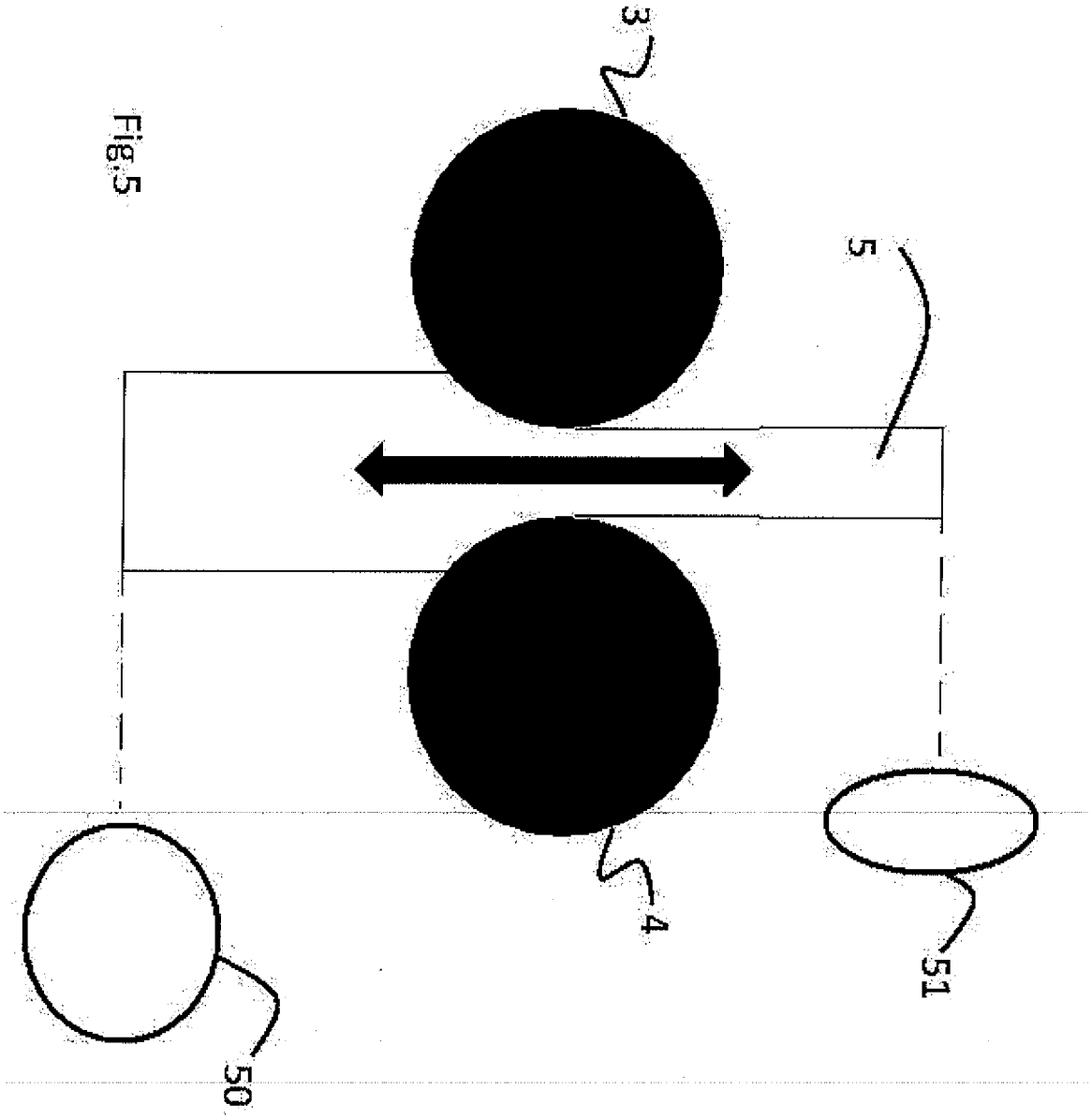


Fig.4

Fig.5



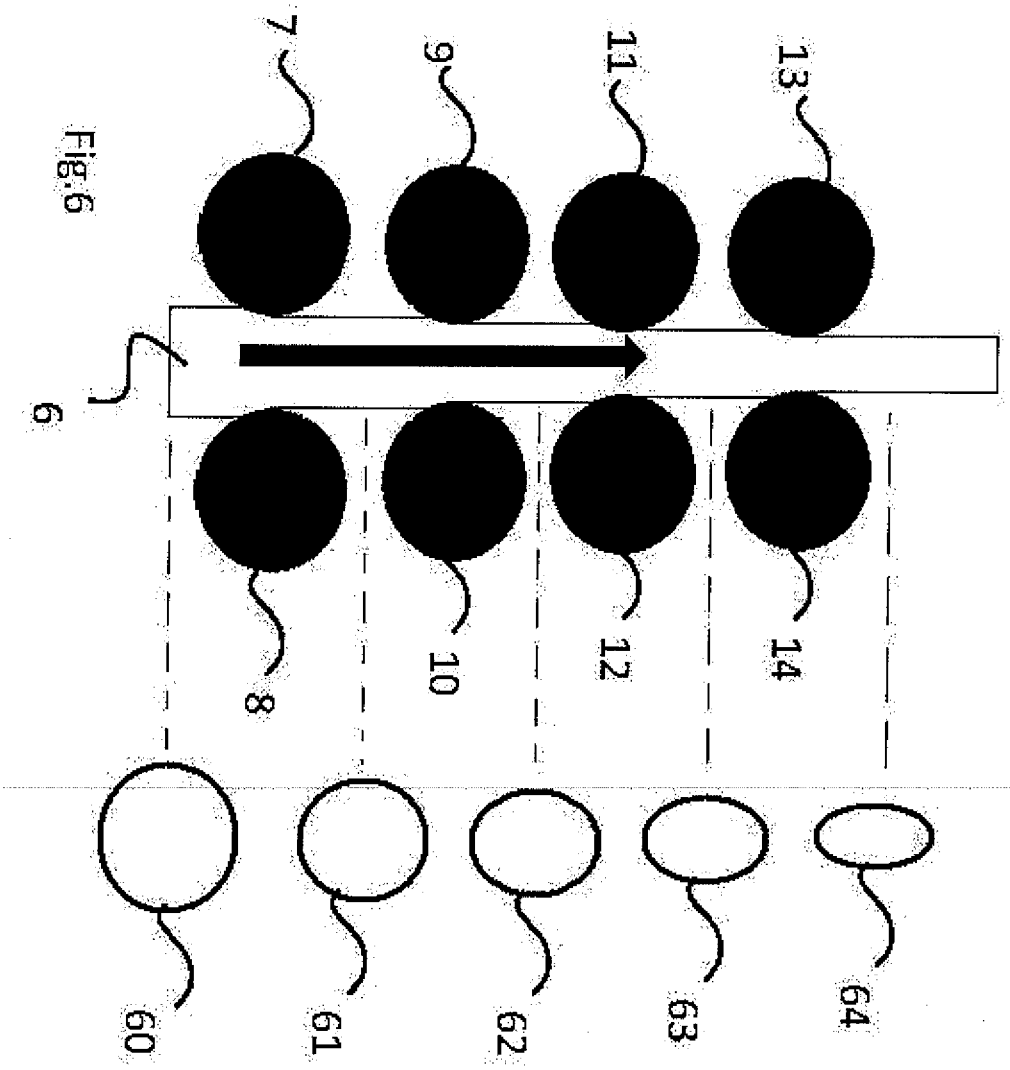


Fig.6

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
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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	21 August 2008	Cano Palmero, A

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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