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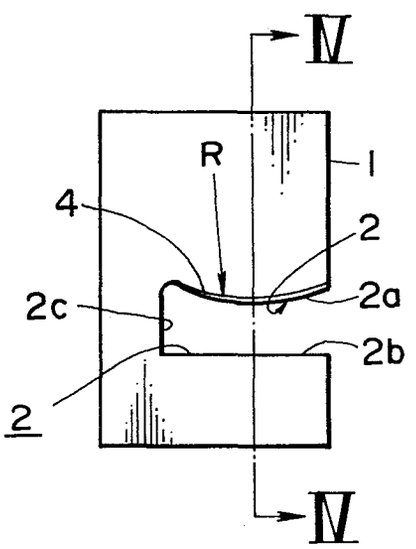
(54) Chamfering method for a curved slot corner.

(57) Chamfering a longitudinally curved slot corner (3) which is formed by a front surface (1c) of a slotted member and longitudinally curved surface (2a) of the slotted member (1) defining a slot (2) is executed as follows. First, the slotted member (1) is held between an upper holder (5) and a lower holder (6). Next, a backup plate (8) whose upper surface (8a) is curved in every plane normal to the longitudinal direction of the backup plate (8) is placed in the slot (2) and a grinding belt (7) is applied to the upper surface (8a) of the backup plate (8) so as to travel in the slot (2). Then, the upper and lower holders (5, 6) are relatively shifted so that the slotted member (1) is tilted, thereby pushing the grinding belt (7) in running against the longitudinally curved slot corner (3) and chamfering it. Since the grinding belt (7) follows the curvature of the curved upper surface (8a) of the backup plate (8), the grinding belt (7) can fit the longitudinally curved slot corner (3) and grind it.



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TITLE OF THE INVENTION

CHAMFERING METHOD FOR A CURVED SLOT CORNER

BACKGROUND OF THE INVENTION

1. Filed of the Invention

The present invention relates to a method by belt-grinding of chamfering a curved slot corner formed by a front surface of a slotted member and a longitudinally curved surface of said slotted member defining a slot.

2. Description of the Prior Art

Chamfering of a straight slot corner which is formed by a front surface of a slotted member and a longitudinally straight surface of said slotted member defining a slot is usually executed as follows. First, the slotted member is held between an upper holder and a lower holder. Next, a backup plate whose upper surface is flat is placed in a slot formed in the slotted member and a grinding belt is applied to the upper surface of the backup plate so as to travel in the slot. Then, by relatively shifting the upper holder and the lower holder in position so that the slotted member may be tilted, the backup plate is pushed toward the straight slot corner to be chamfered by a slot corner which is diagonally opposed to said straight slot corner to be chamfered. The

grinding belt which is running is pressed by the backup plate against the straight slot corner to be chamfered and the chamfering of said straight slot corner is executed.

However, according to the above-mentioned chamfering method, the chamfer width is liable to vary in the longitudinal direction of the slot, when the slot corner is curved in the longitudinal direction of the slot and for this reason, this method of chamfering has been inapplicable to the chamfering of a curved slot corner.

SUMMARY OF THE INVENTION

An object of the present invention is to provide a method for chamfering a longitudinally curved slot corner formed by a front surface of a slotted member and a longitudinally curved surface of said slotted member defining a slot. The chamfering method for a curved slot corner according to the present invention comprises the following steps. The first step is to hold the upper end and the lower end of the slotted member with an upper holder and a lower holder respectively. The second step is to place in a slot of the slotted member a backup plate whose upper surface is curved in a plane normal to the longitudinal direction of the backup

plate. The third step is to apply a flexible grinding belt to the upper surface of the backup plate so as to let the grinding belt travel in the slot. The fourth step is to make said upper holder and lower holder shift relative to each other, thereby tilting the slotted member, and push said backup plate toward a longitudinally curved slot corner to be chamfered by a longitudinally straight slot corner diagonally opposed to said longitudinally curved slot corner, and then press the grinding belt which is running against the longitudinally curved slot corner to be chamfered by said backup plate, thereby executing the chamfering of said longitudinally curved slot corner.

In this method, since the upper surface of the backup plate is curved, the grinding belt, following the curvature of said backup plate, can grind the longitudinally curved slot corner of the slotted member. Thus it is made possible to chamfer a longitudinally curved slot corner, which has been impossible in the conventional method executed by using a flat backup plate.

In this method, by varying the thickness of the backup plate and the curvature of its upper surface, the chamfer angle and the width of the chamfer in the

longitudinal direction of the slot can be arbitrarily selected.

BRIEF DESCRIPTION OF THE DRAWINGS

The above and other objects, features and advantages of the present invention will be apparent and readily understood from the following detailed description of a preferred embodiment of the invention, taken in conjunction with the accompanying drawings, of which:

Figure 1 is a front view of a slotted member before chamfering is executed;

Figure 2 is a sectional view of the slotted member along to line II - II in Fig. 1;

Figure 3 is a front view of the slotted member after chamfering is executed;

Figure 4 is a sectional view of the slotted member along line IV - IV in Fig. 3;

Figure 5 is a partial sectional view of the chamfering device with slotted members held between an upper holder and a lower holder;

Figure 6 is a partial sectional view of the chamfering device in which a backup plate is partly placed in the slots of the slotted members;

Figure 7 is a partial sectional view of the chamfering device in which a grinding belt is applied to the upper surface of the backup plate;

Figure 8 is a whole sectional view of the chamfering device in which the slotted members are being chamfered;

Figure 9 is a sectional view of the slotted member along line IX - IX in Fig. 8;

Figure 10 is an oblique view of the backup plate;

Figure 11 is an oblique view showing a projection of a longitudinally curved slot corner onto a plane normal to the longitudinal direction of the grinding belt; and

Figure 12 is a partial sectional diagram illustrating the relationship among the thickness t of the backup plate, the thickness T of the slotted member, the thickness t' of the grinding belt and the width W of the slot.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Figures 1 and 2 illustrate a slotted member before chamfered by the method of the present invention. Figures 3 and 4 illustrate the same slotted member after chamfered by the method of the present invention. As

seen from the figures, the slotted member 1 constitutes of a plate with a slot 2. The slot 2 extends from one side 1a of the slotted member 1 toward the other side 1b of the member 1 and it is open at said one side 1a. The slot 2 penetrates from the front surface 1c to the back surface 1d of the slotted member 1 in the thickness direction of the member 1.

Of the two longitudinal side surfaces of the slot 2, one side surface 2a is curved in the longitudinal direction of the slot, while the other side surface 2b is flat and longitudinally straight. The side surface 2a is continuous to the bottom surface 2c of the slot 2 and the bottom surface 2c is continuous to the side surface 2b.

In the illustrated example, the side surface 2a consists of a cylindrical surface with a radius R which is convex toward the side surface 2b. The longitudinally curved slot corner 3 which is formed by the longitudinally curved side surface 2a of the slot 2 and the front surface 1a of the slotted member 1 is a corner to be chamfered.

Figures 5 to 9 illustrate the process of chamfering according to the present invention.

As indicated in Fig. 5, first a plurality of slotted members 1 with slots 2 are held between the upper holder 5 and the lower holder 6. The upper holder 5 has

a plurality of grooves 5a which are open downward, while the lower holder 6 has a plurality of grooves 6a which are open upward. The slotted members 1 have their top ends held in the grooves 5a of the upper holder 5 and their bottom ends held in the grooves 6a of the lower holder 6.

The upper holder 5 and the lower holder 6 can be shifted in position relative to each other with parallelness maintained. By this positional shifting, the slotted members 1 are tilted from vertical position.

Next, as indicated in Fig. 6, a backup plate 8 is placed so that it may partly be placed in every slot 2 of the slotted members 1. The upper surface 8a of the backup plate 8a, that is, the belt-contacting surface 8a of the backup plate 8 is curved within every plane normal to the longitudinal direction of the backup plate 8, while the back surface 8b of the backup plate 8 is flat and straight within every plane normal to the longitudinal direction of the backup plate 8.

Next, as indicated in Fig. 7, a grinding belt 7 is applied to the upper surface of the backup plate 8 so as to travel in every slot 2 of the slotted members 1. The grinding belt 7 is flexible and it is made of, e.g., a non-woven textile with one side coated with abrasive

grains. . The grinding belt 7, as seen from Fig. 8, is an endless belt.

Then, as indicated in Fig. 8, the positions of the upper holder 5 and the lower holder 6 are relatively shifted, thereby causing the slotted members 1 to tilt by a chamfering angle.

In this condition, the backup plate 8 is pushed toward the longitudinally curved slot corner 3 to be chamfered at the back surface 8b thereof by a longitudinally straight slot corner 3' diagonally opposed, in the slot cross section, to said longitudinally curved slot corner 3 to be chamfered. Since the side surface 2b of the slot 2 is longitudinally straight and the back surface 8b of the backup plate 8 is also straight in every plane normal to the longitudinal direction of said backup plate 8, in the process of chamfering, the back surface 8b of the backup plate 8 is brought into contact with the whole length of the longitudinally straight corner 3' diagonally opposed to the longitudinally curved slot corner 3. In consequence, the backup plate 8 presses the grinding belt 7, with which it is in contact, against the longitudinally curved slot corner 3 to be chamfered. Thus, the longitudinally curved slot corner 3 can be chamfered by the running grinding belt 7. In this instance, the grinding belt 7

travels in the direction from the front surfaces 1c of the slotted members 1 toward the back surfaces 1d of the members 1.

In the above process of chamfering, since the grinding belt 7 is flexible, it can curve itself following the profile of the curved upper surface 8a of the backup plate 8 and thus well fitting the longitudinally curved slot corner 3 to be chamfered, the grinding belt 7 can form a successful chamfer 4 at the corner 3. In this manner, chamfering of a longitudinally curved slot corner which has been impossible by the conventional chamfering method is rendered possible.

The upper surface 8a of the backup plate 8 contacting with the grinding belt 7 is designed such that its profile within every plane normal to the longitudinal direction of the backup plate 8 is the same as the profile of the projection 9 (see Fig. 11) of the longitudinally curved slot corner 3 onto a plane A normal to the longitudinal direction of the grinding belt 7 when the slotted members 1 are tilted by a chamfer angle θ, that is, the angle of the surface of the chamfer 4 against the longitudinally curved slot surface 2a.

Such a profile of the upper surface 8a of the backup plate 8 makes the width of the chamfer 4 uniform over the entire longitudinal length of the longitudinally

curved slot corner 3. The profile of the upper surface 8a of the backup plate 8 may differ from that of said projection 9, but in such a case, the width of the chamfer 4 will vary in the longitudinal direction of the longitudinally curved slot corner 3.

Meanwhile, as indicated in Fig. 12, the thickness t of the backup plate 8 is in the following relationship with the desired chamfer angle θ, the width W of the slot 2, the thickness t' of the grinding belt 7 and the thickness T of the member 1:

$$t = W\cos\theta - T\sin\theta - t'$$

Therefore, the chamfer angle θ is variable through adjusting the thickness of the backup plate 8. Accordingly the width of the chamfer 4 and the chamfer angle can be controlled.

In a chamfering work, one slotted member 1 or a plurality of slotted members 1 may be held between the upper holder 5 and the lower holder 6. When a plurality of slotted members 1 are held between the upper holder 5 and the lower holder 6 as shown in Fig. 8, the chamfering efficiency can be increased, because a plurality of members 1 can be chamfered in a single chamfering work.

Although only a preferred embodiment of the present invention has been described in detail, it will be appreciated by those skilled in the art that various

modifications and alterations can be made to the particular embodiment shown without materially departing from the novel teachings and advantages of this invention. Accordingly, it is to be understood that all such modifications and alterations are included within the scope of the invention as defined by the following claims.

WHAT IS CLAIMED IS:

1. A chamfering method for a slot corner (3) to bechamfered formed by a front surface (1c) of a slotted member (1) as a workpiece and a surface (2a) of said slotted member (1) defining a slot(2), in which, first, said slotted member (1) is held between an upper holder (5) and a lower holder (6) and next a backup plate (8) is partly placed in said slot (2) and a grinding belt (7) is applied to the upper surface (8a) of said backup plate (8) so as to travel in said slot (2) and then said slotted member (1) is tilted to push said backup plate (8) toward said slot corner (3) to be chamfered by means of a slot corner (3') diagonally opposed to said slot corner (3) and press said grinding belt (7) in running against said slot corner (3) through said backup plate (8), characterized in that said slot corner (3) to be chamfered is curved in the longitudinal direction of said slot (2) and the upper surface (8a) of said backup plate (8) is curved within every plane normal to the longitudinal direction of said backup plate (8) so as to make said grinding belt (7) having flexibility follow the curvature of the upper surface (8a) of said backup plate (8) when pressed and to make said grinding belt (7) fit said slot corner (3) curved in the longitudinal direction of said slot (2) to grind said slot corner (3).

2. A chamfering method of claim 1 characterized in that the upper surface profile of said backup plate (8) within every plane normal to the longitudinal direction of said backup plate (8) is the same as a profile of a projection (9) of said longitudinally curved slot corner (3) to be chamfered onto a plane normal to the longitudinal direction of said grinding belt (7).

3. A chamfering method of claim 1 characterized in that the thickness t of said backup plate (8) is in the following relationship with the desired chamfer angle θ, the width W of said slot(2), the thickness t' of said grinding belt (7) and the thickness T of said slotted member(1):

$$t = W\cos\theta - T\sin\theta - t'$$

4. A chamfering method of claim 1 characterized in that surface (2b) of said slot (2) opposed to said longitudinally curved surface (2a) defining the slot (2) is longitudinally straight and the back surface (8b) of said backup plate (8) is also straight in every plane normal to the longitudinal direction of said backup plate (8) so that, in the process of chamfering, said back surface (8b) of the backup plate (8) is brought into contact with the whole length of said corner (3') diagonally opposed to said longitudinally curved slot corner (3).

5. A chamfering method of claim 1 characterized in that said slot (2) extends from one side (1a) of said slotted member (1) toward the other side (1b) of said slotted member (1) and it is open at said one side (1a).

6. A chamfering method of claim 1 characterized in that a plurality of slotted members (1) are held by said upper holder (5) and said lower holder (6) so that all the longitudinally curved slot corners (3) of said slotted members (1) can be chamfered in a single chamfering work.

7. A chamfering method of claim 1 characterized in that said grinding belt (7) is an endless one.

8. A chamfering method of claim 1 characterized in that said grinding belt (7) consists of a flexible non-woven textile coated with abrasive grains on one side.

FIG.1

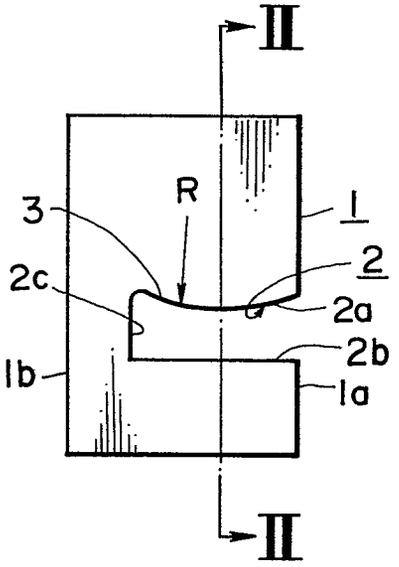

FIG.2

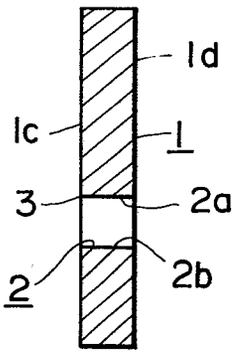

FIG.3

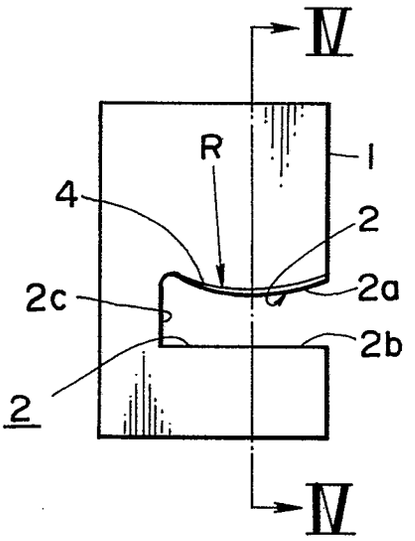

FIG.4

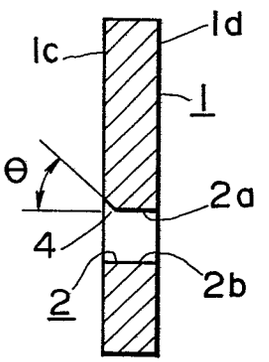

FIG.5

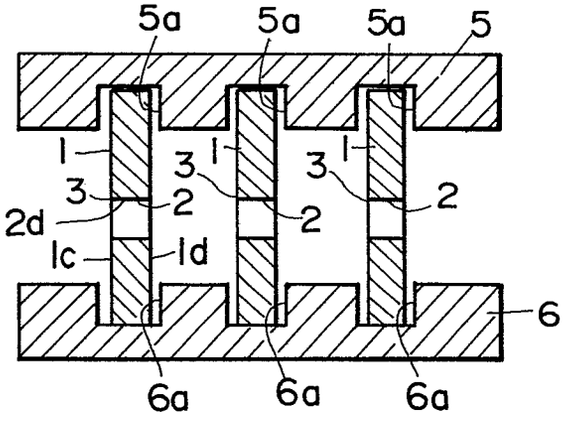

FIG.6

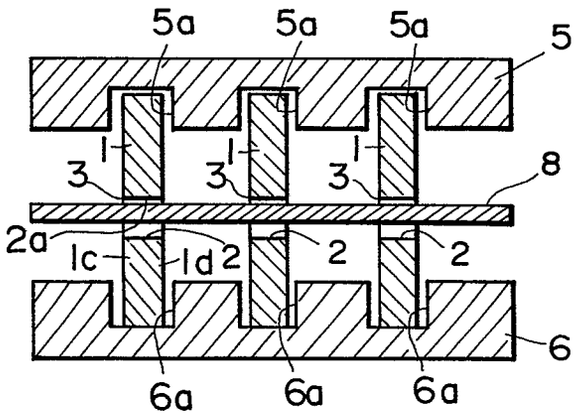

FIG.7

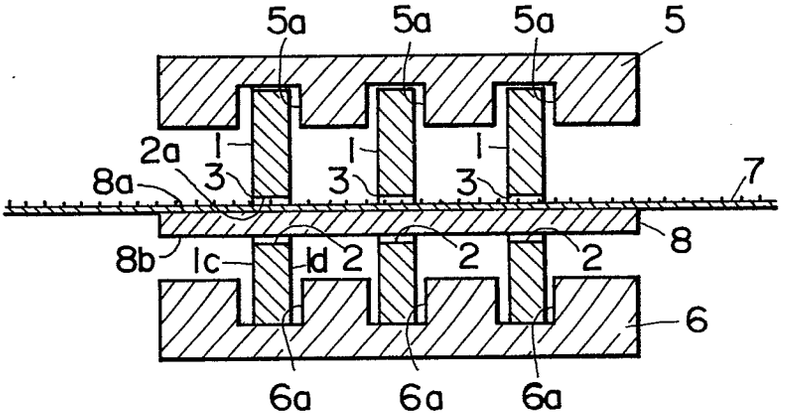

FIG.8

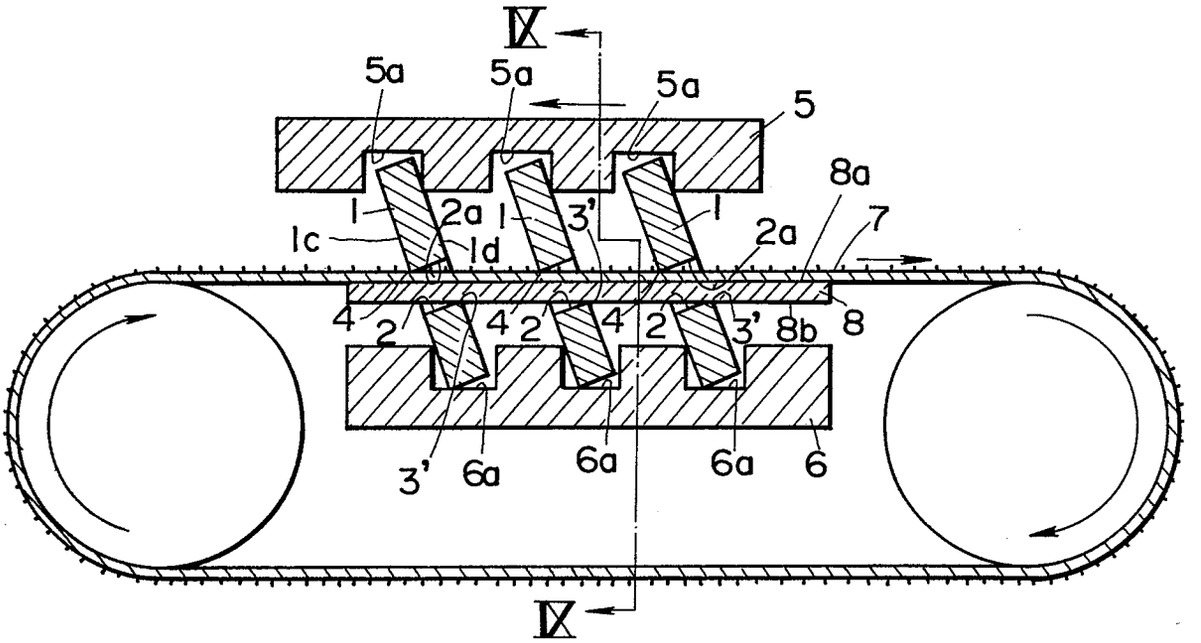
IX
5a
5a
5a
5
8a
7
1
2a
1
3'
1
2a
1c
1d
4
2
4
2
4
2
3'
8b
8
3'
6a
6a
6a
6
IX

FIG.9

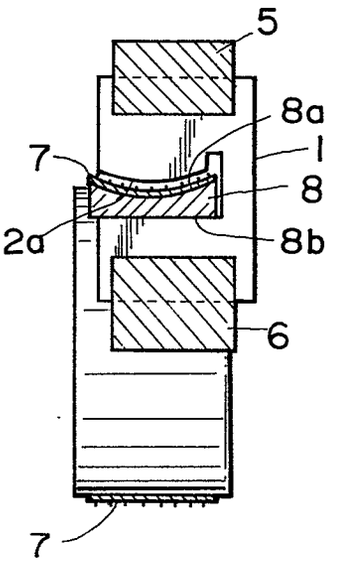
5
8a
7
1
8
2a
8b
6
7

FIG.10

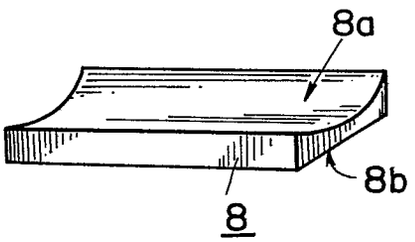

FIG.11

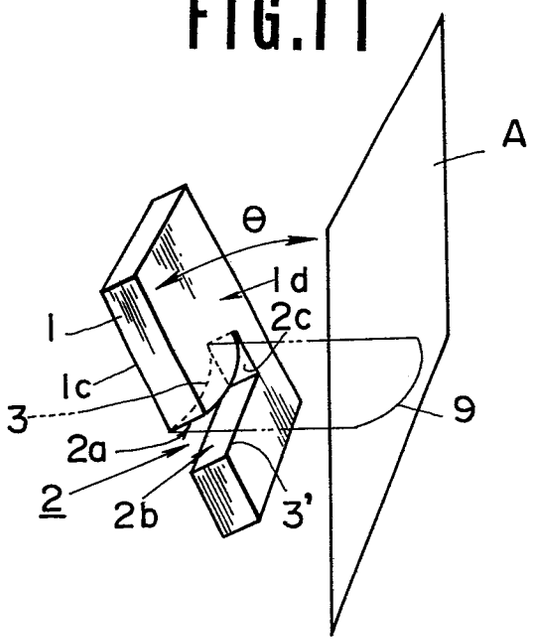

FIG.12