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Brees et al.

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(54) **SHIELDED STAMPED STATOR BLADE**

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F04D 29/38 (2006.01)
F16H 41/28 (2006.01)

(52) **U.S. Cl.**
CPC ***F16H 41/28*** (2013.01); *Y10S 416/03* (2013.01)
USPC ..... **416/231 B**; 416/DIG. 3; 416/197 C

(58) **Field of Classification Search**
USPC ..... 416/231 R, 231 A, 231 B, DIG. 3, 197 C, 416/180; 415/211.2, 191
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

1,770,575	A *	7/1930	Ksoll	244/212
2,637,487	A *	5/1953	Sawyer	415/115
2,834,573	A	5/1958	Stalker	
3,572,034	A *	3/1971	Fisher	60/341
2004/0237516	A1 *	12/2004	Shin	60/362
2007/0224042	A1 *	9/2007	Brees et al.	415/208.2

* cited by examiner

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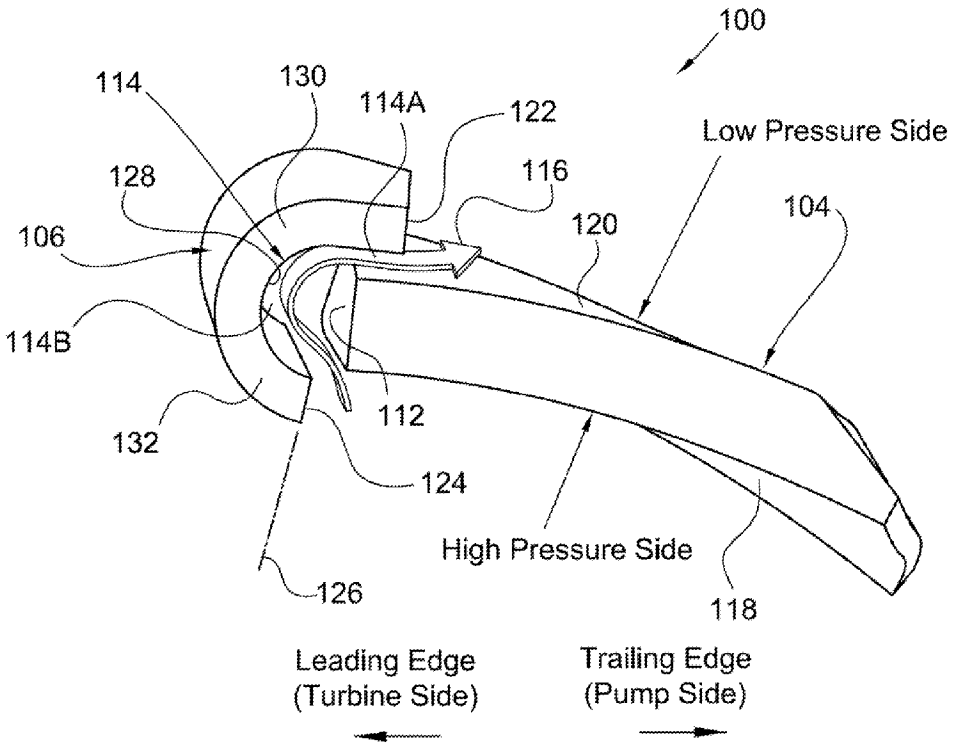
(57) **ABSTRACT**

A blade for a stator in a torque converter including: a first blade segment connected to first inner and outer circumferential sections; a second blade segment, separately formed from the first blade segment, connected to second inner and outer circumferential sections, and including first and second portions; and a channel disposed between the first and second blade segments. In a circumferential direction, the first and second portions are separated by the channel.

10 Claims, 5 Drawing Sheets



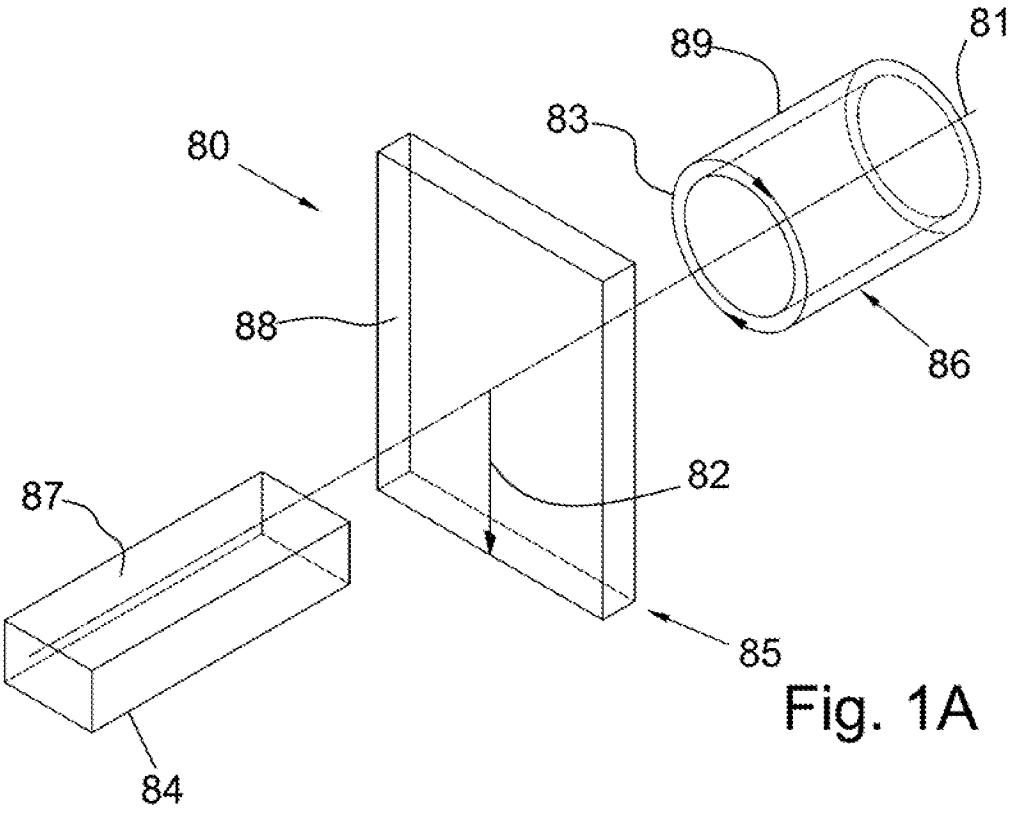


Fig. 1A

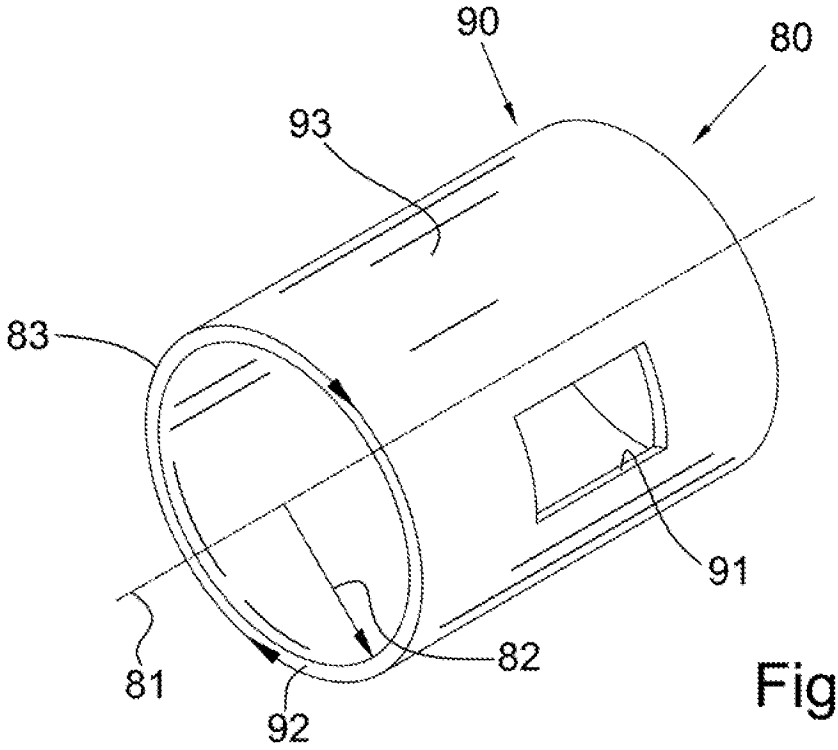


Fig. 1B

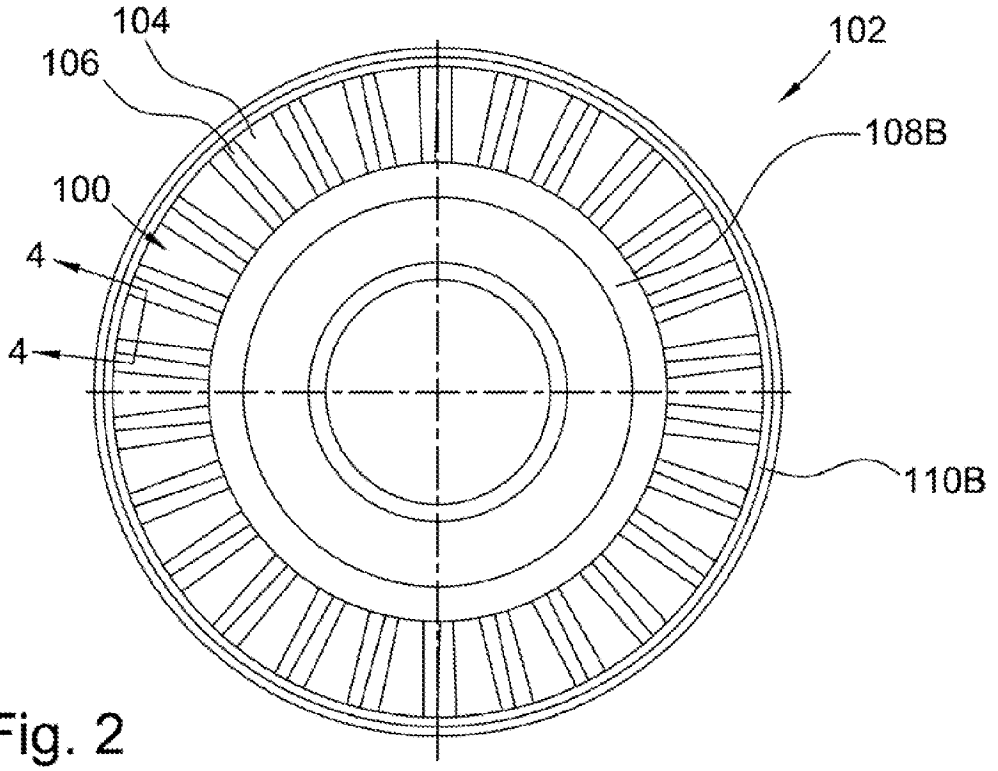


Fig. 2

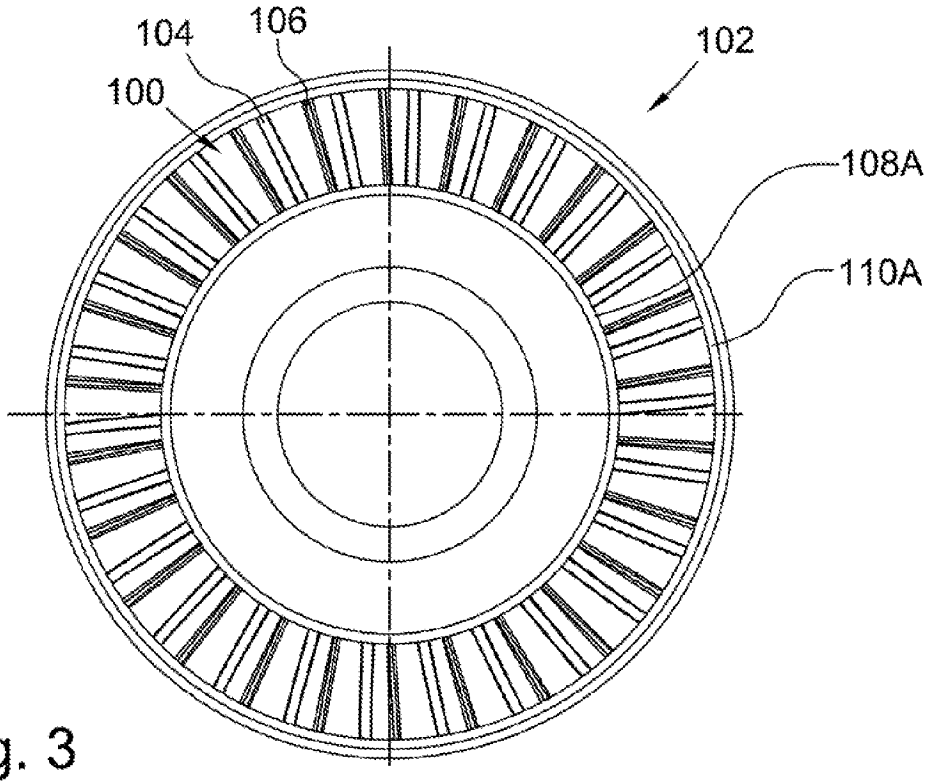


Fig. 3

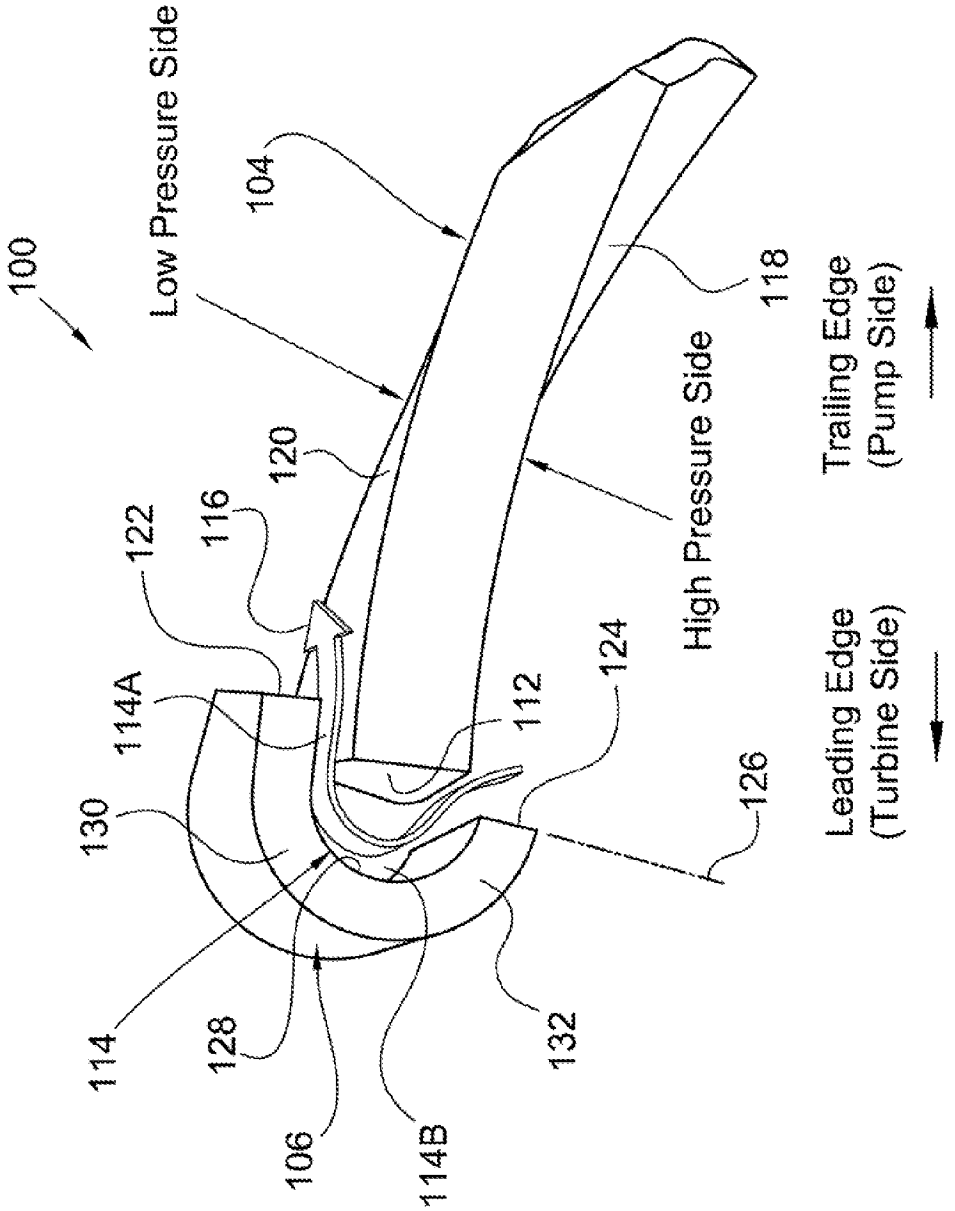

100
Low Pressure Side
104
118
Trailing Edge
(Pump Side)
120
116
122
114A
112
124
High Pressure Side
130
126
Leading Edge
(Turbine Side)
114
128
106
114B
132

Fig. 4

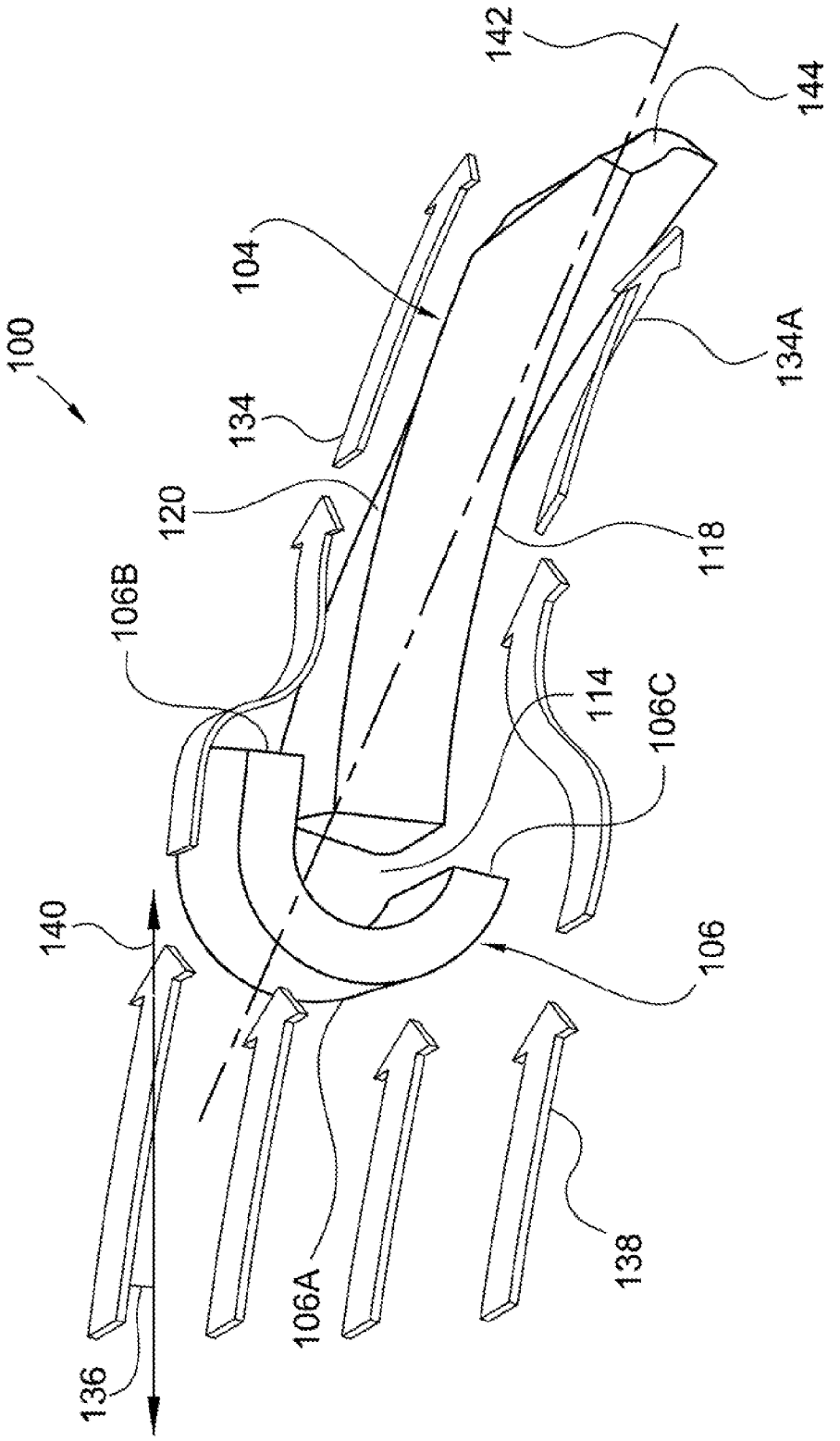

142
144
104
100
134A
134
120
118
106B
114
106C
140
106
106A
138
136

Fig. 5A

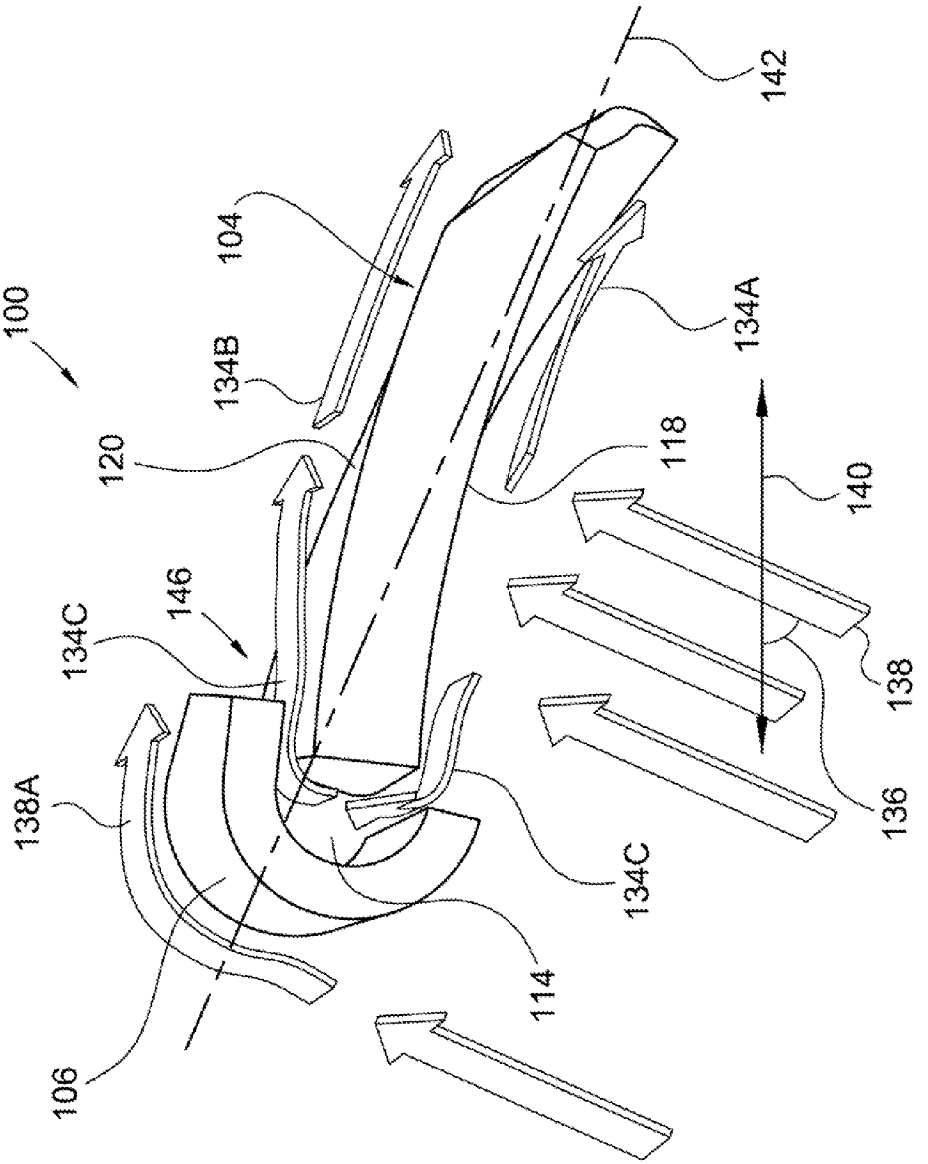

100
104
134B
120
146
134C
138A
106
114
134C
142
134A
118
140
138
136

Fig. 5B

SHIELDED STAMPED STATOR BLADE

CROSS-REFERENCE TO RELATED APPLICATIONS

This application claims the benefit under 35 U.S.C.§119(e) of U.S. Provisional Application No. 61/210,975, filed Mar. 25, 2009, which application is incorporated herein by reference.

FIELD OF THE INVENTION

The invention relates to blades for a stator, in particular, two-part blades for a stator for a torque converter.

BACKGROUND OF THE INVENTION

The prior art teaches the use of two-part blades for a stator for a torque converter.

BRIEF SUMMARY OF THE INVENTION

The present invention broadly comprises a blade for a stator in a torque converter including: a first blade segment connected to first inner and outer circumferential sections; a second blade segment, separately formed from the first blade segment, connected to second inner and outer circumferential sections, and including first and second portions; and a channel disposed between the first and second blade segments. In a circumferential direction, the first and second portions are separated by the channel.

In one embodiment, the second blade segment includes first and second radially disposed ends, the first radially disposed end is circumferentially aligned with the first blade segment and the second radially disposed end is circumferentially misaligned with the first blade segment.

In one embodiment, for a speed ratio of 0.0 for the stator, the blade is for enabling a flow of fluid for the stator through the channel. In one embodiment, for a speed ratio of 0.9 for the stator, the blade is for disabling a flow of fluid for the stator through the channel. In one embodiment, when an angle between a flow of fluid in the stator and an axial direction is less than a flow angle, the blade is for blocking a flow of fluid for the stator through the channel. In one embodiment, when an angle between a flow of fluid in the stator and an axial direction is greater than a flow angle, the blade is for enabling a flow of fluid for the stator through the channel.

The present invention also broadly comprises a blade for a stator in a torque converter, including: a first blade segment connected to first inner and outer circumferential sections and including first and second radially disposed sides; a second blade segment, separately formed from the first blade segment, connected to second inner and outer circumferential sections, and including a first radially disposed end circumferentially aligned with the first radially disposed side and a second radially disposed end axially aligned with the second radially disposed side; and a channel disposed between the first and second blade segments.

It is a general object of the present invention to provide a two-part blade for a stator in a torque converter that optimizes fluid flow through the stator.

These and other objects and advantages of the present invention will be readily appreciable from the following description of preferred embodiments of the invention and from the accompanying drawings and claims.

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

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

FIG. **2** is a front view of present invention blades in a stator;

FIG. **3** is a back view of the stator shown in FIG. **2**;

FIG. **4** is a cross-sectional view of a blade shown in FIG. **2** along line **4**-**4** in FIG. **2**;

FIG. **5**A is a cross-sectional view of the blade shown in FIG. **4** depicting fluid flow for a higher speed ratio; and,

FIG. **5**B is a cross-sectional view of the blade shown in FIG. **4** depicting fluid flow for a lower speed ratio.

DETAILED DESCRIPTION OF THE INVENTION

At the outset, it should be appreciated that like drawing numbers on different drawing views identify identical, or functionally similar, structural elements of the invention. While the present invention is described with respect to what is presently considered to be the preferred aspects, it is to be understood that the invention as claimed is not limited to the disclosed aspects.

Furthermore, it is understood that this invention is not limited to the particular methodology, materials and modifications described 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 preferred methods, devices, and materials are now described.

FIG. **1**A 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. **1**B is a perspective view of object **90** in cylindrical coordinate system **80** of FIG. **1**A 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.

FIG. **2** is a front view of present invention blades **100** in stator **102**.

FIG. **3** is a back view stator **102** shown in FIG. **2**.

FIG. **4** is a cross-sectional view of blade **100** shown in FIG. **2** along line **4**-**4** in FIG. **2**. The following should be viewed in light of FIGS. **2** through **4**. Blade **100** in stator **102** includes blade segments **104** and **106**. Blade segment **104** is connected to inner and outer circumferential sections **108**A and **110**A, respectively, of the stator. Blade segment **106** is connected to inner and outer circumferential sections **108**B and **110**B, respectively, of the stator. Blade segments **104** and **106** are formed separately, that is, the segments are separate and distinct pieces with respect to each other. In one embodiment, blade segment **104** is formed integral with circumferential sections **108**A and **110**A and blade segment **106** is formed integral with circumferential sections **108**B and **110**B. Segment **104** includes leading radially disposed edge **112**. By radially disposed we mean that the end is substantially oriented in a radial direction, for example, between sections **108**A and **110**A. Segment **106** at least partially overlaps edge **112**. Blade **100** also includes channel **114** disposed between segments **104** and **106**.

A portion of the channel is circumferentially disposed between blade segments **104** and **106**, for example, portion **114**A of the channel and a portion of the channel also is axially disposed between blade segments **104** and **106**, for example, portion **114**B of the channel. Thus, the channel forms fluid flow path **116** communicating between radially disposed sides **118** and **120** of blade segment **104**, as further described infra.

Blade segment **106** includes radially disposed ends **122** and **124**. End **122** is circumferentially aligned with blade segment **104** and end **124** is circumferentially misaligned with end **122**, for example, along line **126**. Otherwise stated, blade segment **106** is at least partially axially aligned with radially disposed sides **118** and **120**. Portions of blade segment **106** also can be described as including, a C-shaped curve, the C-shaped curve including surface **128** facing blade segment **104** and at least partially axially aligned with blade segment **104**.

Blade segment **106** includes portions **130** and **132** at opposite ends of the blade segment. In a circumferential direction, portions **130** and **132** are separated by the channel. That is, segment **106** can be described as a "J" shape with portion **132** forming the curved "lower" part.

FIG. **5**A is a cross-sectional view of blade **100** shown in FIG. **4** depicting fluid flow for a higher speed ratio.

FIG. **5**B is a cross-sectional view of blade **100** shown in FIG. **4** depicting fluid flow for a lower speed ratio. The following should be viewed in light of FIGS. **2**-**5**B. Advantageously, blade **100** produces smooth fluid circulation through and around the blade during operation of the stator. For example, flow lines **134** are kept close to the surfaces of the blade, for example, along sides **118** and **120**, thus optimizing flow of the fluid but also maintaining energy in the fluid flowing past and through the blades. By maintaining smooth fluid circulation, more fluid can be passed through the stator, which in turn increases the capacity and efficiency of a torque converter (not shown) in which the stator is installed.

in FIG. **5**A, at a higher speed ratio, for example, 0.9, for the torque converter, angle **136** between fluid flow lines **138** for fluid from a turbine (not shown) and axial direction **140** is relatively small. Subsequently, the angle between fluid flow lines **138** and longitudinal axis **142** for blade segment **104** approaches zero degrees. Advantageously, in FIG. **5**A, some of high-pressure high-velocity flow **138** is redirected along low pressure side **118** of the blade, for example, as shown by flow lines **134**A. The redirection of flow **138** creates fluid flow in the desired direction towards the pump (not shown), that is, toward trailing edge **144** of blade segment **104**. Flow lines **134**A greatly reduce possible recirculation area at low pressure side **118**, since flow lines **134**A adhere closely to low pressure side **118** and the shape of blade segment **106** enables better flow adherence at leading edge **106**A of blade **100**. Thus, flow area is eased (recirculation area is reduced) and efficiency of the turning of the fluid is increased. In addition, a larger radius is possible with blade segment **106**, for example, between edges **106**B and **106**C of blade segment **106**. Such increase in radius causes fluid passing through the stator to remain attached to the shield for a greater distance along leading edge **106**A; and therefore to be turned more towards the desired direction (toward edge **144** along sides **118** and **120**), before separation occurs between the fluid and the sides.

In FIG. **5**B, at a lower speed ratio, for example, 0.0, for the torque converter, also called. Stall, angle **136** is relatively large. Subsequently, the angle between fluid flow lines **138** and longitudinal axis **142** for blade segment **104** approaches 90 degrees. Because a larger radius is possible with blade segment **106**, for example, between edges **106**B and **106**C of blade segment **106**, fluid flow is able to attach around the shield with a minimum of recirculation, for example, as shown in flow lines **138**A. The flow quickly transits from blade segment **106** to blade segment **104** and quickly attaches to sides **118** and **120**, for example, as shown by flow lines **134**B, since an angle between lines **138**A and **134**B is relatively small. On side **118**, portions of flow **138** is directed toward trailing edge **144**, for example, as shown by flow lines **134**A, and portions of flow **138** is directed through channel **114**, as shown by flow lines **134**C. As flow lines **134**C exit opening **146** of the channel, the flow lines are already adhering to side **120** and create a flow pattern that more quickly draws flow lines **138**A to side **120**. Thus, the flow around blade segments **106** and **104** is very smooth and efficient.

Thus, in one embodiment, for a higher speed ratio, for example, 0.9, for the torque converter, the blade is for blocking, or disabling, a flow of fluid, for example, flow lines **134**C, for the stator through the channel. Thus, in one embodiment, for a lower speed ratio, for example, of 0.0, for the torque converter, the blade is for enabling a flow of fluid, for example, flow lines **134**C, for the stator through the channel.

In one embodiment, blade segment **104** and inner and outer circumferential sections **108**A and **110**A are stamped from a single piece of material. In another embodiment, blade segment **106** and inner and outer circumferential sections **108**B and **110**B are stamped from a single piece of material. In one embodiment, blade segment **104** and inner and outer circumferential sections **108**A and **110**A are cast as a single piece. In another embodiment, blade segment **106** and inner and outer circumferential sections **108**B and **110**B are cast as a single

piece. In one embodiment, blade segment **104**, inner and outer circumferential sections **108**A and **110**A, blade segment **106**, and inner and outer circumferential sections **108**B and **110**B are cast as a single piece.

Although stator **102** is shown with a specific number of blades **100**, it should be understood that stator **102** is not limited to a particular number of blades **100**. It should be understood that a present invention blade is not limited to the exact configuration and shape shown in the drawings and that other configurations and shapes are included in the spirit and scope of the claimed invention.

Thus, it is seen that the objects of the present invention are efficiently obtained, although modifications and changes to the invention should be readily apparent to those having ordinary skill in the art, which modifications are intended to be within the spirit and scope of the invention as claimed. It also is understood that the foregoing description is illustrative of the present invention and should not be considered as limiting. Therefore, other embodiments of the present invention are possible without departing from the spirit and scope of the present invention.

What we claim is:

1. A blade for a stator in a torque converter, comprising:
- a first blade segment connected to first inner and outer circumferential sections;
- a second blade segment, separately formed from the first blade segment, connected to second inner and outer circumferential sections, and including:
  - first and second radially disposed sides connected to the first inner and outer circumferential sections;
  - a first radially disposed end connecting the first and second radially disposed sides; and,
  - a second radially disposed end connecting the first and second radially disposed sides; and,
- a channel, wherein:
  - a first line, oriented only in a circumferential direction:
    - passes through the first radially disposed end or is co-linear with the first radially disposed end;
    - passes through in sequence: the channel, the second radially disposed side, and the first radially disposed side; and,
  - a second line, oriented only in the circumferential direction, passes through in sequence: the first radially disposed side, the second radially disposed side, the channel, the second radially disposed side and the first radially disposed side.

2. The blade of claim **1** wherein for a speed ratio of 0.0 for the stator, the blade is for enabling a flow of fluid for the stator through the channel.

3. The blade of claim **1** wherein for a speed ratio of 0.9 for the stator, the blade is for disabling a flow of fluid for the stator through the channel.

4. The blade of claim **1** wherein when an angle between a flow of fluid in the stator and an axial direction is less than a flow angle, the blade is for blocking a flow of fluid for the stator through the channel.

5. The blade of claim **1** wherein when an angle between a flow of fluid in the stator and an axial direction is greater than a flow angle, the blade is for enabling a flow of fluid for the stator through the channel.

6. The blade of claim **1** wherein:
- the first blade segment includes a third radially disposed end connecting third and fourth radially disposed sides; and
- a third line, oriented only in the axial direction, passes through the second radially disposed end and is off-set from the third radially disposed end in the circumferential direction.

7. A blade for a stator in a torque converter, comprising:
- a first blade segment connected to first inner and outer circumferential sections and including first and second radially disposed sides connected to the first inner and outer circumferential sections;
- a second blade segment, separately formed from the first blade segment and connected to second inner and outer circumferential sections; and,
- a channel disposed between the first and second blade segments, wherein a first line oriented only in a circumferential direction passes through in sequence: the first radially disposed side, the second radially disposed side, the channel, the second radially disposed side and the first radially disposed side.

8. The blade of claim **7** wherein:
- the first blade segment includes first and second radially disposed ends connecting the first and second radially disposed sides;
- the second blade segment includes a third radially disposed end connecting third and fourth radially disposed sides;
- a second line, oriented only in an axial direction, passes through the first radially disposed end and is off-set from the third radially disposed end in a first circumferential direction;
- a third line, oriented only in the axial direction, passes through the second radially disposed end and is off-set from the third radially disposed end in a second circumferential direction opposite the first circumferential direction; and,
- an entirety of the third radially disposed end is circumferentially located between the second and third lines.

9. A blade for a stator in a torque converter, comprising:
- a first blade segment connected to first inner and outer circumferential sections and including first and second radially disposed sides and a first radially disposed end connecting the first and second radially disposed sides;
- a second blade segment:
  - separately formed from the first blade segment:
  - connected to second inner and outer circumferential sections by third and fourth radially disposed sides: and
  - including:
    - a second radially disposed end connecting the third and fourth radially disposed sides; and
    - a third radially disposed end including a surface:
      - connecting the third and fourth radially disposed sides;
      - facing the second radially disposed side in an axial direction;
      - axially aligned with the second radially disposed side; and,
      - forming a straight edge beginning at the third radially disposed side and extending in a straight line to the fourth radially disposed side;
- a channel disposed between the first and second blade segments, wherein:
  - a first line, oriented only in an axial direction passes, through the second radially disposed end and the second radially disposed side;
  - a second line, oriented only in a circumferential direction, passes through the third radially disposed end and the first and second radially disposed sides;
  - the straight edge is co-linear with the second line; and,

a third line, oriented only in the circumferential direction, passes through in sequence: the third radially disposed side, the fourth radially disposed side, the channel, the fourth radially disposed side and the third radially disposed side.

10. The blade of claim **9** wherein:

a fourth line, oriented only in the axial direction passes, through the second radially disposed end and is off-set from the first radially disposed end in a first circumferential direction;

a fifth line, oriented only in the axial direction, passes through the third radially disposed end and is off-set from the first radially disposed end in a second circumferential direction opposite the first circumferential direction; and,

an entirety of the first radially disposed end is circumferentially located between the fourth and fifth lines oriented only in the axial direction.

* * * * *