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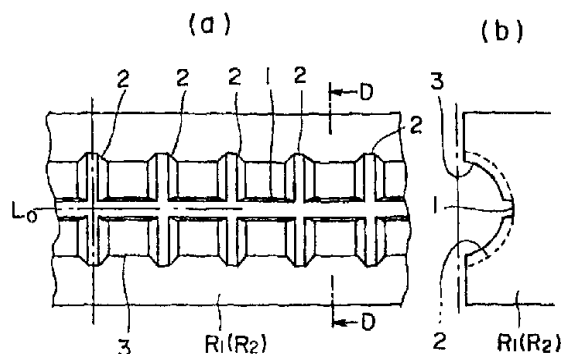
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(54)Title: METHOD OF ROLLING DEFORMED BAR AND ROLL FOR DEFORMED BAR

(54)発明の名称 異形棒鋼の圧延方法および異形棒鋼用ロール



(57) Abstract

A deformed bar having knots and four ribs on its surface is produced by performing the final finish rolling by means of a two-roll rolling mill. Rolls R_1 , R_2 of the two-roll rolling mill have a peripheral groove (3), knot grooves (2) and a bottom groove (1). The peripheral groove (3) is substantially semi-circular in cross section, and is provided over the whole peripheral surface of the roll. The knot grooves (2) are made in the groove surfaces of the peripheral groove (3) and have a predetermined width so as to cross the peripheral groove (3). The cross section of the bottom groove (1) is an isosceles trapezoid and the groove (1) is provided along the center line of the peripheral groove (3) over the whole circumference of the peripheral groove.

(57) 要約

最終仕上圧延を2ロール圧延機で行うことによって節と4本のリブが形成された異形棒鋼を得る。最終仕上用2ロール圧延機で使用するロール(R₁, R₂)は、周溝(3)と節溝(2)と底溝(1)とを有する。周溝(3)は、断面が略半円状であって、ロール周面に、周方向全体に渡って形成されている。節溝(2)は、この周溝(3)の溝面に、この周溝(3)と交差するように所定幅で形成されている。底溝(1)は、断面が等脚台形状であり、周溝(3)の溝幅方向中心部に、周方向全体に渡って形成されている。

情報としての用途のみ

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ABSTRACT

A steel bar for concrete reinforcement having knots and four ribs on its surface is produced by performing the final finish rolling by means of a two-roll rolling mill. Rolls R_1 , R_2 of the two-roll rolling mill have a roll caliber (3), round calibers (2) and a bottom groove (1). The roll caliber (3) is substantially semi-circular in cross section, and is provided over the whole peripheral surface of the roll. The round calibers (2) are made in the groove surfaces of the roll caliber (3) and have a predetermined width so as to cross the roll caliber (3). The cross section of the bottom groove (1) is an isosceles trapezoid and the groove (1) is provided along the center line of the roll caliber (3) over the whole circumference of the roll caliber.

Technical Field

The present invention relates to a two-roll rolling mill for producing steel bar having ribs and knots formed thereon, to a continuous hot rolling method for producing steel bar having four longitudinally extending ribs which
5 utilises the two-roll rolling mill, and to steel bar produced by the method. The steel bar is suitable for concrete reinforcement.

Background Art

10 Fig. 6 shows a usual existent steel bar for concrete reinforcement. In Fig. 6, (a) is a side elevational view and (b) is a cross sectional view taken along line X-X in (a). The steel bar for concrete reinforcement 5 has a plurality of protrusions (knots) 12 formed on a
15 circumferential surface of a round bar material along a circumferential direction substantially at an equal distance in a longitudinal direction. Further, two protrusions (ribs) 4 are formed along the longitudinal direction at positions spaced apart by 180° in the
20 circumferential direction of a cross sectional circle.

Such a steel bar for concrete reinforcement 5 is produced by a final finish rolling mill of a continuous hot rolling facility in which a plurality of 2-roll rolling mills are arranged in tandem by rolling using finishing rolls R_1 ,
5 R_2 as shown in Fig. 7 and Fig. 8.

Fig. 7 is a front elevational view illustrating an arrangement of both of finishing rolls and Fig 8(a) is a developed view for a roll circumferential surface, and (b) is a cross sectional view taken along line Y-Y in (a). As can
10 be seen from the figures, a roll caliber 3 having a substantially semicircular cross sectional shape is formed over the entire circumferential direction to both of finishing rolls R_1 and R_2 for forming a pass for final finishing. Further, a caliber surface of the roll caliber 3
15 is provided with round calibers 2 in perpendicular to the roll caliber 3.

Then, by passing a material S rolled into an elliptic cross section by a row of upstream rolling mills through a pass defined with both of the finishing rolls R_1 and R_2 ,
20 knots 12 corresponding to the round calibers 2 and ribs 4 formed by the material overfill from the gap between the rolls R_1 and R_2 are formed.

Further, the knots of the steel bar for concrete reinforcement are sometimes disposed obliquely to the
25 longitudinal direction. In this case, as shown in Fig. 9,

round calibers 2 of the finishing roll R are formed being inclined by a predetermined angle α relative to the circumferential direction. In Fig. 9, (a) is a developed view for a circumferential surface of the finishing roll R and (b) is a cross sectional view taken along line Z-Z thereof. Also in this case, ribs of the steel bar for concrete reinforcement obtained are only the two ribs formed by metal overfill from a gap between the finishing rolls R.

10 In recent years, such steel bar for concrete reinforcements have been bent by a fabrication machine. In this case, if there are only two ribs, it is difficult to stably support the surface of the steel bar for concrete reinforcement by a feeding device or a supporting device of
15 the fabrication machine. Accordingly, it has been demanded a steel bar for concrete reinforcement having four ribs substantially at an equal distance in the circumferential direction. Further, if the ribs are present by four, they also provide a merit of increasing adhesion with concretes.

20 However, a technique for producing a steel bar for concrete reinforcement having four ribs has not yet been established. For instance, according to the technique filed previously by the present applicant and the like (refer to the publication of Japanese Patent Laid-Open Hei
25 7-323302), although a steel bar for concrete reinforcement with four ribs can be produced by using a 4-roll rolling mill as a

final finishing rolling mill, this technique increases a cost. Further, forming four ribs by applying final finish rolling by a 2-roll rolling mill has not yet been put to practical use.

5 The present invention has been accomplished in view of the foregoing and it is an object to obtain a steel bar for concrete reinforcement provided with knots and four ribs by applying final finish rolling by a 2-roll rolling mill.

10 Disclosure of the Invention

15 In a first aspect, the present invention provides a two-roll rolling mill for producing a steel bar having ribs and knots formed thereon, the two-roll rolling mill including a pair of rolls arranged opposing one another, each of the pair of rolls having formed therein:

20 a roll caliber having a substantially semicircular cross sectional shape formed entirely in a circumferential direction on a circumferential surface of the roll;

25 round calibers formed so as to cross the roll caliber on the surface of the roll caliber; and

 a bottom groove having a substantially trapezoidal cross sectional shape and having an opening width larger than a bottom width, and formed entirely over the circumferential direction at a central portion in the direction of the caliber width of the roll caliber,

whereby produced steel bar has two ribs formed by metal overfill from the gaps between the pair of rolls

and two ribs formed by metal flow to the bottom grooves of the pair of rolls.

In a second aspect, the present invention provides a continuous hot rolling method for producing steel bar having four longitudinally extending ribs, the method including passing steel through upstream rolling mills and thereafter passing the steel through a two-roll rolling mill according to the first aspect of the present invention.

10 In a third aspect, the present invention provides steel bar produced by a method according to the second aspect of the present invention.

According to method of the present invention, two ribs are formed by metal flow to the bottom groove formed in each of the rolls in addition to two ribs formed by metal overfill from the gap between the rolls. Since the ribs formed by the bottom groove are disposed in the central portion in the direction of the width of the caliber of the roll caliber, a steel bar for concrete reinforcement having
15 four ribs formed at an equal distance or substantially equal distance in the circumferential direction can be obtained.

Further, for example as shown in Fig. 1, the rolls may be disposed such that the bottom surface of the bottom groove 1 and the bottom surface of the round calibers 2 are aligned, and the round calibers 2 and the roll caliber 3 are perpendicular and, as shown in Fig. 2, it is preferred to perform rolling while setting such a condition that the width of H_1 between ribs 4a and 4b formed by metal overfill
25 and metal flow is aligned or substantially aligned with the
30

diameter A_1 of a cross sectional circle of the round caliber 2.

According to this method, the four ribs are formed each at an equal distance or at a substantially equal distance in the circumferential direction, as well as the outer circumferential surface of all of the ribs is aligned or substantially aligned with the outer circumferential surface of the knot, and the knot is formed at a right angle to the rib.

Further, as shown in Fig. 2, the roll is preferably adapted such that the depth of the bottom groove 1 is 10% or less of a mean diameter of a product, the bottom groove 1 has a substantially isosceles trapezoidal cross sectional shape, an angle made between not parallel two sides is 10° or more, and the bottom width b of the bottom groove 1 is 4% or more of the mean diameter.

Preferably, the substantially trapezoidal shape and the substantially isosceles trapezoidal shape mean shapes in which two parallel sides of the trapezoid (not including parallelogram) and isosceles trapezoid are not strictly linear but are coaxially arcuate. Then, a shorter one of arcs forms the bottom surface of the bottom groove, while the longer one forms the opening. Further, the mean diameter of the product means a mean diameter of a round bar portion excepting the knots and ribs of the steel bar for concrete reinforcement.

Then, as shown in Fig. 2, the advancing speed of the material S is aligned with a rotational speed of the rolls R_1 , R_2 on the circumferential surface, but a corner a in the roll

caliber 3 as an opening of the bottom wall 1 has a small radius of rotation, and the rotational speed at the corner a is slower than the advancing speed of the material s. Therefore, while a excess force exerts on the corner a and
5 tends to cause a crack while rolling, a crack can be suppressed by defining the shape of the bottom groove 1 as described previously.

When it was actually examined whether a crack was caused at the corner a of the roll by varying the angle θ
10 and the groove width b, a result as shown in the graph of Fig. 3 was obtained in a case of setting the depth of the bottom groove 1 to 10% of the mean diameter of the product, which is an upper limit according to JIS standards. From the graph, it can be seen that if the depth of the bottom groove 1 is
15 10% of the mean diameter of the product, no roll crack is caused if the angle θ is 10° or more and the groove width b is 4% or more of the mean diameter of the product. Further, since the roll crack is suppressed as the depth for the bottom groove 1 is smaller, roll crack is not caused also in
20 a case where the depth of the bottom groove 1 is 10% or less for the mean diameter of the product, so long as the angle θ is 10° or more and the groove width b is 4% or more for the mean diameter of the product.

The roll crack is suppressed as the groove width b of
25 the bottom groove 1 is larger and the angle θ is greater,

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and upper limit values for them are determined by product standards defined in accordance with JIS or the like.

Brief Explanation of the Drawings

Fig. 1 is a view illustrating a preferred roll of a 2-roll rolling mill for final finishing, in which (a) is a developed view of a roll circumferential surface and (b) corresponds to a cross sectional view taking along line D-D in (a).

Fig. 2 is a front elevational view illustrating a roll arrangement of a 2-roll rolling mill for final finishing to perform a preferred method of the present invention.

10 Fig. 3 is a graph for explaining the operation of the present invention.

Fig. 4 is a front elevational view illustrating a roll pass of a 2-roll rolling mill for final finishing in one embodiment according to the present invention.

15 Fig. 5 is a illustrating a state in a feed roller for a steel bar for concrete reinforcement obtained by a preferred embodiment according to the present invention in which (a)-(c) represent different states respectively.

20 Fig. 6 is a view illustrating an example of an existent steel bar for concrete reinforcement in which (a) is a side elevational view and (b) corresponds to a cross sectional view taken along line X-X thereof.

Fig. 7 is a schematic view illustrating a roll

arrangement in a 2-rolling mill for final finishing for obtaining a steel bar for concrete reinforcement shown in Fig. 6.

Fig. 8 is a developed view (a) illustrating the roll of Fig. 7 and a cross sectional view (b) taken along line Y-Y thereof.

Fig. 9 is a view illustrating a roll of a 2-roll rolling mill for final finishing used in existent steel bar for concrete reinforcement rolling, in which (a) is a developed view of a roll circumferential surface and (b) corresponds to a cross sectional view taken along line Z-Z in (a).

Best Mode for Practicing the Invention

For explaining the present invention in more details, one embodiment will be explained in accordance with appended drawings.

Fig. 1 is a view illustrating a roll of a 2-roll rolling mill for final finishing used in this embodiment, in which (a) is a developed view for a roll circumferential surface and (b) corresponds to a cross sectional view along line D-D in (a). Further, Fig. 4 is a front elevational view illustrating a roll pass of a 2-roll rolling mill for final finishing formed by the roll in Fig. 1.

As shown in Fig. 1, roll R_1 (R_2) has a roll caliber 3

of a substantially semicircular cross sectional shape formed over the entire circumferential direction at a roll circumferential surface. Further, round calibers 2 each of a predetermined width are engraved to the roll caliber 3 so as to cross the center line L_0 in the direction of the caliber width of the roll caliber 3. The round calibers 2 are formed each at an equal distance along the circumferential direction of the roll caliber 3 (that is center line L_0 in the direction of the caliber width). Further, a bottom groove 1 having a substantially isosceles trapezoidal cross sectional shape and having an opening width greater than the bottom width is formed to the central portion in the direction of the caliber width of the roll caliber 3 over the entire circumferential direction.

As shown in Fig 4, the bottom surface of the bottom groove 1 is aligned with the bottom surface of the round caliber 2. Further, the depth c for the bottom groove 1 and the round caliber 2 is 0.85 mm, the diameter of the pass (mean diameter of the product) A_2 is 15.9 mm, the angle made between the not parallel two sides of the isosceles trapezoid constituting the cross section of the bottom groove 1 is 60° , and the bottom width b of the bottom groove 1 is 2.0 mm.

Further, an inclined portion 3a is formed to a boundary portion of the circumferential surfaces of rolls R_1 , R_3 relative to the roll caliber 3. The roll distance d is

set to 2.0 mm, and the angle made between the inclined portions 3a of both of the rolls R_1 and R_2 is set to 60° . The depth c of the bottom groove 1 corresponds to 5.3% of the mean diameter A_2 of the product, while the groove width b on the bottom of the bottom groove 1 corresponds to 13% of the mean diameter A_2 of the product respectively.

Such a 2-roll rolling mill was installed as a final finish rolling mill, and a round bar material rolled to a predetermined outer diametrical size by a row of ordinary 2-roll mills was put to finish rolling. In this case, as shown in Fig. 2 described above, a roll gap of a roll mill disposed just before the final finish rolling mill was adjusted such that the width H_1 of the ribs 4a, 4b formed by the material S overfill and flow going out of the final finish rolling mill was aligned with the diameter A_1 of the cross sectional circle of the round caliber 2.

As a result, a steel bar for concrete reinforcement in which four ribs were formed in the circumferential direction substantially at an equal distance, the outer circumferential surface of all of the ribs was aligned with the outer circumferential surface of the knot and the knots were formed in perpendicular to the ribs was obtained with no roll crack trouble.

Accordingly, when the thus obtained steel bar for concrete reinforcement 5 is rotated, as shown in Fig. 5(a)-

(c), in a feed roller 6 as a feeding device of a fabrication machine, at least one rib 4 always abuts against each groove surface 6a of the feed roller 6. Therefore, the steel bar for concrete reinforcement is fed accurately while being supported securely on the feed roller 6.

Further, since the knots 12 are in perpendicular to the rib 4, there is also a merit that twist is not caused upon bending fabrication.

Further, in the embodiment described above, since the depth g of the bottom groove 1 is made to 5.3% of mean diameter A_2 of the product and the groove width b on the bottom of the bottom groove 1 is made to 13% of the means diameter A_2 of the product, a steel bar for concrete reinforcement 5 having four ribs 4 was obtained stably with no occurrence of roll cracking trouble.

Industrial Applicability

As described above, in the method of the present invention, a steel bar for concrete reinforcement provided with knots and four ribs can be obtained stably by performing final finish rolling by means of a 2-roll rolling mill.

This enables to obtain a steel bar for concrete reinforcement with four ribs by applying a rolling facility for producing existent 2-ribbed steel bar for concrete reinforcements and merely changing the roll of the 2-roll

rolling mill for final finishing. Accordingly, the method and the roll according to the present invention can be utilized suitably as a method of producing a steel bar for concrete reinforcement having four ribs at a reduced cost and
5 a roll used therefor.

CLAIMS

1. A two-roll rolling mill for producing a steel bar having ribs and knots formed thereon, the two-roll rolling mill including a pair of rolls arranged opposing one another, each of the pair of rolls having formed therein:
- 5 a roll caliber having a substantially semicircular cross sectional shape formed entirely in a circumferential direction on a circumferential surface of the roll;
- 10 round calibers formed so as to cross the roll caliber on the surface of the roll caliber; and
- a bottom groove having a substantially trapezoidal cross sectional shape and having an opening width larger than a bottom width, and formed entirely over
- 15 the circumferential direction at a central portion in the direction of the caliber width of the roll caliber,
- whereby produced steel bar has two ribs formed by metal overfill from the gaps between the pair of rolls and two
- 20 ribs formed by metal flow to the bottom grooves of the pair of rolls.
2. A two-roll rolling mill as claimed in claim 1 wherein a bottom surface of the bottom groove and a bottom surface of the round caliber are aligned and the round
- 25 calibers and the roll caliber are arranged perpendicularly.
3. A two-roll rolling mill as claimed in claim 2 wherein the depth of the bottom groove is 10% or less of the mean diameter of the steel bar, the bottom groove has a substantially isosceles trapezoidal cross sectional
- 30 shape, the angle made between sides of the bottom groove is 10° or more, and the bottom width of the bottom groove is 4% or more of the mean diameter of the steel bar.
4. A two-roll rolling mill for producing a steel bar having ribs and knots formed thereon, the two-roll rolling
- 35 mill being substantially as herein described with reference to Figures 1-5 of the accompanying drawings.

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5. A continuous hot rolling method for producing steel bar having four longitudinally extending ribs, the method including passing steel through upstream rolling mills and thereafter passing the steel through a two-roll rolling mill as claimed in any one of the preceding claims.

6. Steel bar produced by a method as claimed in claim 5.

DATED this 5th day of July 1999

KAWASAKI STEEL CORPORATION

10 By its Patent Attorneys
GRIFFITH HACK

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FIG. 1 (a)

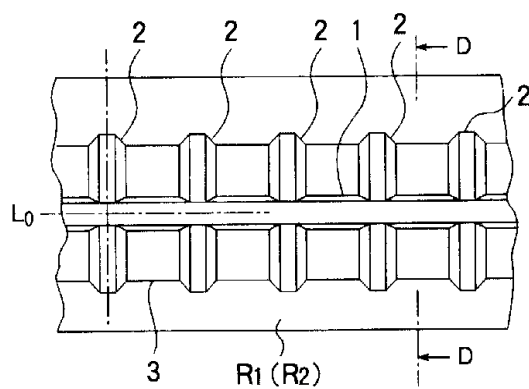


FIG. 1 (b)

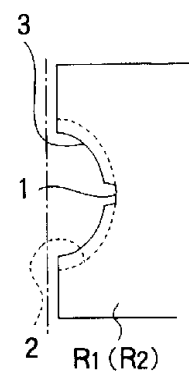


FIG. 2

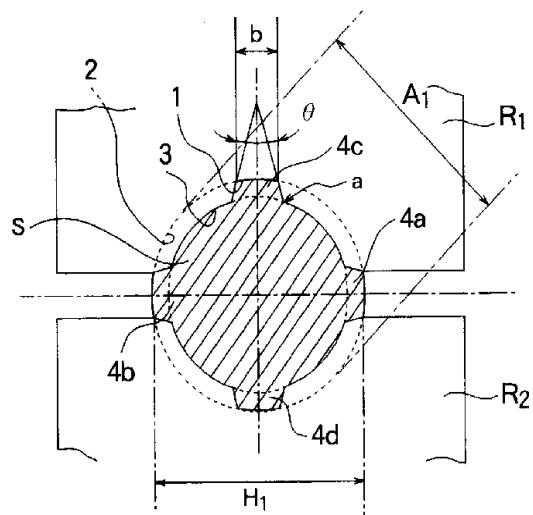


FIG. 3

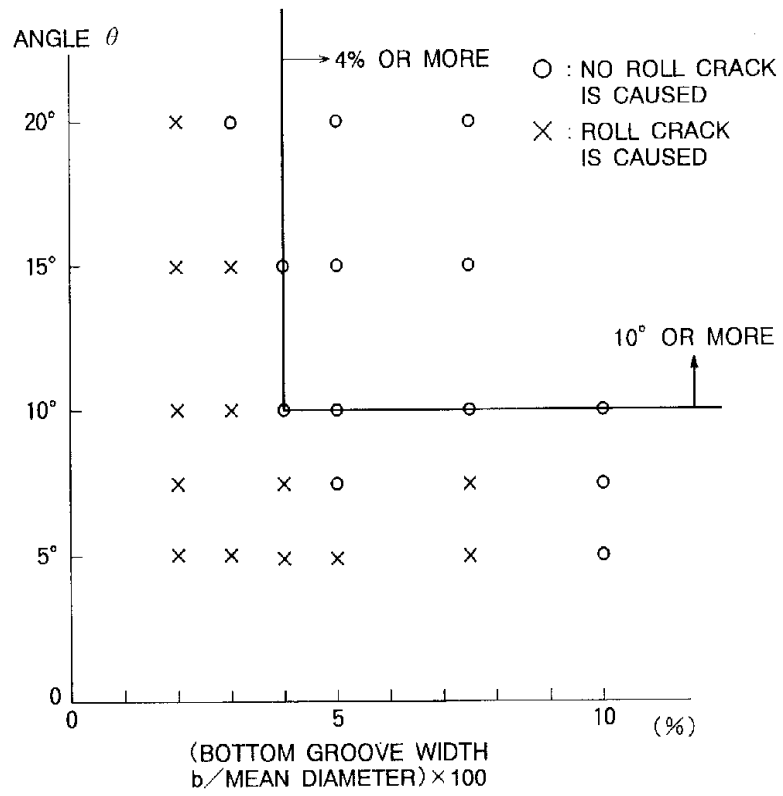


FIG. 4

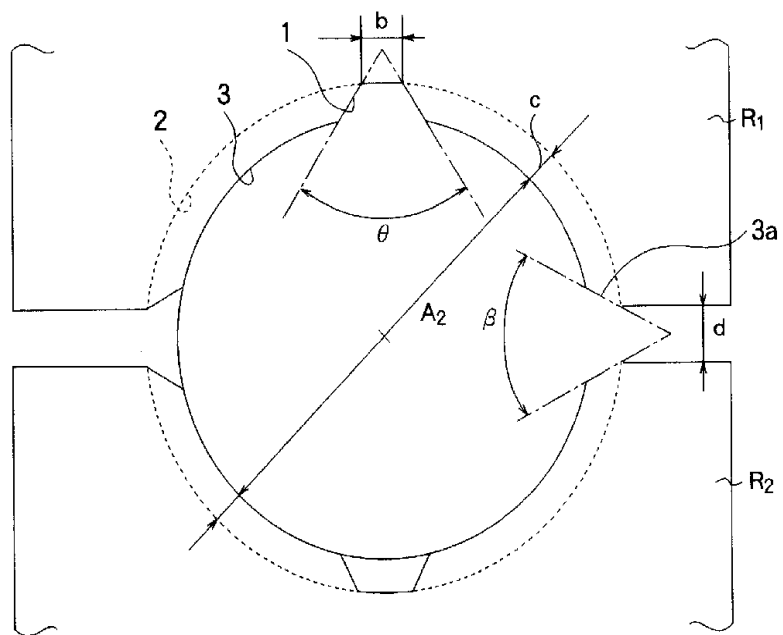


FIG. 5(a)

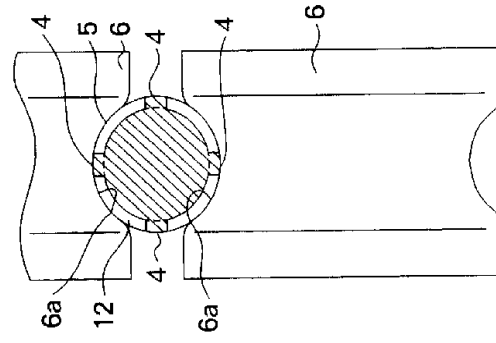


FIG. 5(b)

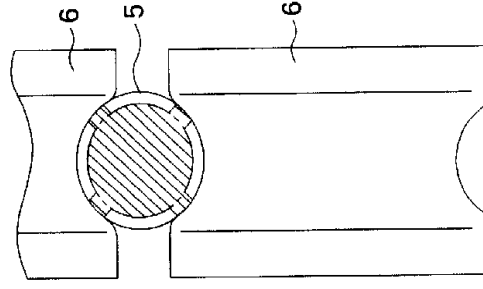


FIG. 5(c)

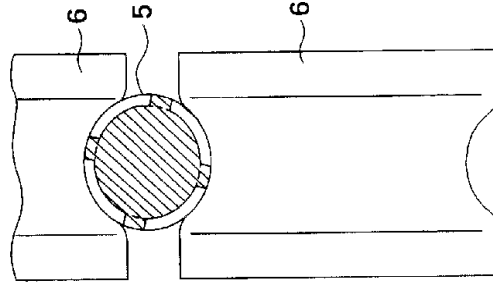


FIG. 6(a)

FIG. 6(b)

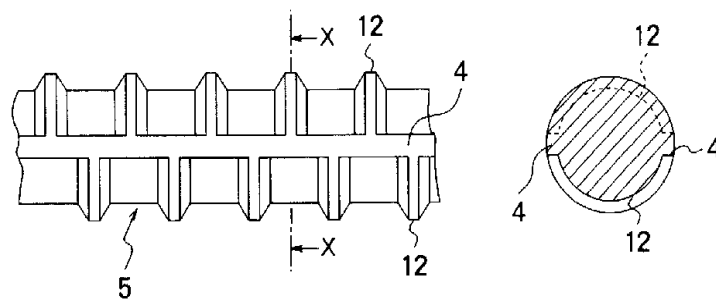


FIG. 7

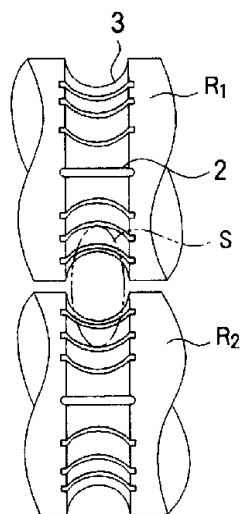


FIG. 8(a)

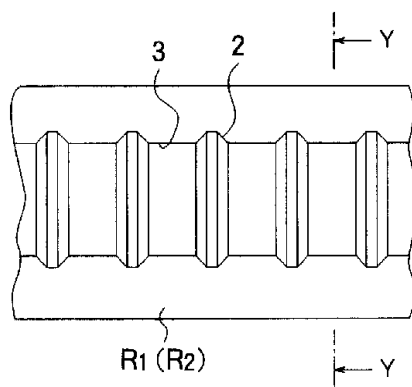


FIG. 8(b)

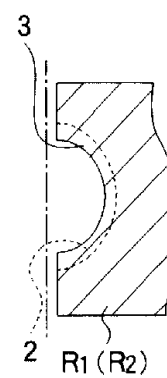


FIG. 9(a)

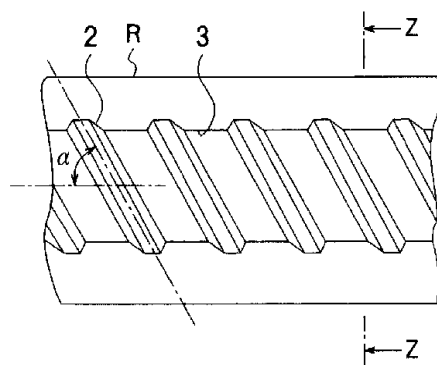


FIG. 9(b)

