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(71) Applicant *(for all designated States except US)*: **SAMICK PRECISION IND. CO., LTD.** [KR/KR]; 952-2, Wolam-dong, Dalseo-gu, Daegu 704-833 (KR).

(72) Inventors; and

(75) Inventors/Applicants *(for US only)*: **JIN, Moon Young** [KR/KR]; 101/1301 Hwasung Town Sungsae 2nd, Igok-dong, Dalseo-gu, Daegu 704-140 (KR). **CHO, Choong Rae** [KR/KR]; 205/704 Buyoung e-Green, Dongcheon-dong, Buk-gu, Daegu 702-737 (KR). **CHO, Dong Hyun** [KR/KR]; 102/1202 Dongseo-Youngnam, Guam-dong, Buk-gu, Daegu 702-757 (KR). **KIM, Geun Young** [KR/KR]; 182, Yongheung-ri, Daega-myeon, Seongju-gun, Gyeongbuk 719-863 (KR).

(74) Agent: **LEE, Sang-mock**; B-1802, Samhomulsan Bldg. 275-6, Yangjae-dong, Seocho-gu, Seoul 137-941 (KR).

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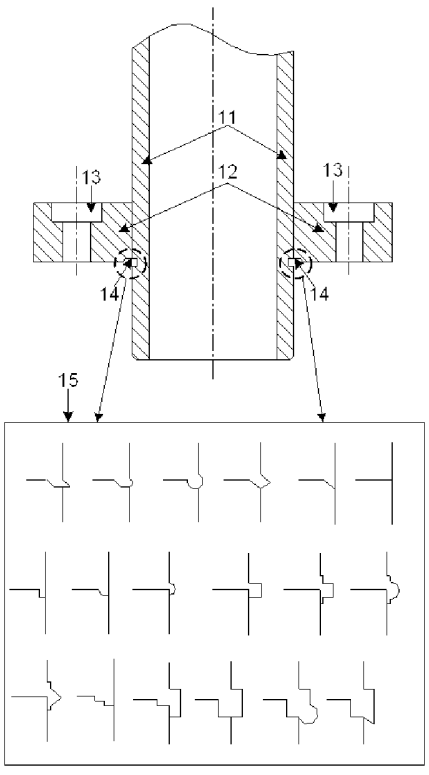
(54) Title: A MANUFACTURING METHOD OF MACHINERY PARTS FOR LINEAR MOTION AND LINEAR BUSHING MANUFACTURED BY THE ABOVE METHOD



(57) Abstract: Disclosed herein are a flanged type linear bushing formed by coupling of an outer sleeve and a flange and a manufacturing method of the same. The manufacturing method includes the steps of: machining an edge of an outer sleeve at a predetermined angle for a smooth coupling between a flange and the outer sleeve; forming a recess on the outer periphery of the outer sleeve in uniform depth and width in consideration of thickness of the outer sleeve for permitting an easy laser welding after coupling the flange and the outer sleeve with each other; machining an inside edge of flange along with inner circle of flange in a form corresponding to the recess formed on the outer sleeve to permit the easy laser welding; coupling the flange and the outer sleeve manufactured by the above steps; and welding the coupled portion, where the recess formed on the outer sleeve and the structure formed on the flange are coupled with each other, with high energy beam, or welding the coupled portion with high energy beam of good linearity while feeding filler metal of a predetermined diameter to the coupled site at a predetermined speed. The present invention can improve productivity through automation of process, obtain dimensional stability and precision, and reduce manufacturing costs by reducing the number of manufacturing processes.

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Description

A MANUFACTURING METHOD OF FLANGE TYPE LINEAR BUSHING USING LASER AND FLANGE TYPE LINEAR BUSHING MANUFACTURED BY THE ABOVE METHOD

Technical Field

[1] The present invention relates to a manufacturing method of a flanged type linear bushing, which includes machining an edge of an outer sleeve at a predetermined angle for a smooth coupling between a flange and the outer sleeve, coupling the flange and outer sleeve, welding the coupled portion with high energy beam or welding the coupled portion with high energy beam of good linearity while feeding filler metal to a welding site, and a flanged type linear bushing manufactured by the above method.

Background Art

[2] In general, a flanged type linear bushing is manufactured by a cold forging method, a brazing bonding method, a adhesive bonding method, a shrink fitting method, a method for screwing an outer sleeve and a flange, a wedge and nut assembling method, and a snap ring fixing method. The cold forging method has several problems since a manufacturing process is complicated. If uniform and stable structure is not obtained by relieving of stress generated during the cold forging and annealing of fibrous structure, the cold forging process causes difficulty on materials to having a good turning performance, surface evenness, and mechanical properties due to the stress resulted from carburization for hardness. Copper brazing is one of the most used method in metal bonding, but has a problem in that it causes lowering of strength of the parent metal, lowering of surface hardness and increasing brittleness since material is deformed and decarburized during brazing due to required high temperature for the melt flow of copper. Furthermore, the adhesive bonding method has several problems since it is very difficult to control appropriate surface roughness, tolerance of dimension, maintenance of clean surface and environmental pollution from bonding material. The method for screwing the outer sleeve and the flange has a problem in that process costs are expensive since the process must be precise, and the screw joint may be loosened during use.

[3] The wedge and nut assembling method and the snap ring fixing method have a problem in that it is difficult to make products of good quality since machinedportions are complicated and manufactured products cannot maintain uniform standard quality due to difficulty of assembly which often occurred by dimensional deviation of components.

[4] Moreover, the cold forging method and the brazing bonding method in the con-

ventional manufacturing methods have further problem in that the machining procedure is complicated and it is difficult to apply on automatic process for mass production since the surface of flanged linear bushing should be machined as a solid form of flanged type of linear bushing through entire the steps of turning, thermal treatment, surface treatment and grinding.

Disclosure of Invention

Technical Problem

[5] Accordingly, it is an object of the present invention to provide a manufacturing method of a flanged type linear bushing, which includes the steps of: machining an edge of an outer sleeve at a predetermined angle for a smooth coupling between a flange and the outer sleeve; forming a recess on the outer periphery of the outer sleeve in uniform depth and width in consideration of thickness of the outer sleeve for an easy laser welding after coupling the flange and the outer sleeve with each other; machining an inside edge of a flange along with inner circle of a flange in a form corresponding to the recess formed on the outer sleeve to permit the easy laser welding; coupling the flange and the outer sleeve manufactured by the above steps; and welding the outer sleeve with recess and the flange with inside edge cut which are coupled with each other, with high energy beam, or welding the coupled portion with high energy beam of good linearity while feeding filler metal of a predetermined diameter to the coupled site, and a flanged type linear bushing manufactured by the above method, thereby reducing manufacturing costs by improving productivity through automation and reducing the number of manufacturing processes.

[6] It is another object of the present invention to provide a manufacturing method of a flanged type linear bushing and a flanged type linear bushing manufactured by the above method, which can save management expenses by reducing stock quantities of components in comparison with the integrated type linear bushing by the brazing bonding method or the cold forging method since the outer sleeve and the flange are separately manufactured and can be supplied when they are needed to be coupled and welded with high energy beam of good linearity.

[7] It is still another object of the present invention to provide a manufacturing method of a flanged type linear bushing and a flanged type linear bushing manufactured by the above method, which can minimize deformation of a welded portion and obtain good welding performance since high energy is supplied only to a tiny area of the welding site in a short time of period using high energy beam. It is necessary to design and manufacture a flange and an outer sleeve in a structure to have no influence on the outward appearance and operation of using before they are welded with high energy beam of good linearity.

[8] It is yet another object of the present invention to provide a manufacturing method of a flanged type linear bushing and a flanged type linear bushing manufactured by the above method, which a stress buffering structure capable of absorbing stress generated by welding can be formed adjacent to a welding site at the flange, thereby preventing or minimizing defects generated by the thermal stress when the outer sleeve and the flange are coupled and welded with each other with high energy beam of good linearity.

[9] It is a further object of the present invention to provide a manufacturing method of a flanged type linear bushing and a flanged type linear bushing manufactured by the above method, which a filler metal made of alloy (nickel, chrome, and others) and having a predetermined diameter is located and fed to the coupled site between the flange and the outer sleeve if necessary so that the filler metal is co-melted with the materials of coupled portion by high energy beam and penetrated into the coupled portion, thereby strengthening the welded portion and providing good welding performance by absorbing stress generatedduring direct welding of outer sleeve and flange, of which materials have different compositions, respectively.

Technical Solution

[10] The above technical problems can be solved by a manufacturing method of a flanged type linear bushing, which includes the steps of: machining an edge of an outer sleeve at a predetermined angle for a smooth coupling between a flange and the outer sleeve; forming a recess on the outer periphery of the outer sleeve in uniform depth and width in consideration of thickness of the outer sleeve for permitting an easy laser welding after coupling the flange and the outer sleeve with each other; machiningthe inside edge of flange along with inner circle of flange in a form corresponding to the recess formed on the outer sleeve to permit the easy laser welding; coupling the flange and the outer sleeve manufactured by the above steps; and welding the coupled portion, where the recess formed on the outer sleeve and the structure formed on the flange are coupled with each other, with high energy beam, or welding the coupled portion with high energy beam of good linearity while feeding filler metal of a predetermined diameter to the coupled site, and a flanged type linear bushing manufactured by the above method.

Advantageous Effects

[11] The present invention can improve productivity through automation and reduce manufacturing costs since the outer sleeve and the flange are separately designed and manufactured and integrally coupled with each other and the coupled portion is easily welded with high energy beam of good linearity, for example, laser.

[12] Furthermore, the present invention can save management expenses by reducing

stock quantities of components in comparison with the integrated type linear bushing made by the brazing bonding method and the cold forging method since the outer sleeve and the flange are separately manufactured and can be supplied when they are needed to be coupled and welded with high energy beam of good linearity.

[13] Moreover, the present invention can minimize deformation of a welded portion and obtain good welding performance since high energy is supplied only to the tiny area of welded site in a short time of period using high energy beam. It is necessary to design and manufacture a flange and an outer sleeve in a structure to have no influence on the outward appearance and operation of using before they are welded with high energy beam of good linearity.

[14] In addition, the present invention can further prevent or minimize defects generated by thermal stress of welding when the outer sleeve and the flange are coupled and welded with each other with high energy beam of good linearity, since a stress buffering structure capable of absorbing stress generated by welding is formed adjacent to a welding position at the flange.

[15] Additionally, the present invention can strengthen the welded portion and provide good welding performance by absorbing stress generated during direct welding of outer sleeve and flange, of which materials have different compositions, respectively. The filler metal made of alloy (nickel, chrome, and others) and having a predetermined diameter is located and fed on the coupled site between the flange and the outer sleeve if necessary so that the filler metal is co-melted with the materials of coupled portion by high energy beam and penetrated into the coupled portion.

Brief Description of the Drawings

[16] FIG. 1 is a view showing a state where a flange and an outer sleeve according to the present invention are coupled with each other (the flange is welded and fixed at the middle of the outer sleeve);

[17] FIG. 2 is a view showing a state where the flange and the outer sleeve according to the present invention are coupled with each other (the flange is welded and fixed at the end of the outer sleeve);

[18] FIG. 3 is a view showing a position of filler metal is feeding on a welding site in order to minimize stress generated during direct welding of outer sleeve and flange, of which materials have different compositions, respectively; and

[19] FIG. 4 is a view showing a size and a form of the filler metal and high energy beam located at the coupled site when the flange and the outer sleeve are welded with each other according to the present invention.

[20]

[21] <Explanation on essential reference numerals in drawings>

[22] 11: outer sleeve 12: flange

[23] 13: fixing bolting hole offlange

[24] 14: welding site for coupled the flange and the outer sleeve

[25] 15: example of various trenched forms of welding portion between the flange and the outer sleeve for providing easy and good welding

[26] 21: buffering structure capable of absorbing stress generated when high energy beam is supplied into the coupled portion

[27] 22: filler metal supplied to absorb stress and permit good welding

[28] 23: coupled site for welding (coupled by structures according to 15)

[29] 24: size of high energy beam

[30] 25: transferring means (head) of high energy beam

Best Mode for Carrying Out the Invention

[31] According to the present invention, a flanged type linear bushing is manufactured by mechanically coupling an outer sleeve and a flange without forming a special structure for permitting an easy welding in order to simplify a manufacturing process, and welding the coupled portion with high energy beam. In more detail, the method for manufacturing the flanged type linear bushing includes the steps of: a) machining an edge of the outer sleeve at a predetermined angle for a smooth and mechanical coupling between the flange (12) and the outer sleeve (11) which are manufactured separately; b) forming a right angle between the plane of flange and the axis outer sleeve by mechanically coupling the flange and the outer sleeve with each other; and c) welding the coupled site between the outer sleeve and the flange with high energy beam (laser or electron beam) which has good linearity. The step a) is for the easy coupling of coupling the flange and the outer sleeve, and the step a) can be omitted in consideration of an economical efficiency if it is not necessary.

Mode for the Invention

[32] Reference will now be made in detail to the preferred embodiments of the present invention, examples of which are illustrated in the accompanying drawings. FIG. 1 is a view showing a state where a flange and an outer sleeve according to the present invention are coupled with each other (in the case where the flange is welded and fixed at the middle portion of the outer sleeve), FIG. 2 is a view showing a state where the flange and the outer sleeve according to the present invention are coupled with each other (in the case where the flange is welded and fixed at the end portion of the outer sleeve), FIG. 3 is a view showing a position of filler metal fed on a welding portion beforethe coupled portion between the flange and the outer sleeve is welded in order to minimize stress generated during direct welding of outer sleeve and flange, of which materials have different compositions, respectively, and FIG. 4 is a view showing a

size and a form of the filler metal and high energy beam located at the coupled site when the flange and the outer sleeve are welded with each other according to the present invention.

[33] According to the present invention, the outer sleeve and the flange are respectively designed and manufactured in such a way that they can be coupled with each other. After the coupling, flanged type linear bushing is manufactured by welding the flange and the outer sleeve with high energy beam of good linearity. A method for manufacturing the outer sleeve includes the steps of: cutting a raw material to a necessary size; turning it to obtain the inner and outer diameters of a desired size; heat treating it to have a necessary hardness; barreling it to remove burr generated during the turning process after the heat treatment; grinding it to obtain precise dimensions and surface roughness using a grinder; and cleaning it to remove oil or fine dust coming from the grinding process. A method for manufacturing the flange includes the steps of: heat treating a raw material to remove the micro-cracks of the material and enhance a process capability, cutting it to a necessary size; turning and milling it to obtain desired size and form; and cleaning it. In general, a conventional brazing bonding has been used copper as a brazing filler metal, but has a disadvantage in that it causes lowering of strength of the parent metal, lowering of surface hardness and increasing brittleness due to deformation and decarburization of the material after brazing since the temperature for the melt flow of copper is high (1000℃ to 1200℃). So, to solve the above problem, additional heat treatment (800℃ to 900℃) has to be done before grinding and cleaning the material after bonding of the outer sleeve and the flange.

[34] In the present invention, the shape of outer sleeve and the flange are pre-designed and manufactured during the machining processto form a specific trenched structure after coupling ofthe flange and the outer sleeve for easy and convenient welding. In more detail, during the manufacturing process of the flange and the outer sleeve, the flange and the outer sleeve according to the present invention can have various shape or recessed structure to form a trenched structure (15) of coupled portion after coupling so that the respectively manufactured flange and outer sleeve can be easily welded with high energy beam (24) of good linearity without having any trouble of welding and application of the flanged type linear bushing. The insertion and press fitting process is important step for precise coupling of the structures formed on the flange and the outer sleeve with each other, before welding high energy beam is carried out.

[35] Alternatively, a filler metal (22) (a thin wire type) of a predetermined diameter can be fed onto the coupled site between the flange and the outer sleeve, when welding is carried out, so as to prevent or minimize defects of the welded portion and provide good welding. The filler metal (22) is made of alloy (nickel, chrome, and so on) capable of absorbing stress, and stress may be generated during direct welding of me-

chanically coupled outer sleeve and flange, of which materials have different compositions, respectively. Thus, during welding using high energy beam, the filler metal isco-melted with the materials of coupled portion by high energy beam and penetrated into the coupled portion and release the stress.

[36] As another method for manufacturing the flanged type linear bushing according to the present invention, to reduce the manufacturing expenses and number of process, the flanged type linear bushing can be manufactured by simple adjusting an incidence angle of high energy beam instead of forming the structure to permit the easy coupling and welding between the outer sleeve and the flange.

[37] In general, the welding of the coupled portion according to the present invention can be carried out uniformly using means for rotating a weldment, or moving a head of a welding machine generating high energy beam, or means for moving both of the weldment and the head of the welding machine. Hereinafter, various preferred embodiments according to the present invention will be described in more detail.

[38]

[39] [First Embodiment]

[40] The first preferred embodiment of the present invention relates to a method for manufacturing the flanged type linear bushing using high energy beam of good linearity by machining an inside edge of the flange. The method for manufacturing the flange type linear bushing includes the steps of: a) machining an inside edge of flange along with inner circle of flange, which will be coupled with an outer sleeve, in order to get easiness of coupling and good welding, and also in order to eliminate the interference of protruding melted and welded surface of flanged linear bushing with a reference plane of application base when it is installed; b) mechanically coupling the outer sleeve with the processed flange at a right angle between the plane of flange and the axis of outer sleeve to each other; and c) welding the coupled portion of the inside edge machinedflange and the outer sleeve, using high energy beam of good linearity.

[41]

[42] [Second Embodiment]

[43] The second preferred embodiment of the present invention relates to a method for manufacturing the flanged type linear bushing including the steps of forming various structures for permitting easy mechanical coupling and welding of an outer sleeve and a flange with each other, and welding the coupled portion with high energy beam after precise coupling. In more detail, the method for manufacturing the flanged type linear bushing includes the steps of: a) machining an edge of the outer sleeve at a predetermined angle for a mechanically smooth coupling of the outer sleeve with the flange; b) forming a recess on the outer periphery of the outer sleeve in predetermined depth and width in consideration of thickness of the outer sleeve to permit an easy

access of high energy beam (laser or electron beam) of good linearity and a good welding after the coupling between the flange and the outer sleeve; c) machining an inside edge of flange along with inner circle of flange to form a required structure for an easy mechanical coupling and an easy laser welding; and d) mechanically coupling the outer sleeve and the flange which are respectively prepared in necessary forms and sizes through the above process to coincide the recess of the outer sleeve and the structure of the flange with each other, and locating the axis of outer sleeve (11) and plane of the flange (12) at a right angle to each other, and welding the coupled portion with high energy beam of good linearity. In the step c), the recess of the outer sleeve and the machined structure of the flange may have various forms according to the use purpose of the flange and a position coupled with the outer sleeve. That is, the recess of the outer sleeve and the structure of the flange are not restricted to one form, and may form various structures (15) and sizes (round type, inclined type, tiered type, valley type, and so on)in consideration of easy and good welding, outward appearance after welding, relief of stress, and so on. And, the flange itself can be manufactured in various forms such as a round form, an oval form, a square form or a rectangular form according to the application and location of use. Moreover, the flange can be located at the end or middle portion of the outer sleeve and coupled with other structure according to the length and use purpose.

[44] Furthermore, if necessary, a stress buffering structure for absorbing stress due to the welding may be formed adjacent to the welding site at the flange in order to further prevent or minimize defects which may be caused by thermal stress due to high energy when the outer sleeve and the flange are coupled and welded with high energy beam of good linearity. The step a) for forming the structure for the easy coupling between the flange and the outer sleeve can be omitted in consideration of an economical efficiency.

[45]

[46] [Third Embodiment]

[47] The third preferred embodiment of the present invention relates to a method for manufacturing a flanged type linear bushing by utilizing a filler metal to prevent defect of the welded portion and provide good welding of coupled portion, since the filler metal can absorb the stress generated due to the high energy of welding by co-melting of filler metal with the materials of coupled portion and penetrating into the welded portion between a flange and an outer sleeve which are made of materials with different compositions, respectively.

[48] The method for manufacturing a flanged type linear bushing using the filler metal will be described in more detail. After the step b) of the first embodiment, the method for manufacturing a flanged type linear bushing using the filler metal in the first

preferred embodiment further includes the steps of: c) closely locating the filler metal, which is made of alloy and has a predetermined diameter, to the coupled site (23) between the flange and the outer sleeve; and d) welding by co-melting of filler metal with the materials of coupled portion and penetrating into the welded portion using high energy beam (laser or electron beam) of good linearity while continuously feeding the filler metal to the coupled site.

[49] After the step d) of the second embodiment, the method for manufacturing a flanged type linear bushing using the filler metal in the second preferred embodiment further includes the steps of: e) closely locating the filler metal, which is made of alloy and has a predetermined diameter, to the coupled site (23) between the flange and the outer sleeve; and f) welding by co-melting of filler metal with the materials of coupled portion and penetrating into the welded portion using high energy beam (laser or electron beam) of good linearity while continuously feeding the filler metal to the coupled site.

[50]

[51] [Fourth Embodiment]

[52] The fourth preferred embodiment of the present invention relates to a method for manufacturing a flanged type linear bushing without having any interference of protruding welded surface of flanged linear bushing with a reference plane of application base when it is installed, in the first embodiment and the third embodiment, by utilizing a trenched structure which is formed by coupling of the recessed outer sleeve and the machining processed flange, as referring to FIGS. 1 and 2, in the case where the outer sleeve and the flange are coupled with each other through the steps of closely locating the filler metal to the coupled site between the outer sleeve and the flange on which a bolt head is placed, and welding the coupled portion while feeding the filler metal to the coupled site using high energy beam of good linearity.

[53] Hereinafter, the fourth preferred embodiment will be described in more detail. The method for manufacturing the flanged type linear bushing includes the steps of: a) coupling the outer sleeve with the flange by fitting, as can be referred in Fig. 1 and Fig. 2, after forming a recess structure on the outer sleeve and a machined structure on a flange, respectively; b) mechanically coupling the outer sleeve and the flange at a right angle; c) closely locating the filler metal to the coupled site between the outer sleeve and the flange on which a bolt head is placed; and d) welding the coupled portion between the outer sleeve and the flange, where the filler metal is located, using high energy beam of good linearity while feeding the filler metal to the coupled site. According to the fourth preferred embodiment, since a protrusion of welded area is located below the plane of flange in the flanged linear bushing, it can be easily obtai ned the flange type linear bushing without having any interference of protruding

welded surface of flanged linear bushing with a reference plane of application base when it is installed. The filler metal serves to minimize defects by considerably absorbing stress generated due to high energy to the welded area between the outer sleeve and the flange which are made of materials with different compositions, respectively, and to provide strong and good welding efficiency by being co-melted with the materials of coupled portion and penetrated into the welded portion using high energy beam (laser or electron beam) of good linearity

[54] As in the best mode for carrying out the invention and in the first preferred embodiment, the flange and the outer sleeve are separately manufactured. After that, when a consumer selects the flange and the outer sleeve, the selected flange and outer sleeve are mechanically and simply coupled with each other, and then the coupled portion between the flange and the outer sleeve is welded. Alternatively, as in the best mode for carrying out the invention and in the first and second preferred embodiments, the filler metal made of alloy and having the predetermined diameter is closely located to the coupled site in a state where the flange and the outer sleeve are mechanically coupled with each other, and then, welded with high energy beam of good linearity so that the filler metal is co-melted with the materials of coupled portion and penetrated into the coupled portion, whereby the present invention can minimize defects of the welded portion and provide good welding efficiency since the filler metal absorbs stress generated from the welded portion between the flange and the outer sleeve by high energy. In the best mode for carrying out the invention and in the first and second preferred embodiments, high energy welding used for coupling the outer sleeve and the flange with each other can be carried out by TIG welding, electron beam welding, and various high output laser. It is preferable that the filler metal is made of alloy material in consideration of the materials of the outer sleeve and the flange, and the diameter (thickness) of the filler metal is smaller than that of high energy beam of linearity which arrives at the coupled site when the outer sleeve and the flange are welded, so that the filler metal is completely melted with the materials of coupled portion and penetrated into the coupled portion during welding. High energy beam of good linearity has to minimize deformationof the welded portion and provide good welding efficiency when high output laser or electron beam is radiated to the welded site. According to this invention, if the laser can generate enough energy to provide good welding performance, any kind of high output laser can be useful to accomplish the purpose the present invention, such as Nd-YAG laser (CW or pulse type, initial high output pulse laser, and so on).

Industrial Applicability

[55] As described above, the present invention can improve productivity through

automation and reduce manufacturing costs since the outer sleeve and the flange are separately designed, manufactured and integrally coupled with each other, and the coupled portion is easily welded with high energy beam of good linearity, such as a laser.

[56] Furthermore, the present invention can reduce quantities in stocks of components and management expenses in comparison with the integrated type linear bushing by the brazing bonding method and the cold forging method since the outer sleeve and the flange are separately manufactured and can be supplied in a state where they are coupled and welded with high energy beam of good linearity if necessary.

Claims

[1] A method for manufacturing a flanged type linear bushing using high energy beam of good linearity, the method comprising the steps of:
a) forming a structure at an inside edge of flange by machining process in order to get a trenched structure after coupled with an outer sleeve for easy welding and preventing a protrusion of welded area over the plane of the flange in the flanged type linear bushing;
b) mechanical coupling the outer sleeve with the machined flange at a right angle between the plane of the flange and the axis of outer sleeve to each other; and
c) welding the coupled site, where the machined flange is in contact with the outer sleeve, using high energy beam of good linearity in a state where the outer sleeve and the flange are coupled with each other.

[2] A method for manufacturing a flanged type linear bushing using high energy beam of good linearity, the method comprising the steps of:
a) forming a recess on the outer periphery of the outer sleeve in order to get a trenched structure after coupled with a flange for easy welding and preventing a protrusion of welded area over the plane of flange in the flanged linear bushing;
b) machining an inside edge of the flange in order to get a trenched structure after coupledwith the above recessed outer sleeve for easy welding and preventing a protrusion of welded area over the plane of the flange in the flanged linear bushing
c) coinciding the outer sleeve and the processed portion of the flange and mechanical coupling the outer sleeve and the flange at a right angle between the plane of flange and the axis of outer sleeve to each other; and
d) welding the coupled site between the outer sleeve and the flange using high energy beam of good linearity.

[3] The method for manufacturing a flange type linear bushing according to claim 1 or 2, further comprising the step of closely locating a filler metal to the coupled site between the outer sleeve and the flange which will be welded, and welding the coupled portion while feeding the filler metal which is made of alloy and has a diameter smaller than that of high energy beam used for welding.

[4] A method for manufacturing a flanged type linear bushing using high energy beam of good linearity, the method comprising the steps of:
a) fitting and coupling an outer sleeve to a flange;
b) mechanically coupling the outer sleeve and the flange at a right angle between the plane of flange and the axis of outer sleeve to each other;
c) closely locating a filler metal to the coupled site between the outer sleeve and

the flange on which a bolt head is placed;

d) welding the coupled site between the outer sleeve and the flange where the filler metal is located, using high energy beam of good linearity while feeding the filler metal to the coupled site.

[5] The method for manufacturing a flanged type linear bushing according to claim 3, wherein high energy beam of linearity used for welding the coupled outer sleeve and flange is one of high output pulse type laser, high output CW laser, and electron beam.

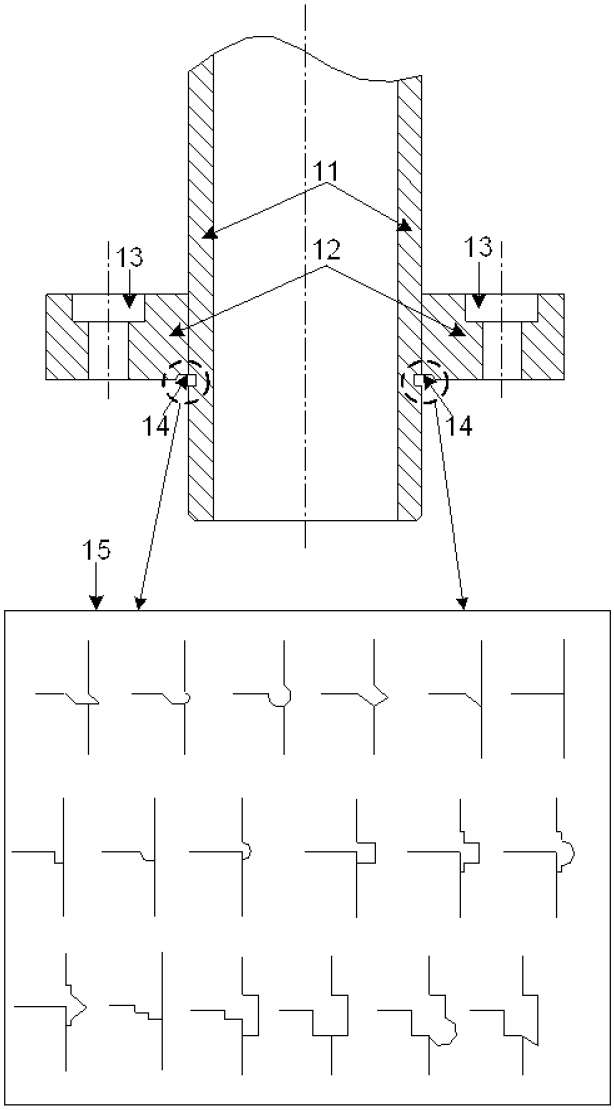
[6] The method for manufacturing a flanged type linear bushing according to claim 5, wherein a stress buffering structure for absorbing stress generated by welding and permitting better welding is formed adjacent to the welding site at flange in order to prevent or minimize defects which may be caused by thermal stress when the outer sleeve and the flange are coupled and welded using high energy beam of good linearity.

[7] A flanged type linear bushing manufactured by the manufacturing method according to claim 1 or 2.

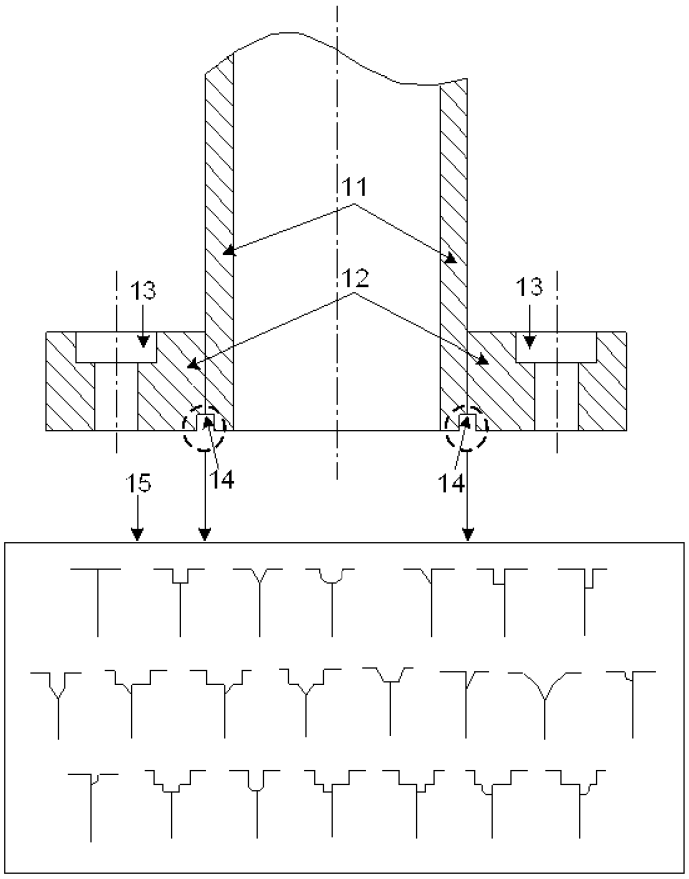
[8] A flanged type linear bushing manufactured by the manufacturing method according to claim 3.

[9] A flanged type linear bushing manufactured by the manufacturing method according to claim 4.

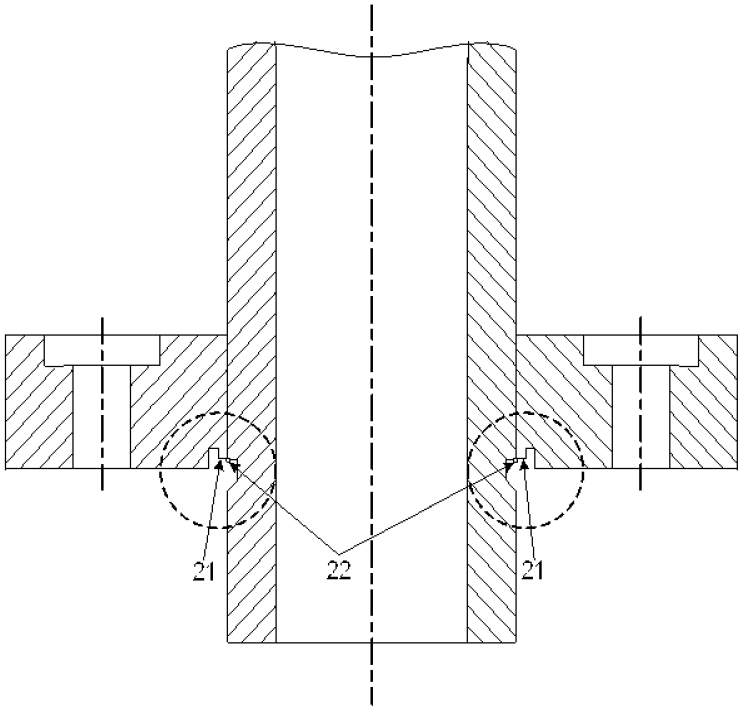
[Fig. 1]



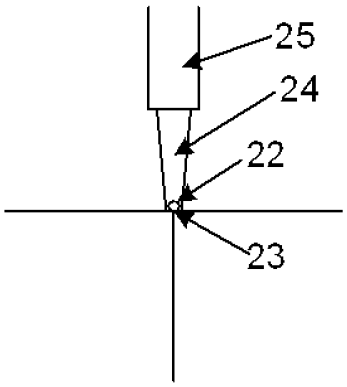
[Fig. 2]



[Fig. 3]



[Fig. 4]



PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference	**FOR FURTHER ACTION**	see Form PCT/ISA/220 as well as, where applicable, item 5 below.
PCT_E0503		
International application No.	International filing date *(day/month/year)*	(Earliest) Priority Date *(day/month/year)*
PCT/KR2005/004545	**26 DECEMBER 2005 (26.12.2005)**	27 JANUARY 2005 (27.01.2005)

Applicant

Samick Precision IND. CO., LTD. et al

This International search report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This international search report consists of a total of 3 sheets.

☐ It is also accompanied by a copy of each prior art document cited in this report.

1. **Basis of the report**
   a. With regard to the **language**, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.
      ☐ The international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).
   b. ☐ With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, see Box No. I.
2. ☐ **Certain claims were found unsearchable** (See Box No. II)
3. ☐ **Unity of invention is lacking** (See Box No. III)
4. With regard to the **title,**
   ☐ the text is approved as submitted by the applicant.
   ☒ the text has been established by this Authority to read as follows:
   A MANUFACTURING METHOD OF MACHINERY PARTS FOR LINEAR MOTION AND LINEAR BUSHING MANUFACTURED BY THE ABOVE METHOD
5. With regard to the **abstract,**
   ☒ the text is approved as submitted by the applicant.
   ☐ the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box No. IV. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.
6. With regard to the drawings,
   a. the figure of the **drawings** to be published with the abstract is Figure No. 1
      ☒ as suggested by the applicant.
      ☐ because the applicant failed to suggest a figure.
      ☐ because this figure better characterizes the invention.
   b. ☐ none of the figure is to be published with the abstract.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2005/004545

A. CLASSIFICATION OF SUBJECT MATTER

B23P 13/00(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC8 B26B, B23K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
KR.JP : classes as above

Electronic data base consulted during the intertnational search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP59-189092 A (TOSHIBA CORP.) 26 October 1984 see claim, figure 1-7	4,9
A	JP4-200887 A (HITACHI LTD.) 21 July 1992 see abstract	1,2,4
A	JP1-186280 A (MITSUI CONSTR CO. LTD.) 25 July 1989 see abstract	1,2,4
A	JP57-36083 A (TOSHIBA CORP.) 26 February 1982 see abstract	1,2,4

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents,such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
24 MARCH 2006 (24.03.2006)	**24 MARCH 2006 (24.03.2006)**

Name and mailing address of the ISA/KR	Authorized officer
Korean Intellectual Property Office 920 Dunsan-dong, Seo-gu, Daejeon 302-701, Republic of Korea Facsimile No. 82-42-472-7140	LEE, Jin Uk Telephone No. 82-42-481-5514

Form PCT/ISA/210 (second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/KR2005/004545

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