



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
14.05.2008 Bulletin 2008/20

(51) Int Cl.:
C22C 33/02 ^(2006.01) **B22F 5/08** ^(2006.01)
B21K 1/76 ^(2006.01)

(21) Application number: **07254067.7**

(22) Date of filing: **12.10.2007**

(84) Designated Contracting States:
**AT BE BG CH CY CZ DE DK EE ES FI FR GB GR
HU IE IS IT LI LT LU LV MC MT NL PL PT RO SE
SI SK TR**
Designated Extension States:
AL BA HR MK RS

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(30) Priority: **23.10.2006 US 585297**

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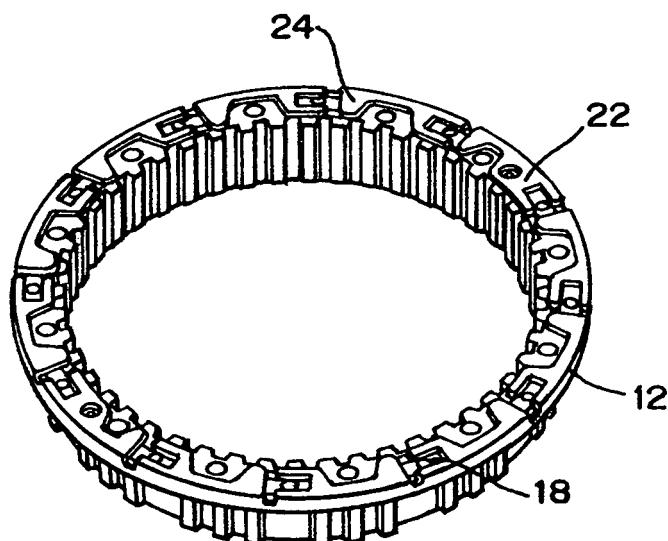
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(54) **Manufacture of clutch components**

(57) Clutch components for automotive use usually include a pair of clutch members (12) with operative faces (22). In particular, planar one way clutches include a pair of clutch members whose operative faces (22) are enclosed spaced opposition, with each clutch face including a plurality of recesses defining respective load bearing shoulders. A plurality of struts (18) are disposed between the coupling face of the members, and such struts are moveable between the coupling position and non cou-

pling position. A preferable method of manufacturing such clutch components includes powder metal operations comprising die compacting a metal powder into a metal blank, sintering the metal blank to form a sintered metal blank, and cooling the sintered metal blank to form a cooled metal blank. The preferred metallic structure of the cooled metal blank is 50-80% martensite and 20-50% bainite and fine pearlite. The application is especially useful for clutches used as backing plates in clutch brake applications.

FIG.2



Description

BACKGROUND OF THE INVENTION

[0001] The present invention relates to automotive clutch or transmission components and, more particularly, to so called one way clutches wherein one or more struts provide a mechanical coupling between opposed clutch faces and a pair of coaxially rotateable members.

[0002] As explained in U. S. Patent 6,571,926, in such one way clutches, a driving member engages a driven member.

[0003] A thin flat strut is carried within each of the driving members' pockets such that a first longitudinal end may readily engage and bear against the shoulder defined by the corresponding recess in the driving member. The struts second, opposite longitudinal end is urged by spring force toward and against the driven member, thereby contacting a complimentary surface on the driven member.

[0004] The materials and processing of such clutch components use high hardenability metals to produce the clutch components. Such materials can be used as backing plates in automotive transmissions. The metallic micro structure of such currently used materials is nearly 100% martensite which is strong and wear resistant. However, because the subject clutch component operates in a contacting environment generating extreme heat, the clutch component is also susceptible to damage and localized injury from hot spots. Such hot spots are produced by interaction with mating friction plates made from a variety of friction materials. Temperatures in these hot spot zones can approach 1500°F (815°C) or more. Because the currently used materials are highly hardenable and the hot spot temperatures may exceed the critical temperature or austenitizing temperature for steel, the metal in the area of the hot spots can be readily transformed into untempered martensite. Such untempered martensite areas on the backing plate face of the clutch component can be an initiation site for brittle fractures which can readily propagate causing ultimate clutch component failure.

[0005] Accordingly, it is an object of the present invention to provide an improved automotive component that can withstand the temperatures generated in a clutch or brake in a transmission environment.

[0006] It is another object of the present invention to provide a method of manufacturing an automotive component that can withstand the temperatures generated in a clutch or brake transmission component by use of powder metallurgy techniques including, die compacting, sintering, and quenching.

SUMMARY OF THE INVENTION

[0007] The invention is defined in the independent claims.

[0008] In a preferred method of manufacturing an au-

tomotive component in accordance with the present invention, a low alloy constituent, low hardenability material is utilized that accordingly requires a more aggressive cooling or quenching operation to produce a strong martensitic wear resistant hard structure. The preferred method includes the traditional powder metallurgy operation of die compacting and sintering that is followed by a quenching operation wherein the sintered material is quenched in an environment of a cooling rate that results in a metallic microstructure that is 50-80% martensitic, 20-50% bainitic with a small portion of fine pearlite, generally less than 10%. Quenching may include other quench methods than atmospheric. Because this material does not have high relative hardenability and transform as readily to martensite at a quench rate between 1.9°F and 5.5°F per second, untempered martensite is not formed by localized hot spots in the operation of the automotive component. Because there is almost no untempered martensite in the metallic microstructure, resulting from high localized temperatures fracture initiation sites are sufficiently reduced. The service life of the automotive transmission or clutch brake component such as a backing plate is greatly extended. Further, the resulting micro structure from reduction in hardenability reduces the material's propensity to crack propagation in the finished component.

[0009] The method of manufacturing an automotive component in accordance with an embodiment of the present invention includes the initial provision of a metal pre alloy powder comprising, by weight, 0.35-0.55% nickel, 0.50-0.85% molybdenum, with the balance essentially iron, admixing an additional metal powder of 0.60-0.90% carbon and 1.0-3.0% copper metal powder to form an admixed metal powder. A suitable lubricant is added to the metal powder mixture to form a lubricated admixed metal powder. The lubricant is one of an EBS (Ethylene bis-stearamide) wax, metal stearates or other lubricant suitable for use in die compaction of metal powders.

[0010] The lubricated admixed metal powder is then die compacted, usually at a pressure of between 40 and 65 tons per square inch in the forming die. The die compacted metal blank is then sintered in an atmosphere of nitrogen and hydrogen mixture or other atmosphere suitable for sintering and sinter hardening. The sintering operation itself is usually conducted at a temperature above 2000°F (1090°C), and most usually at a temperature between 2000°F (1090°C) and 2350°F (1290°C) for a period of at least 10 minutes. The sintered metal blank itself is then cooled or quenched in a quenching or cooling operation that reduces the temperature of the sintered at a rate of 1.9°F/sec. (1.05°C/sec.) and 5.5°F/sec. (3.05°C/sec.) metal blank from between 1600°F (870°C) to 2000°F (1090°C), to a temperature of between 450°F (230°C) and 500°F (260°C). The quenched metal blank is then tempered at a temperature of between 350°F (175°C) and 450°F (230°C) for at least one hour to properly temper the quenched metal blank.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] Certain embodiments of the invention will now be described, by way of example, with reference to the drawings, in which:-

Fig. 1 is a perspective view of a clutch assembly in accordance with an embodiment of the present invention;

Fig. 2 is a perspective view of a clutch pocket plate in accordance with an embodiment of the present invention;

Fig. 3 is a bottom view of a pocket plate of a clutch component in accordance with an embodiment of the present invention;

Fig. 4 is a perspective view of a notch plate of a clutch component in accordance with an embodiment of the present invention;

Fig. 5 is a bottom view of a notch plate of a clutch component in accordance with an embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0012] Referring to Figs. 1-5 of the Drawings, an exemplary clutch assembly 10 in accordance with an embodiment of the present invention is seen to include a driving member 12 and a driven member 14, both of which are rotateable about a common normal axis 16. The exemplary clutch assembly 10 further includes a plurality of struts 18, disposed between the driving member 12 on the driven member 14. Struts 18 operate to mechanically couple the driving member 12 to the driven member 14 only when the driving member 12 rotates in a first direction relative to the driven member 14. Such an arrangement is typically referred to as a one way clutch.

[0013] More specifically, in the exemplary clutch assembly 10, the driving member 12 has a clutch face 22 that defines a first reference surface 24 that extends generally normal to the driving member's rotational axis 16. A plurality of recesses are defined in clutch face 22 of driving member 12, with each recess including a load-bearing shoulder that is operative to abuttingly engage a first end of a given strut 18 when the driving member 12 rotates in a first direction. While this embodiment of the invention contemplates any suitable configuration for the recesses of the driving member 12, in the exemplary clutch assembly 10 each recess 26 of the driving member 12 is adapted to receive a respective one of the assembly's struts 18. In such arrangement, struts 18 are nominally carried by the driving member 12 for rotation therewith about the axis 16.

[0014] Driven member 14 similarly includes a clutch face 34, in close-spaced opposition to the clutch face 22 of the driving member 12. Clutch face 34 also includes a reference surface 36 that extends generally normal to

the driven member's rotational axis 16. The driven member's clutch face 34 also includes a plurality of recesses 38 which exceed the number of recesses in the driving member 12. Each of the driven member's recesses 38 is adapted to receive the second end of a given strut 18 when the strut's second end is urged into recess 38. Such urging is typically by a spring seated beneath the strut 18 in the driving member's recess. Each of the driven member's recesses 38 includes a load-bearing shoulder 46 that is operative to engage the second end of a given strut 18 when the driving member 12 rotates in the first direction relative to the driven member 14. Driver member 14 includes a back face friction plate. This back face is subjected to intense localized heating in use.

[0015] The material for the clutch or transmission components of the present invention is a low alloy, low hardenability material that is subjected to an aggressive cooling or quenching operation to produce a strong martensitic, wear resistant metallic structure. The method of the present invention results in clutch or transmission components that have the desired properties.

[0016] In general, a method of manufacturing an automotive component in accordance with one aspect of the present invention comprises the steps of providing an initial pre alloy metal powder comprising, by weight, 0.35-0.55% nickel, 0.50-0.85% molybdenum, with the balance essentially iron. Then an additional 0.60-0.90% carbon, 1.0-3.0% copper metal powder are admixed to the initial metal powder to form an admixed metal powder. A suitable lubricant is added in accordance with powder metal practice to form a lubricated, admixed metal powder. The lubricated admixed metal powder is then die compacted, typically at a pressure of between 40 and 65 tons per square inch, to form a die compacted metal blank. The die compacted metal blank is then sintered to form a sintered metal blank. Such sintering typically is conducted at a temperature above 2000°F (1090°C), and more typically at a temperature between 2000°F (1090°C) and 2350°F (1290°C). The sintered metal blank, which is, in one embodiment of the present invention, either the driven or driving clutch component mentioned above, is then cooled or quenched to form a cooled metal blank. The quenching or cooling operation reduces the temperature of the sintered metal blank from between 1600°F (870°C) to 2000°F (1090°C) to a temperature of 450°F (230°C) and 500°F (260°C). It is desirable that such cooling or quenching be conducted at a rate between 1.9°F (1.05°C) and 5.5°F (3.05°C) per second. The cooled or quenched metal blank is then tempered at a temperature of between 350°F (175°C) and 450°F (230°C) for at least one hour. The resulting automotive component has a microstructure that is 50-80% martensitic, 20-50% bainitic, and a small percentage, usually less than 10%, fine pearlite.

[0017] Because this resulting automotive component material does not transform as readily to martensite, the component does not respond to localized hot spots in clutch or transmission automotive service. Because

there is almost no untempered martensite, the resulting microstructure, which is up to 50% bainitic, eliminates fracture initiation sites thereby extending the serviceable life of the clutch or transmission component. Reduction in hardenability, as compared to the high hardenability materials previously used in such clutch brake or transmission components, reduces the materials propensity to rehardening which further prohibits crack development and propagation.

[0018] Certain examples of the method of carrying out the present invention follow:

Example 1

[0019] In a method of manufacturing an automotive clutch component, an initial pre alloy metal powder of particle sizes between 250 and 1 micron was provided comprising, by weight, .45% nickel, .65% molybdenum, with the balance essentially iron.

[0020] An additional .7% graphite, and 1.75% copper metal powder of particle sizes between 150 and 1 micron, by weight, were admixed to form an admixed metal powder.

[0021] .5% EBS was added as a lubricant to form a lubricated admixed metal powder.

[0022] The lubricated, admixed metal powder was compacted at a pressure of 45 tons per square inch.

[0023] The die compacted metal blank was then sintered at a temperature 2050°F for 15 minutes.

[0024] The sintered metal blank was then quenched at a rate of 5.4°F (3.00°C) per second from an initial temperature of (2000°F) (1090°C) to a temperature of (500°F) (260°C) per use. The quenched metal blank was then tempered at a temperature of (380°F) (190°C) for 60 minutes.

[0025] The resulting material has a metal microstructure that was 50-55% martensitic, 45-50% bainitic and <5% fine pearlite. The Rockwell hardness of the resulting material was about HRA40.

Example 2

[0026] In a method of manufacturing an automotive clutch component, an initial pre alloy metal powder of particle sizes between 250 and 1 microns was provided comprising, by weight, .45% nickel, .65% molybdenum, with the balance essentially iron.

[0027] An additional .9% graphite, and 1.75% copper metal powder of particle size between 150 and 1 micron, by weight, were admixed to form an admixed metal powder.

[0028] .5% EBS was added as a lubricant to form a lubricated admixed metal powder.

[0029] The lubricated, admixed metal powder was compacted at a pressure of 45 tons per square inch.

[0030] The die compacted metal blank was then sintered at a temperature 2050°F for 15 minutes.

[0031] The sintered metal blank was then quenched

at a rate of 1.9°F (1.05°C) per second from an initial temperature of (2000°F) (1090°C) to a temperature of (500°F) (260°C) per use. The quenched metal blank was then tempered at a temperature of (380°F) (190°C) for 60 minutes.

[0032] The resulting material has a metal microstructure that was 60-65% martensitic, 35-40% bainitic and <5% fine pearlite. The Rockwell hardness of the resulting material was about HRA50.

Example 3

[0033] In a method of manufacturing an automotive clutch component, an initial pre alloy metal powder of particle size between 250 and 1 micron was provided comprising, by weight, .45% nickel, .65% molybdenum, with the balance essentially iron.

[0034] An additional .9% carbon, and 1.75% copper metal powder of particle size between 150 and 1 micron, by weight, were admixed to form an admixed metal powder.

[0035] 5% EBS was added as a lubricant to form a lubricated admixed metal powder.

[0036] The lubricated, admixed metal powder was compacted at a pressure of 45 tons per square inch.

[0037] The die compacted metal blank was then sintered at a temperature 2050 for 15 minutes.

[0038] The sintered metal blank was then quenched at a rate of 1.9°F (1.0°C) per second from an initial temperature of (2000°F) (1090°C) to a temperature of (500°F) (260°C) per use. The quenched metal blank was then tempered at a temperature of (380°F) (190°C) for 60 minutes.

[0039] The resulting material has a metal microstructure that was 80% martensitic, 20% bainitic and <1% fine pearlite. The Rockwell hardness of the resulting material was about HRA58.

Claims

1. A method of manufacturing an automotive component comprising the steps of:

providing an initial metal powder comprising, by weight, 0.35-0.55% nickel, 0.50-0.85% molybdenum, with the balance essentially iron, admixing an additional 1.0-3.0% copper metal powder, by weight, to form an admixed metal powder, adding a suitable lubricant for form a lubricated, admixed metal powder, die compacting the lubricated, admixed metal powder to form a die compacted metal blank, sintering the die compacted metal blank to form a sintered metal blank, cooling the sintered metal blank to form a cooled metal blank, the cooled metal blank comprising a metallic

structure of 50-80% martensite and 20-50% bainite and fine pearlite.

2. A method of manufacturing an automotive component comprising the steps of:

providing an initial pre-alloy metal powder comprising, by weight, 0.35-0.55% nickel, 0.50-0.85% molybdenum, with the balance essentially iron,
 admixing an additional 0.60-0.90% carbon and 1.0-3.0% copper metal powder, by weight, to form an admixed metal powder, adding a suitable lubricant to form a lubricated, admixed metal powder,
 die compacting the lubricated, admixed metal powder, to form a die compacted metal blank, sintering the die compacted metal blank to form a sintered metal blank, cooling the sintered metal blank to form a cooled metal blank,
 the cooled metal blank comprising a metallic structure of 50-80% martensite and 20-50% bainite and fine pearlite.

3. The method of claim 1 or 2 wherein the lubricant is one of an Ethylene bis-stearamide wax, metal stearates or other lubricants suitable for die compaction of a metal powder.

4. The method of any preceding claim wherein the initial metal powder is of a particle size from 250 to 1 micron.

5. The method of any preceding claim wherein the admixed metal powder is of a particle size from 150 to 1 micron.

6. The method of any preceding claim wherein in the die compaction is conducted at a pressure of between 40 and 65 tons per square inch.

7. The method of any preceding claim wherein the sintering is conducted at a temperature of above 2000°F (1090°C).

8. The method of claim 7 wherein the sintering is conducted at a temperature of between 2000°F (1090°C) and 2350°F (1290°C).

9. The method of any preceding claim wherein the sintering is conducted for at least 10 minutes.

10. The method of any preceding claim wherein the cooling is a quenching operation in an atmosphere of nitrogen and hydrogen or generated endothermic gas.

11. The method of any preceding claim wherein the cool-

ing is conducted in a manner to reduce the temperature of the sintered metal blank from between 1600°F (870°C) to 2000°F (1090°C) to a temperature of between 450°F (230°C) and 500°F (260°C).

12. The method of any preceding claim wherein cooling of the sintered metal blank is conducted at a rate of between 1.9°F (1.05°C) and 5.5°F (3.05°C) per second.

13. The method of any preceding claim wherein the cooled metal blank is tempered at a temperature of between 350°F (175°C) and 450°F (230°C) for at least one hour.

14. An automotive component having a metal composition comprised of, by weight, 0.35-0.55% nickel, 0.50-0.85% molybdenum, and 1.0-3.0% copper, with the balance essentially iron, wherein the component has a metallic structure of 50-80% martensite and 20-50% bainite and fine pearlite.

15. The component of claim 14 wherein the component has Rockwell hardness of about HRA45.

16. The component of claim 14 or 15 wherein the component is manufactured in a powder metallurgy operation comprising die compacting, sintering, and cooling operations.

17. An automotive component manufactured in a process comprising the steps of any of claims 1 to 13.

FIG. 1

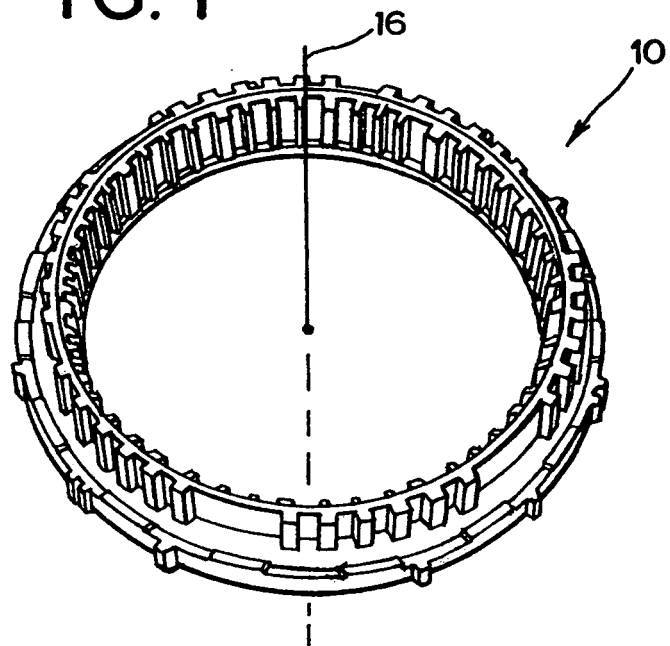
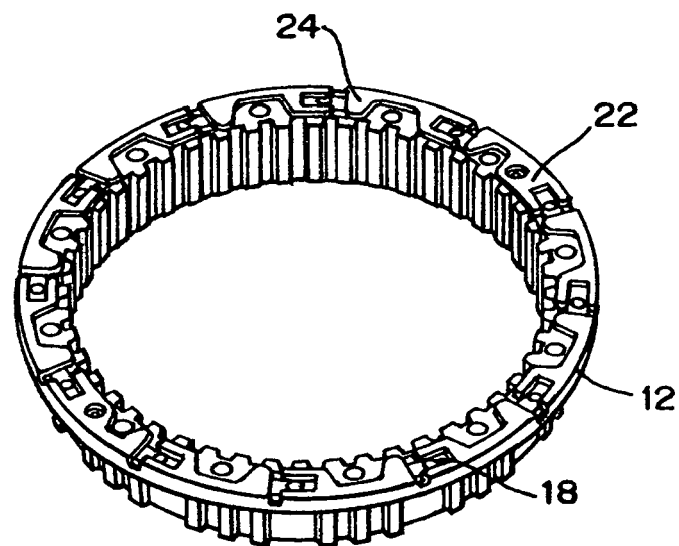


FIG. 2



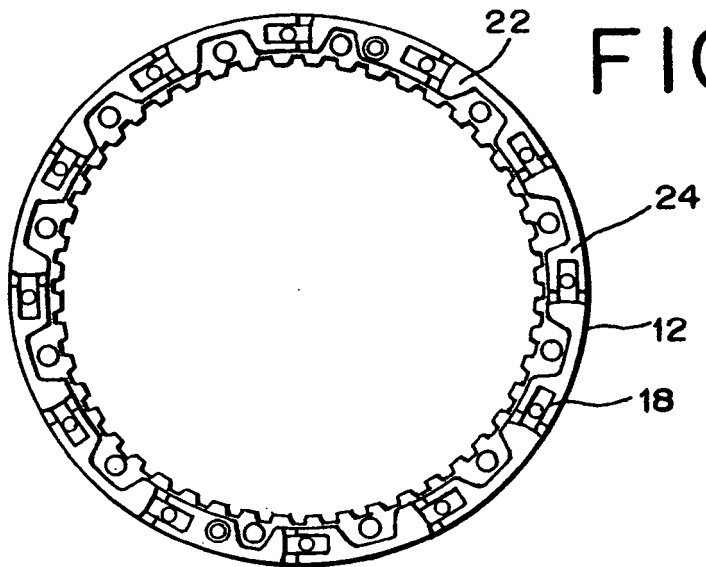


FIG. 3

FIG. 4

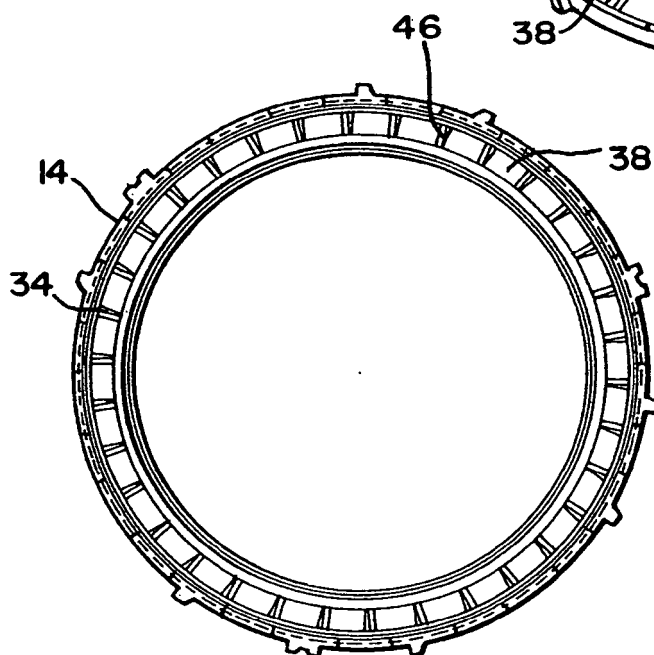
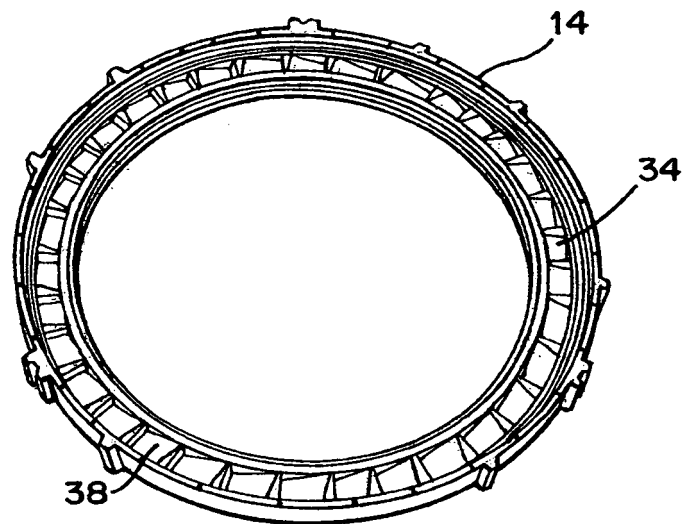


FIG. 5

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- US 6571926 B [0002]