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**Mueller et al.**

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(54) **STAMPED CENTERING PLATE**  
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**Related U.S. Application Data**

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(60) Provisional application No. 61/225,696, filed on Jul. 15, 2009.

(51) **Int. Cl.**  
**F16D 33/00** (2006.01)

(52) **U.S. Cl.** ..... **60/365**

(58) **Field of Classification Search** ..... **60/365,**  
**60/366**

See application file for complete search history.

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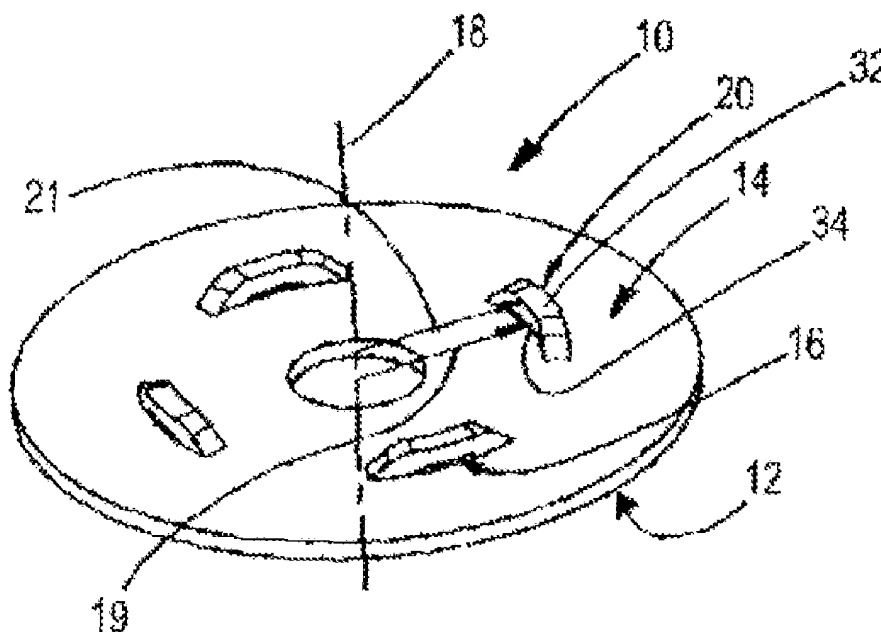
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(57) **ABSTRACT**

The invention relates to a stamped centering plate (10) for a torque converter with a first annular surface (12) having at least one arcuate slot (16), a second annular surface (14) opposite the first annular surface, and at least one arcuate segment (20) axially protruding downward from the second annular surface. The slot has an inner radius and an outer radius, the segment has an inner radius and an outer radius, and at least one of the slot radii is equal to at least one of the segment radii. In an example embodiment of the invention, the segment comprises material displaced to form the slot.

**11 Claims, 4 Drawing Sheets**



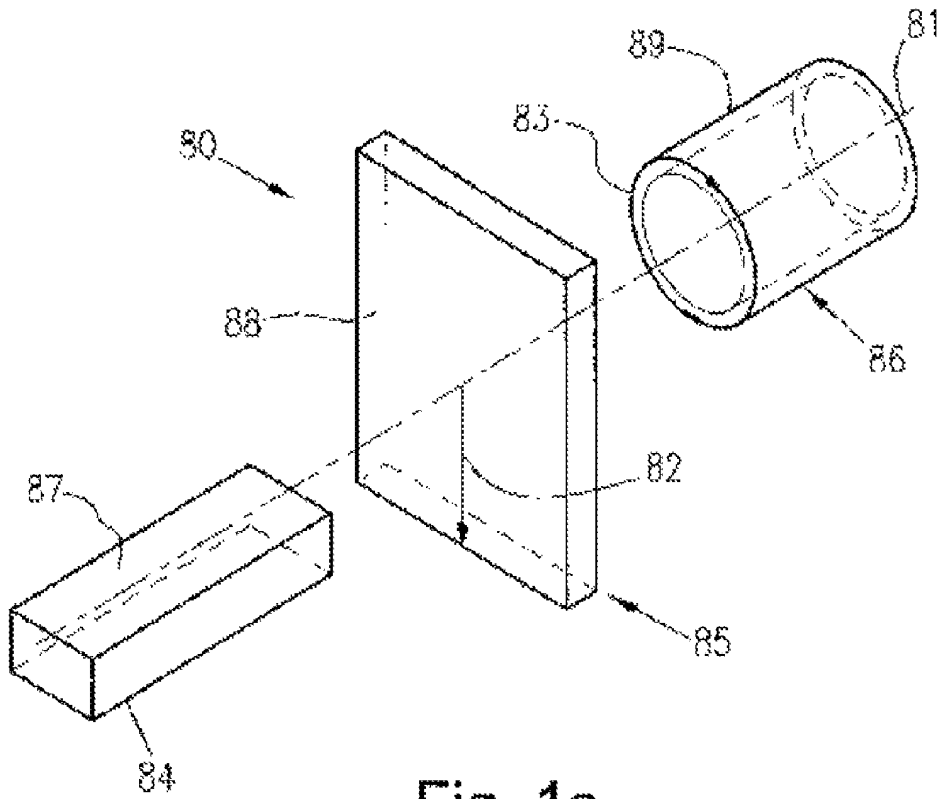


Fig. 1a

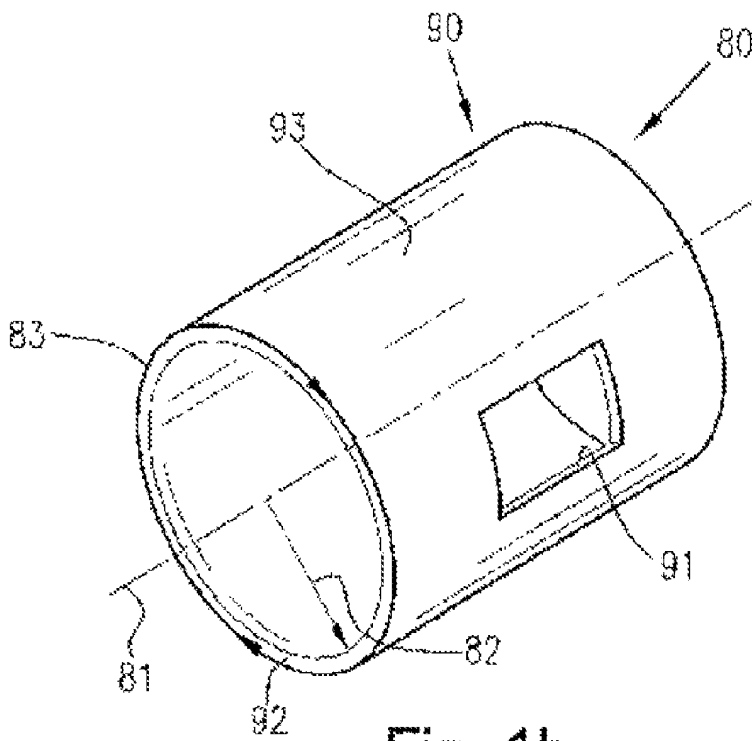


Fig. 1b

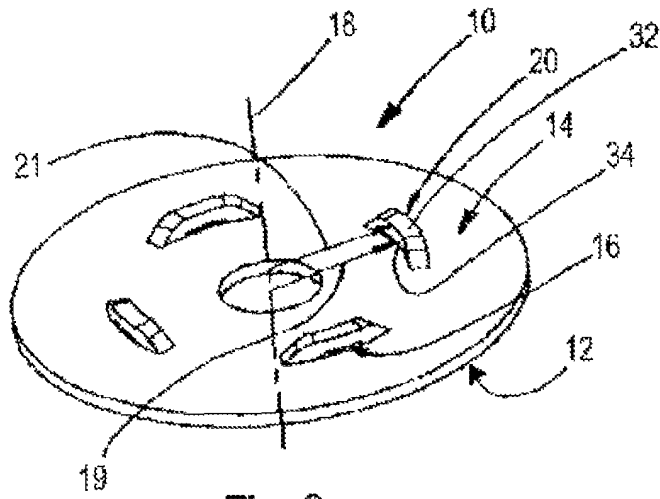


Fig. 2

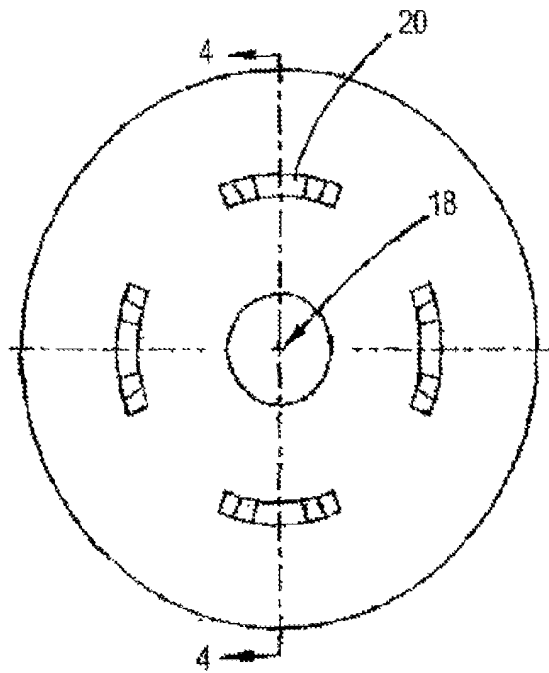


Fig. 3

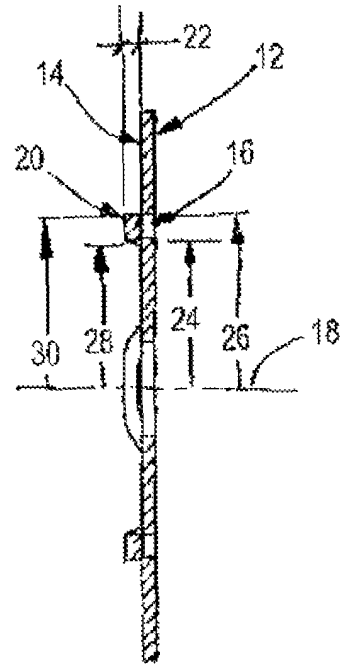


Fig. 4

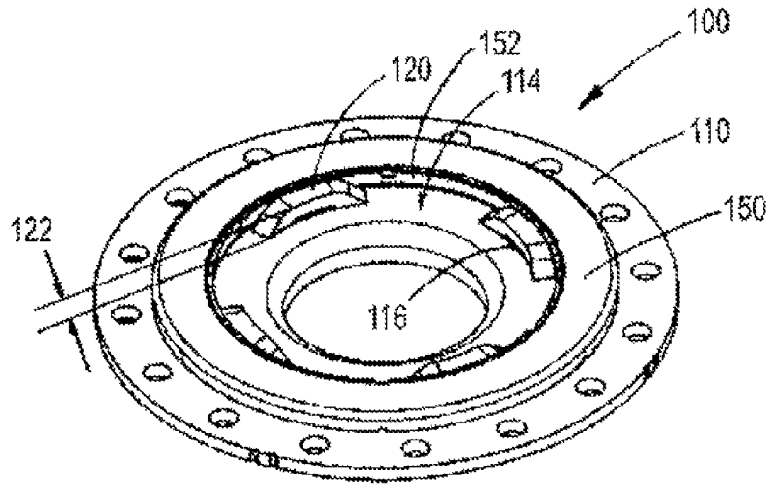


Fig. 5

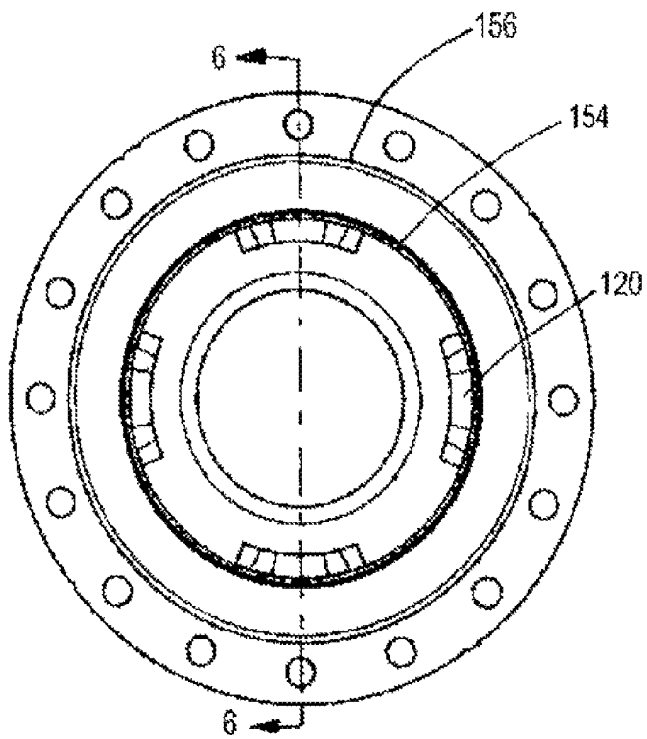


Fig. 6

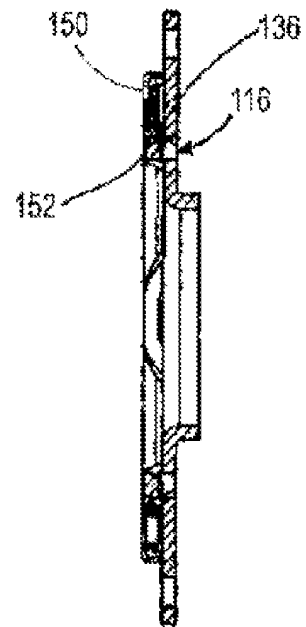


Fig. 7

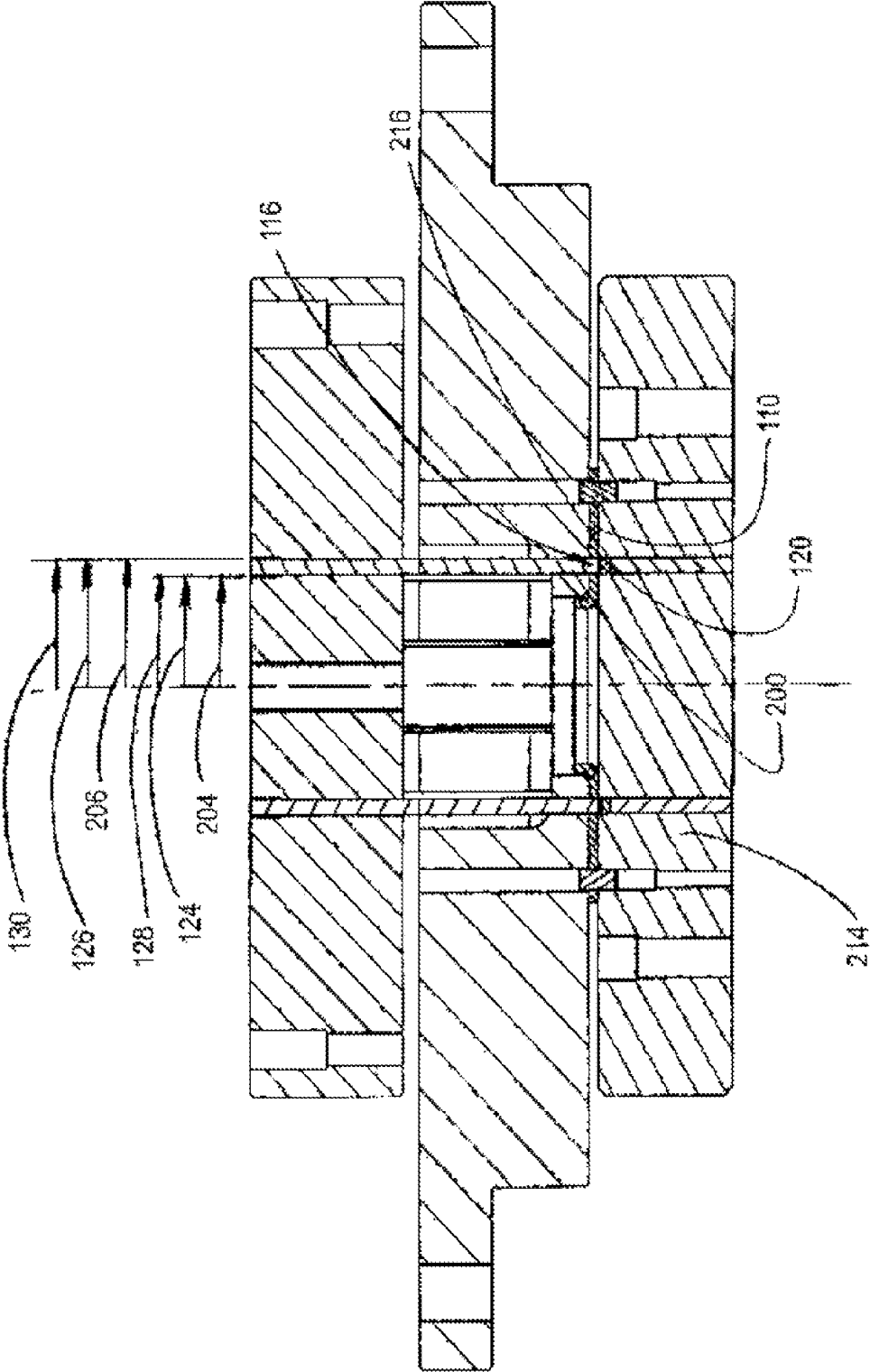


FIG. 8

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**STAMPED CENTERING PLATE****CROSS-REFERENCE TO RELATED APPLICATIONS**

This application is filed under 35 U.S.C. §120 and §365(c) as a continuation of International Patent Application PCT/DE2010/000692, filed Jun. 17, 2010, which application claims priority from U.S. Provisional Patent Application No. 61/225,696, filed Jul. 15, 2009, which applications are incorporated herein by reference in their entirety.

**FIELD OF THE INVENTION**

The invention relates generally to a stamped centering plate for a torque converter, and more specifically to a stamped centering plate with lanced centering features.

**BACKGROUND OF THE INVENTION**

Stamped side plates for torque converters are known. One example is shown in commonly-held United States Patent Application Publication No. US 2007/0137977 A1.

**BRIEF SUMMARY OF THE INVENTION**

Example aspects of the present invention broadly comprise a stamped centering plate for a torque converter with a first annular surface having at least one arcuate slot, a second annular surface opposite the first annular surface, and at least one arcuate segment axially protruding from the second annular surface. The slot has an inner radius and an outer radius, the segment has an inner radius and an outer radius, and at least one of the slot radii is equal to at least one of the segment radii. In an example embodiment of the invention, the segment comprises material displaced to form the slot.

The segment may be formed by material displaced to form the slot. In an example embodiment of the invention, the inner and outer slot radii are equal to the inner and outer segment radii, respectively. The at least one slot may include at least three slots and the at least one arcuate segment may include at least three corresponding arcuate segments axially aligned with the at least three slots.

In an example embodiment of the invention, a height of the segment relative to the annular surface is selected to ensure a bearing remains centered by the segment when the torque converter experiences a ballooned state. The centering plate may be a side plate for a stator of the torque converter, a turbine hub for the torque converter, or a pump hub for the torque converter.

Other example aspects of the present invention broadly comprise a stamped centering plate assembly for a torque converter with an annular centering plate having a plurality of arcuate protrusions, and a bearing having an inner circumference and an outer circumference. The bearing is radially positioned by the protrusions, and a radial wall of the centering plate adjacent to the bearing is continuous between the protrusions and the inner circumference or between the protrusions and the outer circumference.

In an example embodiment of the invention, the bearing has an inside circumferential surface and the protrusions each have an outside circumferential surface, and a radial position of the bearing is maintained by contact between the inside surface and the outside surfaces. In another example embodiment of the invention, the bearing has an outside circumferential surface and the protrusions each have an inside circum-

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ferential surface, and a radial position of the bearing is maintained by contact between the outside surface and the inside surfaces.

Other example aspects of the present invention broadly comprise a method of forming a centering plate for a torque converter including the steps of blanking an annular disk; and axially displacing an arcuate segment with an inner radius and an outer radius out of the disk. At least one of the inner radius or the outer radius is equal to a radius of a slot formed in the disk by the displaced segment. In some example embodiments of the invention, the arcuate segment is axially displaced by a punch having inner and outer radii substantially the same as respective inner and outer radii of the segment. The disk is supported by a die block with a slot having inner and outer radii substantially the same as respective inner and outer radii of the segment. Clearance between inner and outer punch radii and respective inner and outer slot radii is less than 0.5 mm. In an example embodiment of the invention, the clearance is about 0.05 mm.

**BRIEF DESCRIPTION OF THE DRAWINGS**

The nature and mode of operation of the present invention will now be more fully described in the following detailed description of the invention taken with the accompanying drawing figures, in which:

FIG. 1A is a perspective view of a cylindrical coordinate system demonstrating spatial terminology used in the present application;

FIG. 1B is a perspective view of an object in the cylindrical coordinate system of FIG. 1A demonstrating spatial terminology used in the present application;

FIG. 2 is a perspective view of a stamped centering plate according to an example aspect of the invention;

FIG. 3 is a top view of the centering plate of FIG. 2;

FIG. 4 is a section view of the centering plate of FIG. 3 taken generally along line 4-4 in FIG. 3;

FIG. 5 is a perspective view of a stamped centering plate assembly according to an example aspect of the invention shown assembled with a bearing;

FIG. 6 is a top view of the assembly shown in FIG. 6;

FIG. 7 is a section view of the assembly shown in FIG. 6 taken generally along line 7-7 in FIG. 6; and

FIG. 8 is a section view of a stamping die used to manufacture a centering plate.

**DETAILED DESCRIPTION OF THE INVENTION**

At the outset, it should be appreciated that like drawing numbers appearing in different drawing views identify identical, or functionally similar, structural elements. Furthermore, it is understood that this invention is not limited only to the particular embodiments, methodology, materials and modifications described herein, and as such may, of course, vary. It is also understood that the terminology used herein is for the purpose of describing particular aspects only, and is not intended to limit the scope of the present invention, which is limited only by the appended claims.

Unless defined otherwise, all technical and scientific terms used herein have the same meaning as commonly understood to one of ordinary skill in the art to which this invention belongs. Although any methods, devices or materials similar or equivalent to those described herein can be used in the practice or testing of the invention, the following example methods, devices, and materials are now described.

FIG. 1A is a perspective view of cylindrical coordinate system **80** demonstrating spatial terminology used in the

present application. The present invention is at least partially described within the context of a cylindrical coordinate system. System **80** has a longitudinal axis **81**, used as the reference for the directional and spatial terms that follow. The adjectives “axial,” “radial,” and “circumferential” are with respect to an orientation parallel to axis **81**, radius **82** (which is orthogonal to axis **81**), and circumference **83**, respectively. The adjectives “axial,” “radial” and “circumferential” also are regarding orientation parallel to respective planes. To clarify the disposition of the various planes, objects **84**, **85**, and **86** are used. Surface **87** of object **84** forms an axial plane. That is, axis **81** forms a line along the surface. Surface **88** of object **85** forms a radial plane. That is, radius **82** forms a line along the surface. Surface **89** of object **86** forms a circumferential plane. That is, circumference **83** forms a line along the surface. As a further example, axial movement or disposition is parallel to axis **81**, radial movement or disposition is parallel to radius **82**, and circumferential movement or disposition is parallel to circumference **83**. Rotation is with respect to axis **81**.

The adverbs “axially,” “radially,” and “circumferentially” are with respect to an orientation parallel to axis **81**, radius **82**, or circumference **83**, respectively. The adverbs “axially,” “radially,” and “circumferentially” also are regarding orientation parallel to respective planes.

FIG. 1B is a perspective view of object **90** in cylindrical coordinate system **80** of FIG. 1A demonstrating spatial terminology used in the present application. Cylindrical object **90** is representative of a cylindrical object in a cylindrical coordinate system and is not intended to limit the present invention in any manner. Object **90** includes axial surface **91**, radial surface **92**, and circumferential surface **93**. Surface **91** is part of an axial plane, surface **92** is part of a radial plane, and surface **93** is part of a circumferential plane.

The following description is made with reference to FIGS. 2-4. FIG. 2 is a perspective view of a stamped centering plate according to an example aspect of the invention. FIG. 3 is a top view of the centering plate shown in FIG. 2. FIG. 4 is a section view of the centering plate in FIG. 3 taken generally along line 4-4 in FIG. 3. Centering plate **10** includes annular surfaces **12** and **14**. Surface **12** includes at least one slot **16**. In an example embodiment of the invention, slot **16** is an arcuate slot. That is, slot **16** has an arcuate form with a center of the arc disposed proximate to central axis **18** for centering plate **10**. In other words, radius **19** of slot **16** extends between central axis **18** and slot **16**. Slot **16** extends in a generally circumferential direction through surface **12**.

Surface **14**, disposed opposite surface **12**, includes segment **20**. Segment **20** axially protrudes from surface **14** by distance **22**. In an example embodiment of the invention, segment **20** is an arcuate segment. That is, segment **20** has an arcuate form with a center of the arc disposed proximate to central axis **18** for centering plate **10**. In other words, radius **21** of segment **20** extends between central axis **18** and segment **20**. Segment **20** extends in a generally circumferential direction along surface **14**.

Slot **16** includes inner radius **24** and outer radius **26**, and segment **20** includes inner radius **28** and outer radius **30**. In an example embodiment of the invention, at least one of radii **24** and **28** or radii **26** and **30** are equal. For example, inner radius **24** for slot **16** may be concentric with and axially aligned with inner radius **28** for segment **20**. Likewise, outer radius **26** for slot **16** may be concentric with and axially aligned with outer radius **30** for segment **20**.

Slot **16** may be created by axially displacing material from surface **12**. Segment **20** may be formed by axially displacing material from surface **14**. In an example embodiment of the

invention, segment **14** includes material displaced to form slot **16**. That is, top surface **32** of segment **20** includes material displaced from surface **14** and bottom surface **34** of segment **20** includes material displaced from surface **12**. In an example embodiment of the invention, segment **20** includes all material displaced to form slot **16**. That is, slot **16** is created by axially displacing material to form segment **20**.

Centering plate **10** includes a plurality of slots **16** and segments **20**. Although centering plate **10** is shown with a particular number of slots **16** and segments **20**, centering plate **10** may include other numbers of slots **16** and segments **20**. Generally, at least 3 slots and segments are preferred to ensure proper centering, as explained below.

Centering plate **10** is generally a component of a torque converter. In some example embodiments of the invention, centering plate **10** is a side plate for a stator of the torque converter.

The following description is made with reference to FIGS. 4-6. FIG. 4 is a perspective view of a stamped centering plate assembly according to an example aspect of the invention shown assembled with a bearing. FIG. 5 is a top view of the assembly shown in FIG. 5. FIG. 6 is a section view of the assembly shown in FIG. 5 taken generally along line 6-6 in FIG. 5.

Assembly **100** includes centering plate **110** and bearing **150**. Segment **120** axially extends from annular surface **114** by distance **122**. Bearing **150** is centered, or radially positioned, by centering plate **110**, specifically by segments **120**. Radial wall **114** of centering plate **110** adjacent to bearing **150** is continuous between protrusions **120** and inner circumference **154** and between protrusions **120** and outer circumference **156**. In an example embodiment of the invention (not shown), wall **114** is continuous between protrusions **120** and only one of inner circumference **154** and outer circumference **156**.

Height **122** is selected to ensure bearing **150** remains centered by segment **120** when the torque converter (not shown) experiences a ballooned state. For example, under high rotational speeds, increased pressure in the torque converter results in axial displacement of the torque converter casing (not shown), with the increased distance between the radial walls of the casing allowing axial movement of the components therein. Height **122** is selected such that segments **120** are still axially overlapped with inside surface **152** of bearing **150** when the casing experiences maximum axial displacement and the bearing and centering plate become axially separated from one another.

In an example embodiment of the invention, bearing **150** includes inside circumferential surface **152** and protrusions **120** each comprise outside circumferential surface **136**. The radial position of bearing **150** is adjusted by contact between inside surface **152** and outside surfaces **136**. In another example embodiment of the invention (not shown), bearing **150** includes an outside circumferential surface and protrusions **120** each comprise an inside circumferential surface, and the radial position of the bearing is adjusted by contact between the outside surface and the inside surfaces. That is, the bearing is disposed radially inside of the protrusions.

Assembly **100** is generally disposed within a torque converter. For example, assembly **100** may provide a thrust surface between an impeller and stator, between a stator and turbine hub, or between a turbine hub and a cover. Although specific applications of assembly **100** are disclosed, other applications within a torque converter or other powertrain component may exist and should be considered within the scope of the invention.

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The following description is made with reference to FIG. 7. FIG. 7 is a section view of a stamping die used to manufacture a centering plate. According to an example aspect of the invention, a method of forming a centering plate for a torque converter is provided. The method includes the steps of blanking annular disk 110, axially displacing arcuate segment 120 (with punch 200, for example) having inner radius 204 and outer radius 206 out of disk 110. In an example embodiment of the invention, at least one of inner radius 204 or outer radius 206 is equal to radius 124 and/or 126 of slot 116 formed in disk 110 by displaced segment 120.

In some example embodiments of the invention, arcuate segment 120 is axially displaced by punch 200 having inner and outer radii 204 and 206 substantially the same as respective inner and outer radii 128 and 130 of segment 120. Disk 110 may be supported by die block 214 with slot 216 having inner and outer diameters substantially the same as respective inner and outer diameters 128 and 130 of segment 120. Clearance, or difference in radii, between inner and outer punch radii and respective inner and outer slot radii is less than 0.5 mm. In an example embodiment of the invention, the clearance is about 0.05 mm.

Of course, changes and modifications to the above examples of the invention should be readily apparent to those having ordinary skill in the art, without departing from the spirit or scope of the invention as claimed. Although the invention is described by reference to specific preferred and/or example embodiments, it is clear that variations can be made without departing from the scope or spirit of the invention as claimed.

What we claim is:

1. A stamped centering plate for a torque converter comprising:

- a first annular surface;
- a second annular surface opposite the first annular surface;
- at least one arcuate slot passing through the plate and opening to the first and second annular surfaces; and,
- at least one arcuate segment protruding from the second annular surface such that the at least one segment is separated from the second annular surface in a first direction parallel to an axis for the centering plate and including first and second circumferential ends one of which is connected to the first annular surface, wherein:
  - at least a portion of the at least one arcuate segment is aligned with the at least one arcuate slot such that a line parallel to the axis passes through the at least one segment and the at least one arcuate slot;
  - the at least one slot has a first inner radius and a first outer radius, the first inner radius less than the first outer radius;
  - the at least one segment has a second inner radius and a second outer radius, the second inner radius less than the second outer radius;
  - the centering plate is a side plate for a stator of the torque converter; and
    - the first and second inner radii are equal; or,
    - the first and second outer radii are equal.

2. The centering plate of claim 1, wherein the segment comprises material displaced to form the slot.

3. The centering plate of claim 1, wherein the segment is formed by material displaced to form the slot.

4. The centering plate of claim 1, wherein:
- the at least one slot comprises at least three slots;
  - the at least one arcuate segment comprises at least three corresponding arcuate segments; and

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each of the at least three corresponding arcuate segments is aligned, in the first direction, with a respective slot from the at least three slots.

5. The centering plate of claim 1, wherein a height of the segment relative to the second annular surface is selected to ensure a bearing remains centered by the segment.

6. A method of forming a centering plate for a torque converter comprising the steps of:

- blanking an annular disk including first and second oppositely facing annular surfaces;
- displacing an arcuate segment having first and second circumferential ends, a second circumferential end, a first inner radius, and a first outer radius out of the disk such that the arcuate segment is separated from the disk in a line parallel to an axis for the centering plate, the first inner radius less than the first outer radius, and each of the first and second circumferential ends are connected to the first annular surface; and,
- forming a slot passing through the plate, axially aligned with the arcuate segment such that a line parallel to the axis passes through the slot and the arcuate segment, and opening to the first and second surfaces, wherein:
  - the first and second inner radii are equal; or,
  - the first and second outer radii are equal.

7. The centering plate of claim 1, wherein each of the first and second circumferential ends are connected to the first annular surface.

8. The method of claim 6, wherein the centering plate is a side plate for a stator of the torque converter.

9. The method of claim 6 further comprising selecting a height of the segment relative to the second annular surface to ensure a bearing remains centered by the segment.

10. A stamped centering plate for a torque converter comprising:

- a first annular surface;
- a second annular surface opposite the first annular surface;
- at least one arcuate slot passing through the plate and opening to the first and second annular surfaces; and,
- at least one arcuate segment protruding from the second annular surface such that the at least one segment is separated from the second annular surface in a direction parallel to an axis for the centering plate and including first and second circumferential ends one of which is connected to the first annular surface, wherein:
  - at least a portion of the at least one arcuate segment is aligned with the at least one arcuate slot such that a line parallel to the axis passes through the at least one segment and the at least one arcuate slot;
  - the at least one slot has a first inner radius and a first outer radius, the first inner radius less than the first outer radius;
  - the at least one segment has a second inner radius and a second outer radius, the second inner radius less than the second outer radius;
  - a height of the segment relative to the second annular surface is selected to ensure a bearing remains centered by the segment; and,
  - the first and second inner radii are equal; or,
  - the first and second outer radii are equal.

11. The centering plate of claim 10, wherein each of the first and second circumferential ends are connected to the first annular surface.