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(54) LASH ADJUSTER AND METHOD OF MAKING SAME

SPIELAUSGLEICHER UND VERFAHREN ZUR HERSTELLUNG DAVON

DISPOSITIF DE RÉGLAGE DE JEU ET PROCÉDÉ DE FABRICATION DE CE DERNIER

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EP 3 049 645 B1

Description

FIELD

[0001] The present disclosure is directed to a hydraulic or mechanical lash adjuster and a method of manufacturing the same.

BACKGROUND

[0002] Hydraulic or mechanical lash adjusters for internal combustion engines have been in use for many years to eliminate clearance or lash between engine valve train components under varying operating conditions. Lash adjusters can maintain efficiency and reduce noise and wear in the valve train. In some examples, hydraulic lash adjusters can support the transfer of energy from the valve-actuating cam to the valves through hydraulic fluid trapped in a pressure chamber under the plunger.

[0003] The background description provided herein is for the purpose of generally presenting the context of the disclosure.

SUMMARY

[0004] The invention relates to a method of manufacturing a lash adjuster assembly according to claim 1.

[0005] According to additional features, forming can be further defined as forming a lash adjuster body with one of cold forming, stamping, drawing, metal injection molding, powdered metal sintering, and machining. Forming can be further defined as cold-forming the lash adjuster body to the as-formed condition having functional geometry. The preserving can then be further defined as preserving the functional geometry of the leak down portion in the as-formed condition during imparting of the wear resistant surface layer. The preserving can be further defined as preserving the functional geometry of the leak down portion in the as-formed condition after imparting of the wear resistant surface layer.

[0006] According to other features, imparting can be further defined as imparting a wear resistant surface layer to at least the leak down portion of the inner cylindrical surface with a sub-critical temperature process selected from one of ferritic nitrocarburizing, physical vapor deposition, and chemical vapor deposition. The method can also include maintaining a hardness of the lash adjuster body below the wear resistant surface layer after forming and during imparting. Preserving can further comprise preserving the leak down portion of the inner cylindrical surface in the as-formed condition after imparting of the wear resistant surface layer. Preserving can further comprise preserving a majority of the inner cylindrical surface in the as-formed condition after imparting of the wear resistant surface layer. Preserving can further comprise preserving a majority of the outer cylindrical surface in the as-formed condition after imparting of the wear resistant surface layer. Preserving can further comprise preserving a majority of both of the outer cylindrical surface and the inner cylindrical surface in the as-formed condition after imparting of the wear resistant surface layer.

[0007] In other features, the method can also include annealing the lash adjuster body before imparting to relieve stresses arising during forming. The method can also include cleaning the lash adjuster body after imparting and polishing the lash adjuster body after imparting.

[0008] A lash adjuster body for use in a lash adjuster assembly can include an outer cylindrical surface and an inner cylindrical surface. The inner cylindrical surface can have a leak down portion and a blind bore. At least the leak down portion of the inner cylindrical surface can include a wear resistant surface layer imparted with a sub-critical temperature process. The leak down portion can be preserved in an as-formed condition existing prior to the imparting of the wear resistant surface layer.

[0009] According to additional features, the majority of the at least one of the outer cylindrical surface and the inner cylindrical surface can be modified through the sub-critical temperature process being one of ferritic nitrocarburizing, physical vapor deposition, and chemical vapor deposition. The inner cylindrical surface can further comprise a plunger shelf and a notch. The notch can be positioned between the leak down portion and the plunger shelf.

[0010] A lash adjuster assembly can include a lash adjuster body and a leak down plunger. The lash adjuster body can include an outer cylindrical surface and an inner cylindrical surface. The inner cylindrical surface can include a leak down portion and a blind bore. At least the leak down portion of the inner cylindrical surface can include a wear resistant surface layer imparted with a sub-critical temperature process. The leak down portion can be preserved in an as-formed condition existing prior to the imparting of the wear resistant surface layer. The leak down plunger can be slidably received in the inner cylindrical surface against the leak down portion.

[0011] According to additional features, a majority of the outer cylindrical surface and a majority of the inner cylindrical surface include the wear resistant surface layer. The majorities of the outer and inner cylindrical surfaces can be preserved in the as-formed condition existing prior to the imparting of the wear resistant surface layer. A majority of the inner cylindrical surface can include the wear resistant surface layer and a functional geometry of the majority of the inner cylindrical surface can be maintained in the as-formed condition existing prior to the imparting of the wear resistant surface layer. The wear resistant surface layer can have a depth of less than forty microns.

[0012] A method of manufacturing a lash adjuster is disclosed in US 2006/049035 A1.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] The present disclosure will become more fully understood from the detailed description and the accompanying drawings, wherein:

FIG. 1 is flow chart of a process in accordance with an example of the present disclosure;
FIG. 2 is a cross-sectional view of a normally open lash adjuster constructed in accordance with another example of the present disclosure;
FIG. 3 is a cross-sectional view of a normally closed lash adjuster constructed in accordance with another example of the present disclosure;
FIG. 4 is a cross-sectional view of a normally closed lash adjuster constructed in accordance with another example of the present disclosure; and
FIG. 5 is a variant cross-sectional view of a normally closed lash adjuster constructed in accordance with another example of the present disclosure.

DETAILED DESCRIPTION

[0014] A plurality of different embodiments of the present disclosure is shown in the Figures of the application. Similar features are shown in the various embodiments of the present disclosure. Similar features have been numbered with a common reference numeral and have been differentiated by an alphabetic suffix. Similar features across different embodiments have been numbered with a common reference numeral and have been differentiated by an alphabetic suffix. Also, to enhance consistency, the structures in any particular drawing share the same alphabetic suffix even if a particular feature is shown in less than all embodiments. Similar features are structured similarly, operate similarly, and/or have the same function unless otherwise indicated by the drawings or this specification.

[0015] With reference now to FIG. 1, a method of manufacturing a lash adjuster body for use in a lash adjuster assembly can start at 100. At 102, a lash adjuster body can be formed to an as-formed condition. The as-formed condition can be defined as the lash adjuster body having functional geometry at the completion of 102. Functional geometry refers to the fact the lash adjuster body can be operable to perform upon being formed without further processing that would alter the geometry of the lash adjuster body.

[0016] An exemplary lash adjuster body is referenced at 20 in FIG. 2. The lash adjuster body 20 can be formed using established metal forming and/or machining techniques with or without thermal input. Such technique could include cold-forming or cold-forging or cold-heading, deep-drawing cold formed in one or more embodiments of the present disclosure. Cold forming can be a relatively high-speed manufacturing process whereby metal is shaped at relatively lower temperatures. A cold-formed workpiece is not necessarily heated, but can increase in temperature during the cold forming process. Cold forming can be carried out without removing material from a workpiece. Metal can be forced beyond the elastic yield limit but below tensile strength. As used herein, the term "cold-forming" and its derivatives, are intended to encompass what is known in the art as "cold-forging", "cold heading" and "deep drawing". The lash adjuster body blank can be precision cold formed, wherein workpiece dimensions can be held to within microns. In some other embodiments, the lash adjuster body blank can be formed with stamping, drawing, metal injection molding, powdered metal sintering, or machining.

[0017] With reference now to FIG. 2, the lash adjuster body 20 can have an outer cylindrical surface 32 and an inner cylindrical surface 33. The inner cylindrical surface 33 can include a leak down portion 34 and a blind bore 40. The lash adjuster body 20 can be manufactured such that a majority of at least one of the outer cylindrical surface 32 and the inner cylindrical surface 33 is maintained in an as-formed condition. An unground condition can define one example of an as-formed condition. For example only, neither of the surfaces 32, 34 may be subjected to grinding in one or more embodiments of the present disclosure. Generally, grinding and machining are distinct subsets of metal removal generally. Grinding is a microscopic cutting operation and machining is a macroscopic cutting operation. Alternatively, at least one of the surfaces 32, 34 is not subjected to grinding in one or more embodiments of the present disclosure. Generally, if it is desired to grind the inner cylindrical surface 33, the outer cylindrical surface 32 must be ground as well since the lash adjuster body 20 will be held by the outer cylindrical surface 32 during grinding of the inner cylindrical surface 33. The exemplary lash adjuster body 20 of the present disclosure is thus not over-processed.

[0018] Referring again to FIG. 1, the lash adjuster body can be annealed at 104 in one or more embodiments of the present disclosure to reduce residual stresses. Processes for relieving stress alternative to annealing can be applied in some embodiments of the present disclosure. At 106, material can be machined from the lash adjuster body. A lash adjuster body can be machined by defining an aperture or by turning a groove in the outer cylindrical surface of the lash adjuster body, and by metal removal to qualify overall length. As used herein, the term "machining" can mean the use of a chucking machine, drilling machine, turning machine, or broaching machine to remove material.

[0019] At 108, a wear resistant surface layer can be imparted to at least a portion of the lash adjuster body. The wear resistance of the portion of the lash adjuster body can be enhanced by 108. The wear resistant surface layer can be imparted to the outer cylindrical surface 32 and the inner cylindrical surface 33 in one or more embodiments of the present disclosure. Alternatively, the outer cylindrical surface 32 may or may not be imparted with a wear resistant surface layer. Any subcritical temperature process can be applied to impart the wear re-

sistant surface layer, such as by way of example and not limitation ferritic nitrocarburizing (hereafter "FNC"), physical vapor deposition (hereafter "PVD"), or chemical vapor deposition (hereafter "CVD"). Other sub-critical temperature process can be applied as well. FNC is a thermochemical surface hardening process that includes diffusion of nitrogen and carbon onto the lash adjuster body. PVD is a process in which a solid coating material is evaporated by heat or by bombardment with ions on a workpiece to be coated. CVD is a process in which a workpiece is exposed to one or more volatile precursors which react and/or decompose on the workpiece to produce the desired coating. Such processes for imparting a wear resistant surface layer may be employed with or without a vacuum process to minimize or eliminate distortion.

[0020] It is noted that the order of 106 and 108 can be reversed in some embodiments of the present disclosure. In such an embodiment, the machining can include producing a side hole on the body, such as aperture 42. Alternatively, the machining could include creating an outer diameter groove such as groove 27. Alternatively, the machining could include creating the geometry for a hook portion such as hook portion 98b shown in FIG. 4. The machining operation could remove a portion of the wear resistant surface layer that was previously imparted to the lash adjuster body 20. Machining can also include material removal to correct the overall length of the lash adjuster body 20 and include lead-in angles or chamfers and/or radii on the inner and outer cylindrical surfaces.

[0021] According to prior art methods, the lash adjuster body would undergo a heat treatment process such as carbonitriding. Carbonitriding is a metallurgical surface modification technique that is used to increase surface hardness of a metal. Heat-treating the lash adjuster body with a process such as carbonitriding can cause the geometry of the lash adjuster body to be distorted. In such scenarios, a subsequent machining or grinding or material working step is necessary to return the lash adjuster body to its "preheat treated" shape or to an otherwise desired resultant shape. In the embodiments of the present disclosure, a conventional heat treatment step is replaced by incorporating a subcritical temperature process such as FNC or PVD or CVD that imparts a wear resistant surface layer and helps preserve the functional geometry of the lash adjuster body requiring no additional operations to correct distortion. Similar to increasing hardness as provided by carbonitriding, FNC enhances the wear resistance of a surface. In this regard, substantial time and cost savings may be realized by manufacturing the lash adjuster body according to the present method.

[0022] The functional geometry of the lash adjuster body is preserved as the wear resistant surface is being imparted. The lash adjuster body can thus be functionally operable after the imparting of the wear resistant surface. The wear resistant surface layer can have a depth of less than forty microns in some embodiments of the present disclosure. The wear resistant surface layer can have a depth of less than thirty microns in some embodiments of the present disclosure. The wear resistant surface layer can have a depth of less than twenty microns in some embodiments of the present disclosure. The wear resistant surface layer can have a depth of between ten and twenty microns in some embodiments of the present disclosure. The wear resistant surface layer can have a depth of between one and ten microns in some embodiments of the present disclosure.

[0023] At 110, the lash adjuster body can be subjected to cleaning and/or polishing. Cleaning and polishing could be carried out concurrently or sequentially. Any mechanical methods can be applied to re-establish the surface finish after a wear resistant surface layer is imparted. A plurality of lash adjuster bodies can be cleaned and polished at one time.

[0024] At 112, the lash adjuster body can be sized and sorted. The method discussed above can produce more repeatable lash adjuster bodies thereby reducing categories for size and sort operations. Explained further, because (i) the conventional heat treating step that can alter the geometry of the lash adjuster body and (ii) the subsequent machining (such as grinding) step that can further alter the geometry of the lash adjuster body are both eliminated, together less opportunities for the shape of the lash adjuster body to be distorted are presented. The geometries of the lash adjuster bodies are therefore more consistent. Inventory can be reduced. Capital cost can also be significantly reduced for processing the components.

[0025] Referring again to FIG. 2, a lash adjuster assembly constructed in accordance to one example of the present disclosure is shown and generally identified at reference number 10. The lash adjuster assembly 10 is of the Type 2 valve train variety. It will be appreciated, however, that the teachings discussed herein with regard to the lash adjuster assembly 10 can be used in any configuration of lash adjuster and is not limited to the configuration shown in FIG. 2. The lash adjuster assembly 10 can generally include a lash adjuster body 20 and a leak down and ball plunger combination 22. The leak down and ball plunger combination 22 can include a ball plunger 23 and a leak down plunger 25. The discussion above that focused on a method of forming the lash adjuster body 20 may also be applicable to other components of the lash adjuster assembly 10 including, but not limited to, the ball plunger 23 and/or the leak down plunger 25 of the leak down and ball plunger combination 22.

[0026] The lash adjuster body 20 can generally extend along a longitudinal body axis 30 and includes the outer cylindrical surface 32 and the inner cylindrical surface 33. The inner cylindrical surface 33 can define the blind bore 40. A fluid port 42 can be defined through the lash adjuster body 20.

[0027] The lash adjuster body 20 can be assembled with the remaining components of a lash adjuster assembly 10. The components can then be provided into a final

lash adjuster assembly. Referring again to FIG. 2, the leak down plunger 25 and the ball plunger 23 can be inserted in the lash adjuster body 20 at 114. As shown in FIG. 2, the leak down plunger 25 can be received in the inner cylindrical surface 33 of the lash adjuster body 20. All or the majority of the inner cylindrical surface 33 can be preserved in an as-formed condition and the leak down plunger 25 can be slidably engaged with the majority of the inner cylindrical surface 33 during insertion. After assembly and in operation, the leak down plunger 25 can be slidably engaged with the leak down portion 34 of the inner cylindrical surface 33. In the exemplary lash adjuster body 20, the majority of the outer cylindrical surface 32 can also be preserved in an as-formed condition. The exemplary process can end at 116 in FIG. 1.

[0028] Referring again to FIG. 2, the leak down plunger 25 can be configured for reciprocal movement relative to the lash adjuster body 20 along the longitudinal body axis 30. This movement can be sliding movement of the outside surface of the leak down plunger 25 against the leak down portion 34 of the inner cylindrical surface 33. A plunger spring 50 can be disposed within the blind bore 40 underneath the leak down plunger 25 and be configured to bias the leak down plunger 25 in an upward direction (as viewed in FIG. 2) relative to the lash adjuster body 20. The plunger spring 50 can act at all times to elevate the leak down plunger 25 to maintain its engagement with the hemispherical concave surface (not shown) of a rocker arm (not shown). In the example shown, a retaining member 60 is provided adjacent an upper portion of the lash adjuster body 20. The retaining member 60 limits upward movement of the leak down plunger 25 relative to the lash adjuster body 20 and retains the leak down plunger 25 within the lash adjuster body 20.

[0029] The lash adjuster assembly 10 includes a check valve assembly 70 positioned between the plunger spring 50 and the leak down plunger 25 of the leak down and ball plunger combination 22. The check valve assembly 70 functions to either permit fluid communication or block fluid communication between a low-pressure fluid chamber 76 and a high-pressure fluid chamber 78 in response to pressure differential between the two fluid chambers 76 and 78. The check valve assembly 70 can include a retainer 80 that is in engagement with the leak down plunger 25 of the leak down and ball plunger combination 22, a check ball 90, and a check ball spring 96 that is disposed between the leak down plunger 25 and the check ball 90. The check ball spring 96 can be configured to bias the check ball 90 in a downward direction (as viewed in FIG. 2). The check valve assembly 70 can be referred to by those skilled in the art as "normally open."

[0030] With reference now to FIG. 3, a lash adjuster assembly constructed in accordance with another example of the present disclosure is shown and generally identified at reference number 10a. The lash adjuster assembly 10a can extend along an axis 30a and generally include a lash adjuster body 20a and a leak down and ball plunger combination 22a. An aperture 42a can be defined in the lash adjuster body 20a. The lash adjuster assembly 10a can comprise similar components as described above, but be configured as a normally closed lash adjuster. The lash adjuster body 20a can have an outer cylindrical surface 32a and an inner cylindrical surface 33a. The inner cylindrical surface 33a can include a leak down portion 34a, a blind bore 40a, and a plunger shelf 41a. The lash adjuster body 20a can be formed using the techniques described above. Specifically, the lash adjuster body 20a can be constructed using the method described above that avoids a heat treatment step and alternatively incorporates a process that imparts a wear resistant surface layer such as FNC, PVD, or CVD.

[0031] FIG. 4 discloses another embodiment of the present disclosure. A lash adjuster assembly constructed in accordance with another example of the present disclosure is shown and generally identified at reference number 10b. The lash adjuster assembly 10b can extend along an axis 30b and generally include a lash adjuster body 20b and a leak down and ball plunger combination 22b. The lash adjuster body 20b can have an outer cylindrical surface 32b and an inner cylindrical surface 33b. The inner cylindrical surface 33b can include a leak down portion 34b, a blind bore 40b, and a plunger shelf 41b. The inner cylindrical surface 33b can further comprise a notch 43b. The notch 43b can be semi-obovate in cross-section and be positioned between the leak down portion 34b and the plunger shelf 41b. Notches of other shapes can be applied in other embodiments of the present disclosure. An aperture 42b can be defined in the lash adjuster body 20b. The lash adjuster assembly 10b can comprise similar components as described above, but be configured as a normally closed lash adjuster. The lash adjuster body 20b can be formed using the techniques described above. Specifically, the lash adjuster body 20b can be constructed using the method described above that avoids a heat treatment step and alternatively incorporates a subcritical temperature process that imparts a wear resistant surface layer such as FNC, PVD, or CVD.

[0032] The lash adjuster body 20b can define an inner diameter relief or hook portion 98b. The hook portion 98b can be created in the lash adjuster body 20b after a wear resistant surface layer is imparted. The wear resistant surface layer on the inside and/or outside of the hook portion 98b can be removed prior to crimping of the hook portion 98b to prevent fracture or breakage. The hook portion 98b can be crimped or deformed to provide retention of the leak down and ball plunger combination 22b within the lash adjuster assembly 10b and can eliminate the need for bottle-caps, wires and clips to retain the leak down and ball plunger combination 22b. Alternatively, the hook portion 98b of the body 20b, that is used for retention of the leak down and ball plunger combination 22b, can be used with conventional heat treatment of the lash adjuster body. In such application, the case or hard outer layers can be removed before crimping

to prevent cracking or fracturing.

[0033] FIG. 5 discloses another embodiment of the present disclosure, a variant of the embodiment shown in FIG. 4. A lash adjuster assembly constructed in accordance with another example of the present disclosure is shown and generally identified at reference number 10c. The lash adjuster assembly 10c can extend along an axis 30c and generally include a lash adjuster body 20c and a leak down and ball plunger combination 22c. The lash adjuster body 20c can have an outer cylindrical surface 32c and an inner cylindrical surface 33c. The inner cylindrical surface 33c can include a leak down portion 34c, a blind bore 40c, and a plunger shelf 41c. The inner cylindrical surface 33c can further comprise a notch 43c. The notch 43c can be semi-obovate in cross-section and be positioned between the leak down portion 34c and the plunger shelf 41c. Notches of other shapes can be applied in other embodiments of the present disclosure. An aperture 42c can be defined in the lash adjuster body 20c. The lash adjuster assembly 10c can comprise similar components as described above, but be configured as a normally closed lash adjuster. The lash adjuster body 20c can be formed using the techniques described above. Specifically, the lash adjuster body 20c can be constructed using the method described above that avoids a heat treatment step and alternatively incorporates a subcritical temperature process that imparts a wear resistant surface layer such as FNC, PVD, or CVD. The lash adjuster body 20c can define an inner diameter relief or hook portion 98c. The hook portion 98c can be created in the lash adjuster body 20c after a wear resistant surface layer is imparted.

Claims

1. A method of manufacturing a lash adjuster assembly (10b; 10c), the method comprising:

   forming a lash adjuster body (20b; 20c) to an as-formed condition including an outer cylindrical surface (32b; 32c) and an inner cylindrical surface (33b; 33c) having a leak down portion (34b; 34c) and a blind bore (40b; 40c);
   imparting a wear resistant surface layer to at least the leak down portion of the inner cylindrical surface and to a select portion of the lash adjuster body with a sub-critical temperature process; and
   preserving the leak down portion in the as-formed condition during imparting of the wear resistant surface layer; and
   subsequent to imparting the wear resistant surface layer, removing the wear resistant surface layer at a select portion of the lash adjuster body (20b; 20c);
   crimping the select portion of the lash adjuster body (20b; 20c) to create a hook portion (98b; 98c) configured to retain a leak down and ball plunger (22b; 22c) of the lash adjuster assembly (10b; 10c).

2. The method of claim 1 wherein forming is further defined as:
   forming a lash adjuster body (20b; 20c) with one of cold forming, stamping, drawing, metal injection molding, powdered metal sintering, and machining.

3. The method of claim 1 wherein forming is further defined as:
   cold-forming the lash adjuster body (20b; 20c) to the as-formed condition having functional geometry.

4. The method of claim 3 wherein preserving is further defined as:
   preserving the functional geometry of the leak down portion (34b; 34c) in the as-formed condition during and optionally also after imparting of the wear resistant surface layer.

5. The method of claim 1 wherein imparting is further defined as:
   imparting a wear resistant surface layer to at least the leak down portion of the inner cylindrical surface (33b; 33c) with a sub-critical temperature process selected from one of ferritic nitrocarburizing, physical vapor deposition, and chemical vapor deposition.

6. The method of claim 1 wherein preserving further comprises:
   preserving the leak down portion of the inner cylindrical surface (33b; 33c) in the as-formed condition after imparting of the wear resistant surface layer.

7. The method of claim 1 wherein preserving further comprises:
   preserving a majority of the inner and/or outer cylindrical surface (33b; 33c; 32b; 32c) in the as-formed condition after imparting of the wear resistant surface layer.

8. The method of claim 1 further comprising at least one of:

   (a) maintaining a hardness of the lash adjuster body (20b; 20c) below the wear resistant surface layer after forming and during imparting,
   (b) annealing the lash adjuster body (20b; 20c) before imparting to relieve stresses arising during forming, and
   (c) cleaning the lash adjuster body (20b; 20c) after imparting; and
   polishing the lash adjuster body (20b; 20c) after imparting.

9. A lash adjuster body (20b; 20c) for use in a lash

adjuster assembly (10b; 10c), the lash adjuster body comprising:

an outer cylindrical surface (32b; 32c);
an inner cylindrical surface (33b; 33c) having a leak down portion (34b; 34c) and a blind bore (40b; 40c), wherein at least the leak down portion of the inner cylindrical surface includes a wear resistant surface layer imparted with a sub-critical temperature process and the leak down portion is preserved in an as-formed condition existing prior to the imparting of the wear resistant surface layer; and
a hook portion (98b; 98c) formed on an area of the lash adjuster body (20b; 20c) without the wear resistant surface layer, the hook portion configured to retain a leak down and ball plunger (22b; 22c) of the lash adjuster assembly (10b; 10c).

10. The lash adjuster body of claim 9 wherein the majority of the at least one of the outer cylindrical surface (32b; 32c) and the inner cylindrical surface (33b; 33c) is modified through the sub-critical temperature process being one of ferritic nitrocarburizing, physical vapor deposition, and chemical vapor deposition.

11. The lash adjuster body of claim 9 wherein the inner cylindrical surface (33b; 33c) further comprises a plunger shelf (41b; 41c) and a notch (43b; 43c) positioned between the leak down portion (34b; 34c) and the plunger shelf.

12. A lash adjuster assembly comprising:

the lash adjuster body (20b; 20c) of claim 9; and
a leak down plunger (25) slidably received in the inner cylindrical surface (33b; 33c) against the leak down portion (34b; 34c).

13. The lash adjuster assembly of claim 12 wherein a majority of the outer cylindrical surface (32b; 32c) and a majority of the inner cylindrical surface (33b; 33c) include the wear resistant surface layer and the majorities of the outer and inner cylindrical surfaces are preserved in the as-formed condition existing prior to the imparting of the wear resistant surface layer.

14. The lash adjuster assembly of claim 12 wherein a majority of the inner cylindrical surface (33b; 33c) includes the wear resistant surface layer and a functional geometry of the majority of the inner cylindrical surface is maintained in the as-formed condition existing prior to the imparting of the wear resistant surface layer.

15. The lash adjuster body of claim 12 wherein the wear resistant surface layer is further defined as having a depth of less than forty microns.

Patentansprüche

1. Verfahren zur Herstellung einer Spielausgleichsanordnung (10b; 10c), wobei das Verfahren Folgendes umfasst:

Formen eines Spielausgleichskörpers (20b; 20c) in einem geformten Zustand, einschließlich einer zylindrischen Außenfläche (32b; 32c) und einer zylindrischen Innenfläche (33b; 33c), die einen Druckverlustabschnitt (34b; 34c) und eine Sacklochbohrung (40b; 40c) aufweist;
Aufbringen einer verschleißbeständigen Oberflächenschicht auf den mindestens einen Druckverlustabschnitt der zylindrischen Innenfläche und auf einen ausgewählten Abschnitt des Spielausgleichskörpers mittels eines unterkritischen Temperaturvorgangs; und
Erhalten des Druckverlustabschnitts im geformten Zustand beim Aufbringen der verschleißbeständigen Oberflächenschicht; und
nach dem Aufbringen der verschleißbeständigen Oberflächenschicht Entfernen der verschleißbeständigen Oberflächenschicht an einem ausgewählten Abschnitt des Spielausgleichskörpers (20b; 20c);
Crimpen des ausgewählten Abschnitts des Spielausgleichskörpers (20b; 20c), um einen Hakenabschnitt (98b; 98c) zu erzeugen, der dazu ausgelegt ist, einen Druckverlust- und Kugelkolben (22b; 22c) der Spielausgleichsanordnung (10b; 10c) zu halten.

2. Verfahren nach Anspruch 1, wobei das Formen ferner wie folgt definiert ist:
Formen eines Spielausgleichskörpers (20b; 20c) mittels Kaltumformen, Stanzen, Ziehen, Metallspritzgießen, Sintern eines pulverförmigen Metalls oder Fräsen.

3. Verfahren nach Anspruch 1, wobei das Formen ferner wie folgt definiert ist:
Kaltumformen des Spielausgleichskörpers (20b; 20c) in den geformten Zustand, der eine funktionelle Geometrie aufweist.

4. Verfahren nach Anspruch 3, wobei das Erhalten ferner wie folgt definiert ist:
Erhalten der funktionellen Geometrie des Druckverlustabschnitts (34b; 34c) in dem geformten Zustand beim und optional auch nach dem Aufbringen der verschleißbeständigen Oberflächenschicht.

5. Verfahren nach Anspruch 1, wobei das Aufbringen ferner wie folgt definiert ist:

Aufbringen einer verschleißbeständigen Oberflächenschicht auf zumindest den Druckverlustabschnitt der zylindrischen Innenfläche (33b; 33c) mittels eines unterkritischen Temperaturvorgangs, ausgewählt aus Teniferierung, physikalischer Gasphasenabscheidung und chemischer Gasphasenabscheidung.

6. Verfahren nach Anspruch 1, wobei das Erhalten ferner Folgendes umfasst:
Erhalten des Druckverlustabschnitts der zylindrischen Innenfläche (33b; 33c) im geformten Zustand nach dem Aufbringen der verschleißbeständigen Oberflächenschicht.

7. Verfahren nach Anspruch 1, wobei das Erhalten ferner Folgendes umfasst:
Erhalten des Großteils der zylindrischen Innen- und/oder Außenfläche (33b; 33c; 32b; 32c) im geformten Zustand nach dem Aufbringen der verschleißbeständigen Oberflächenschicht.

8. Verfahren nach Anspruch 1, ferner mindestens einen der folgenden Schritte umfassend:

(a) Erhalten einer Härte des Spielausgleichskörpers (20b; 20c) unter der verschleißbeständigen Oberflächenschicht nach dem Formen und beim Aufbringen,
(b) Tempern des Spielausgleichskörpers (20b; 20c) vor dem Aufbringen, um beim Formen auftretende Spannungen abzubauen, und
(c) Reinigen des Spielausgleichskörpers (20b; 20c) nach dem Aufbringen; und
Polieren des Spielausgleichskörpers (20b; 20c) nach dem Aufbringen.

9. Spielausgleichskörper (20b; 20c) zur Verwendung in einer Spielausgleichsanordnung (10b; 10c), wobei der Spielausgleichskörper Folgendes umfasst:

eine zylindrische Außenfläche (32b; 32c);
eine zylindrische Innenfläche (33b; 33c), die einen Druckverlustabschnitt (34b; 34c) und eine Sacklochbohrung (40b; 40c) aufweist, wobei zumindest der Druckverlustabschnitt der zylindrischen Innenfläche eine mittels eines unterkritischen Temperaturvorgangs aufgebrachte verschleißbeständige Oberflächenschicht enthält und der Druckverlustabschnitt in einem geformten Zustand erhalten wird, der vor dem Aufbringen der verschleißbeständigen Oberflächenschicht bestand; und
einen Hakenabschnitt (98b; 98c), der auf einer Fläche des Spielausgleichskörpers (20b; 20c) ohne die verschleißbeständige Oberflächenschicht geformt ist, wobei der Hakenabschnitt dazu ausgelegt ist, einen Druckverlust- und Kugelkolben (22b; 22c) der Spielausgleichsanordnung (10b; 10c) zu halten.

10. Spielausgleichskörper nach Anspruch 9, wobei der Großteil der zylindrischen Außenfläche (32b; 32c) und/oder der zylindrischen Innenfläche (33b; 33c) durch den unterkritischen Temperaturvorgang modifiziert wird, der ausgewählt ist aus Teniferierung, physikalischer Gasphasenabscheidung und chemischer Gasphasenabscheidung.

11. Spielausgleichskörper nach Anspruch 9, wobei die zylindrische Innenfläche (33b; 33c) ferner eine Kolbenauflage (41b; 41c) und eine zwischen dem Druckverlustabschnitt (34b; 34c) und der Kolbenauflage positionierte Kerbe (43b; 43c) umfasst.

12. Spielausgleichsanordnung, Folgendes umfassend:

den Spielausgleichskörper (20b; 20c) nach Anspruch 9; und
einen Druckverlustkolben (25), der verschiebbar in der zylindrischen Innenfläche (33b; 33c) gegen den Druckverlustabschnitt (34b; 34c) aufgenommen wird.

13. Spielausgleichsanordnung nach Anspruch 12, wobei ein Großteil der zylindrischen Außenfläche (32b; 32c) und ein Großteil der zylindrischen Innenfläche (33b; 33c) die verschleißbeständige Oberflächenschicht enthält und der Großteil der zylindrischen Außen- und Innenfläche im geformten Zustand erhalten wird, der vor dem Aufbringen der verschleißbeständigen Oberflächenschicht bestand.

14. Spielausgleichsanordnung nach Anspruch 12, wobei ein Großteil der zylindrischen Innenfläche (33b; 33c) die verschleißbeständige Oberflächenschicht enthält und eine funktionelle Geometrie des Großteils der zylindrischen Innenfläche im geformten Zustand erhalten wird, der vor dem Aufbringen der verschleißbeständigen Oberflächenschicht bestand.

15. Spielausgleichskörper nach Anspruch 12, wobei die verschleißbeständige Oberflächenschicht ferner als eine Tiefe von weniger als vierzig Mikrometer aufweisend, definiert ist.

Revendications

1. Procédé de fabrication d'un assemblage de régleur de jeu (10b ; 10c), le procédé comprenant :

la formation d'un corps de régleur de jeu (20b ; 20c) dans un état tel que formé comprenant une surface cylindrique extérieure (32b ; 32c) et une

surface cylindrique intérieure (33b ; 33c) ayant une partie d'écoulement vers le bas (34b ; 34c) et un alésage borgne (40b ; 40c) ;
la dotation d'une couche de surface résistante à l'usure à au moins la partie d'écoulement vers le bas de la surface cylindrique intérieure et à une partie sélectionnée du corps de régleur de jeu avec un procédé à température sous-critique ; et
la préservation de la partie d'écoulement vers le bas dans l'état tel que formé durant la dotation de la couche de surface résistante à l'usure ; et suite à la dotation de la couche de surface résistante à l'usure, le retrait de la couche de surface résistante à l'usure au niveau d'une partie sélectionnée du corps de régleur de jeu (20b ; 20c) ;
le sertissage de la partie sélectionnée du corps de régleur de jeu (20b ; 20c) pour créer une partie de crochet (98b ; 98c) configurée pour retenir un plongeur à écoulement vers le bas et bille (22b ; 22c) de l'assemblage de régleur de jeu (10b ; 10c).

2. Procédé selon la revendication 1, dans lequel la formation est en outre définie par la formation d'un corps de régleur de jeu (20b ; 20c) avec l'un parmi un façonnage à froid, un estampage, un étirage, un moulage par injection de métal, un frittage de métal en poudre, et un usinage.

3. Procédé selon la revendication 1, dans lequel la formation est en outre définie par le façonnage à froid du corps de régleur de jeu (20b ; 20c) dans l'état tel que formé ayant une géométrie fonctionnelle.

4. Procédé selon la revendication 3, dans lequel la préservation est en outre définie par la préservation de la géométrie fonctionnelle de la partie d'écoulement vers le bas (34b ; 34c) dans l'état tel que formé pendant et éventuellement aussi après dotation de la couche de surface résistante à l'usure.

5. Procédé selon la revendication 1, dans lequel la dotation est en outre définie par la dotation d'une couche de surface résistante à l'usure à au moins la partie d'écoulement vers le bas de la surface cylindrique intérieure (33b ; 33c) avec un procédé à température sous-critique qui est l'un choisi parmi une nitrocarburation ferritique, un dépôt physique en phase vapeur, et un dépôt chimique en phase vapeur.

6. Procédé selon la revendication 1, dans lequel la préservation comprend en outre la préservation de la partie d'écoulement vers le bas de la surface cylindrique intérieure (33b ; 33c) dans l'état tel que formé après dotation de la couche de surface résistante à l'usure.

7. Procédé selon la revendication 1, dans lequel la préservation comprend en outre la préservation d'une majorité de la surface cylindrique intérieure et/ou extérieure (33b ; 33c ; 32b ; 32c) dans l'état tel que formé après dotation de la couche de surface résistante à l'usure.

8. Procédé selon la revendication 1, comprenant en outre au moins l'un parmi :

(a) le maintien d'une dureté du corps de régleur de jeu (20b ; 20c) sous la couche de surface résistante à l'usure après la formation et durant la dotation,
(b) le recuit du corps de régleur de jeu (20b ; 20c) avant la dotation pour relâcher les contraintes survenant durant la formation, et
(c) le nettoyage du corps de régleur de jeu (20b ; 20c) après la dotation ; et
le polissage du corps de régleur de jeu (20b ; 20c) après la dotation.

9. Corps de régleur de jeu (20b ; 20c) pour une utilisation dans un assemblage de régleur de jeu (10b ; 10c), le corps d'ajusteur de jeu comprenant :

une surface cylindrique extérieure (32b ; 32c) ;
une surface cylindrique intérieure (33b ; 33c) ayant une partie d'écoulement vers le bas (34b ; 34c) et un alésage borgne (40b ; 40c), où au moins la partie d'écoulement vers le bas de la surface cylindrique intérieure comprend une couche de surface résistante à l'usure apportée avec un procédé à température sous-critique et la partie d'écoulement vers le bas est préservée dans un état tel que formé existant avant la dotation de la couche de surface résistante à l'usure ; et
une partie de crochet (98b ; 98c) formée sur une zone du corps de régleur de jeu (20b ; 20c) sans la couche de surface résistante à l'usure, la partie de crochet étant configurée pour retenir un plongeur à écoulement vers le bas et à bille (22b ; 22c) de l'assemblage de régleur de jeu (10b ; 10c).

10. Corps de régleur de jeu selon la revendication 9, dans lequel la majorité d'au moins l'une parmi la surface cylindrique extérieure (32b ; 32c) et la surface cylindrique intérieure (33b ; 33c) est modifiée par l'intermédiaire du procédé à température sous-critique qui est l'un parmi une nitrocarburation ferritique, un dépôt physique en phase vapeur, et un dépôt chimique en phase vapeur.

11. Corps de régleur de jeu selon la revendication 9,

dans lequel la surface cylindrique intérieure (33b ; 33c) comprend en outre une plate-forme de plongeur (41b ; 41c) et une encoche (43b, 43c) positionnée entre la partie d'écoulement vers le bas (34b ; 34c) et la plate-forme de plongeur.

12. Assemblage de régleur de jeu comprenant :

le corps de régleur de jeu (20b ; 20c) de la revendication 9 ; et
un plongeur à écoulement vers le bas (25) reçu de façon coulissante dans la surface cylindrique intérieure (33b ; 33c) contre la partie d'écoulement vers le bas (34b ; 34c).

13. Assemblage de régleur de jeu selon la revendication 12, dans lequel la majorité de la surface cylindrique extérieure (32b ; 32c) et la majorité de la surface cylindrique intérieure (33b ; 33c) comprennent la couche de surface résistante à l'usure et les majorités des surfaces cylindriques extérieure et intérieure sont préservées dans l'état tel que formé existant avant la dotation de la couche de surface résistante à l'usure.

14. Assemblage de régleur de jeu selon la revendication 12, dans lequel la majorité de la surface cylindrique intérieure (33b ; 33c) comprend la couche de surface résistante à l'usure et la géométrie fonctionnelle de la majorité de la surface cylindrique intérieure est maintenue dans l'état tel que formé existant avant la dotation de la couche de surface résistante à l'usure.

15. Corps de régleur de jeu selon la revendication 12, dans lequel la couche de surface résistante à l'usure est en outre définie comme ayant une profondeur inférieure à quarante micromètres.

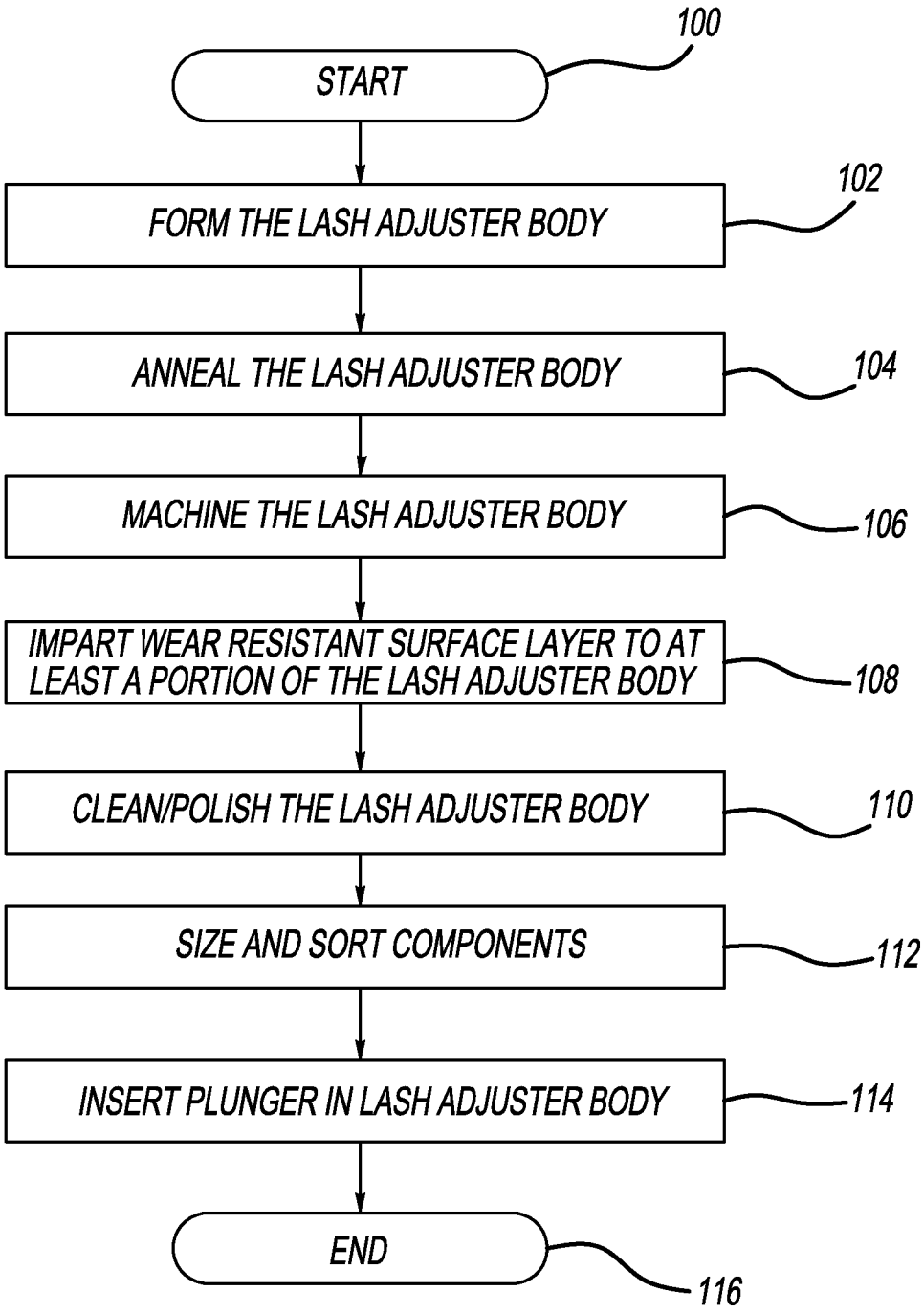
100
START
102
FORM THE LASH ADJUSTER BODY
104
ANNEAL THE LASH ADJUSTER BODY
106
MACHINE THE LASH ADJUSTER BODY
108
IMPART WEAR RESISTANT SURFACE LAYER TO AT LEAST A PORTION OF THE LASH ADJUSTER BODY
110
CLEAN/POLISH THE LASH ADJUSTER BODY
112
SIZE AND SORT COMPONENTS
114
INSERT PLUNGER IN LASH ADJUSTER BODY
116
END

FIG - 1

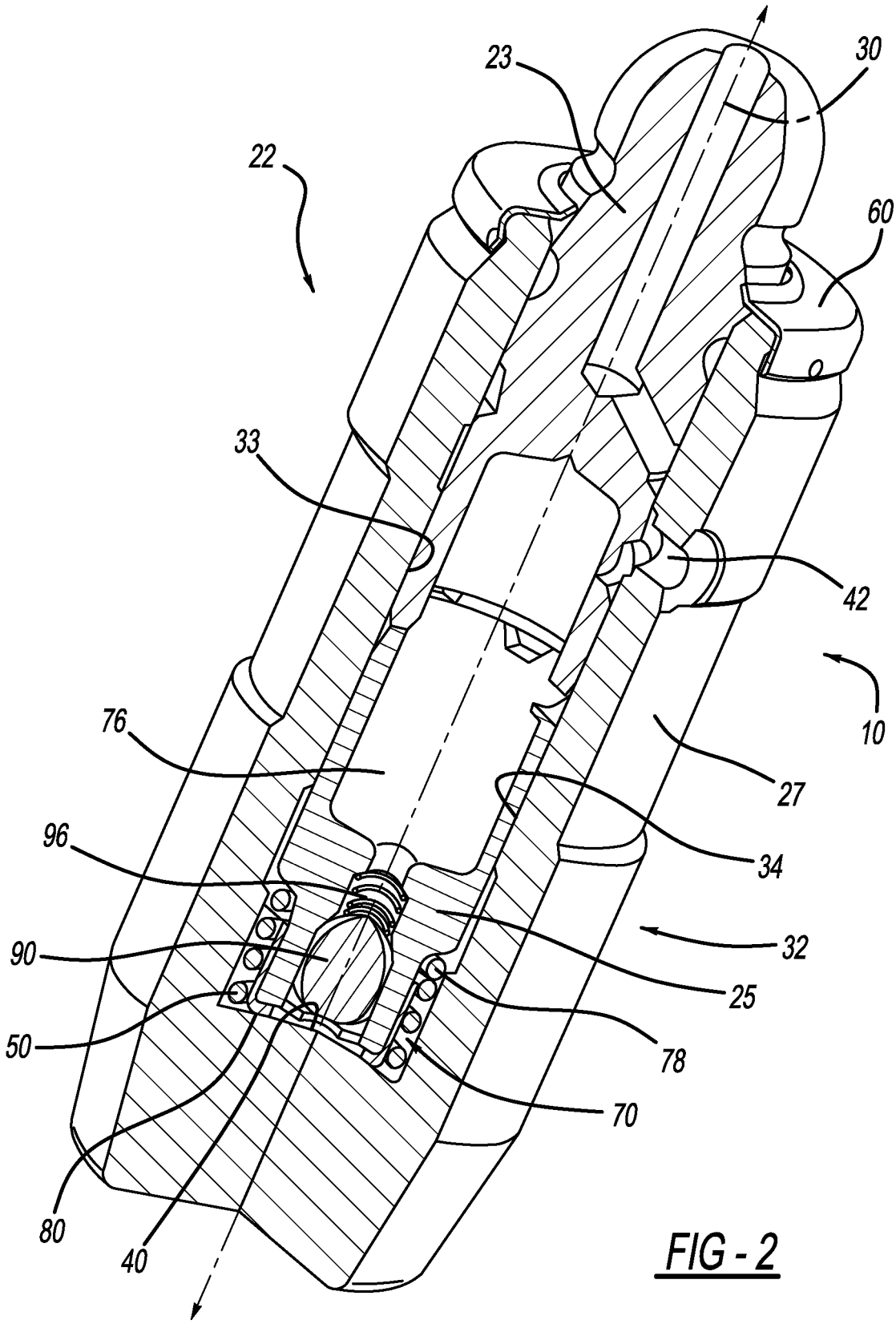

FIG - 2

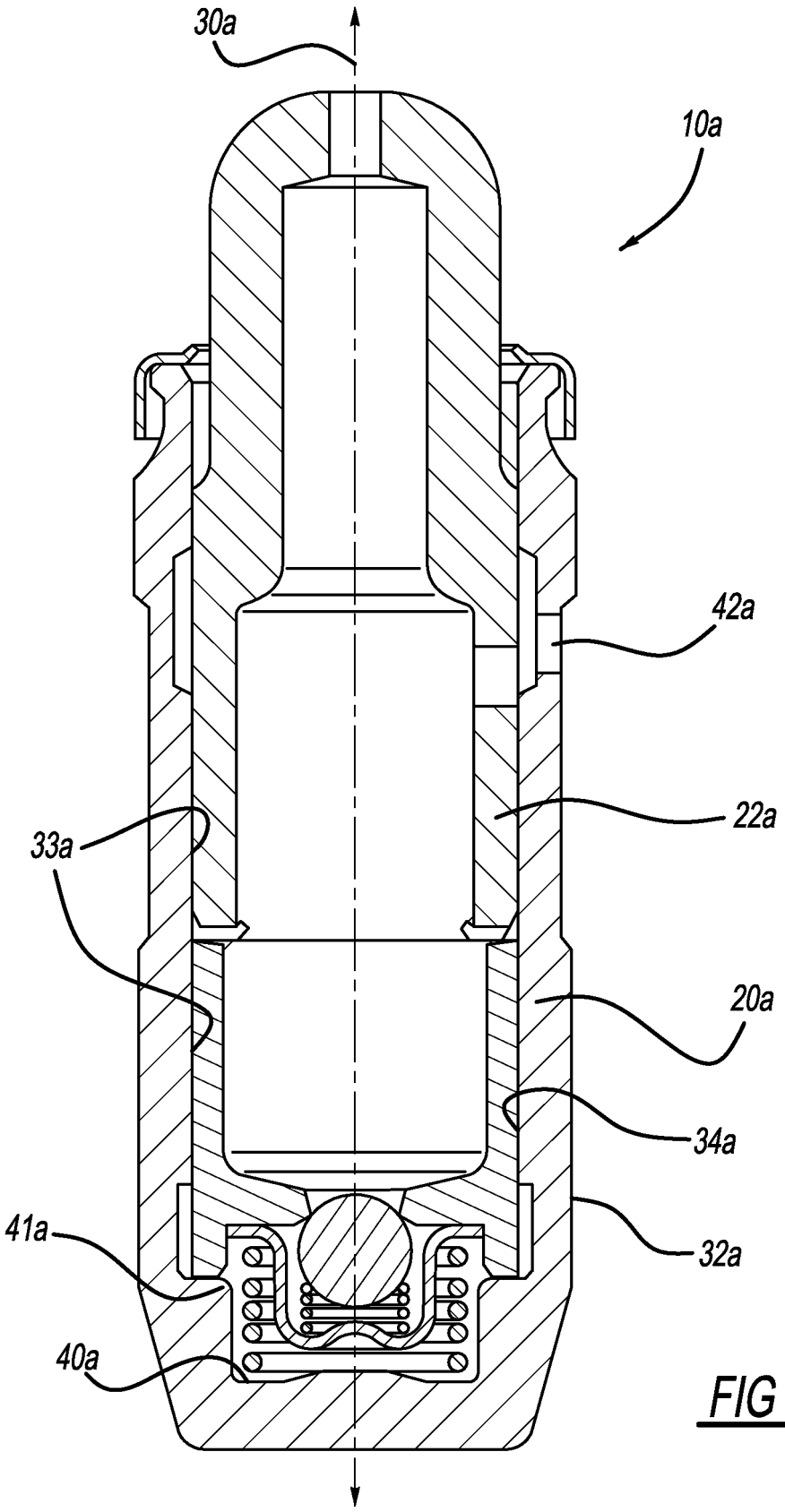

FIG - 3

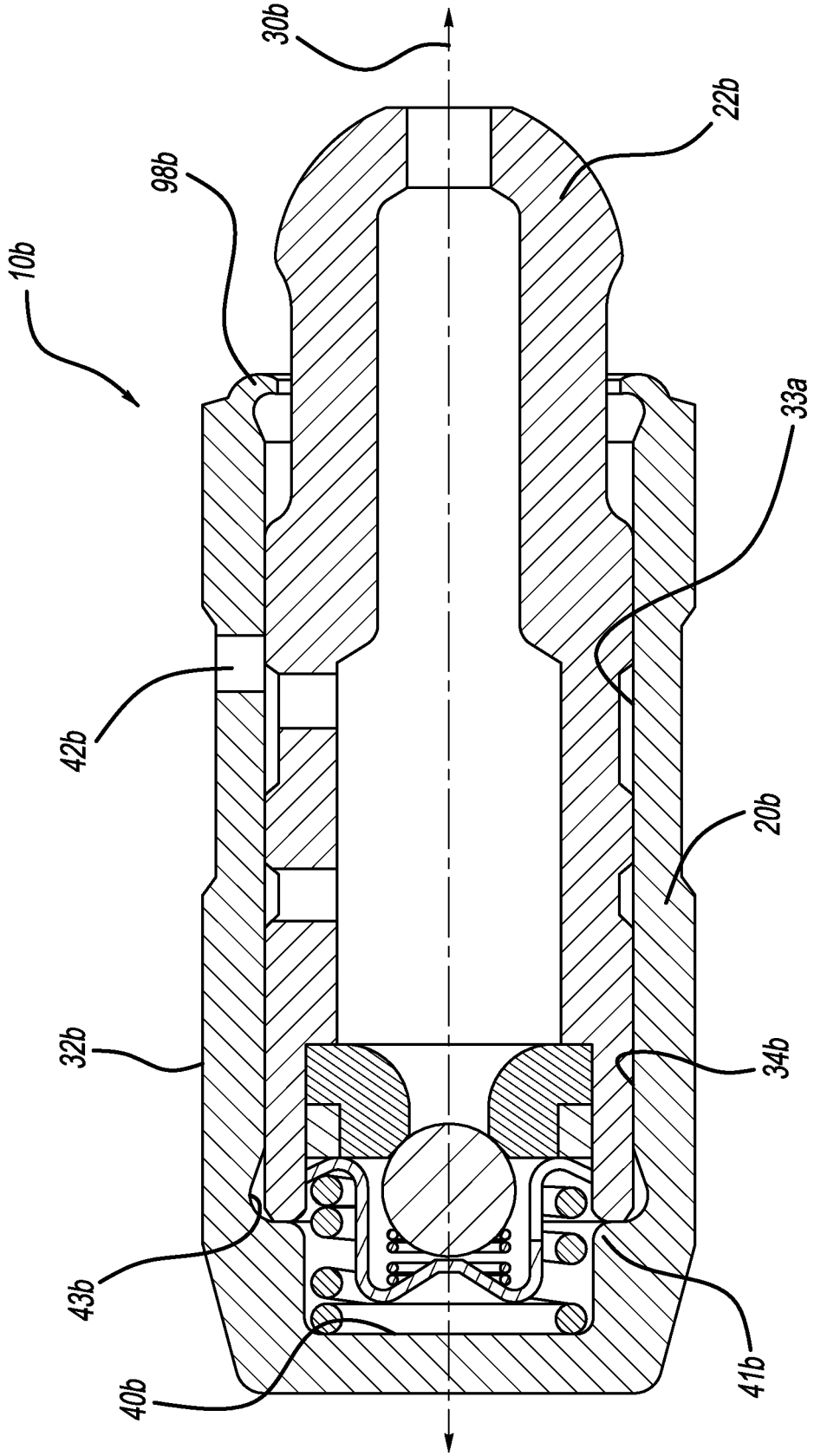

FIG - 4

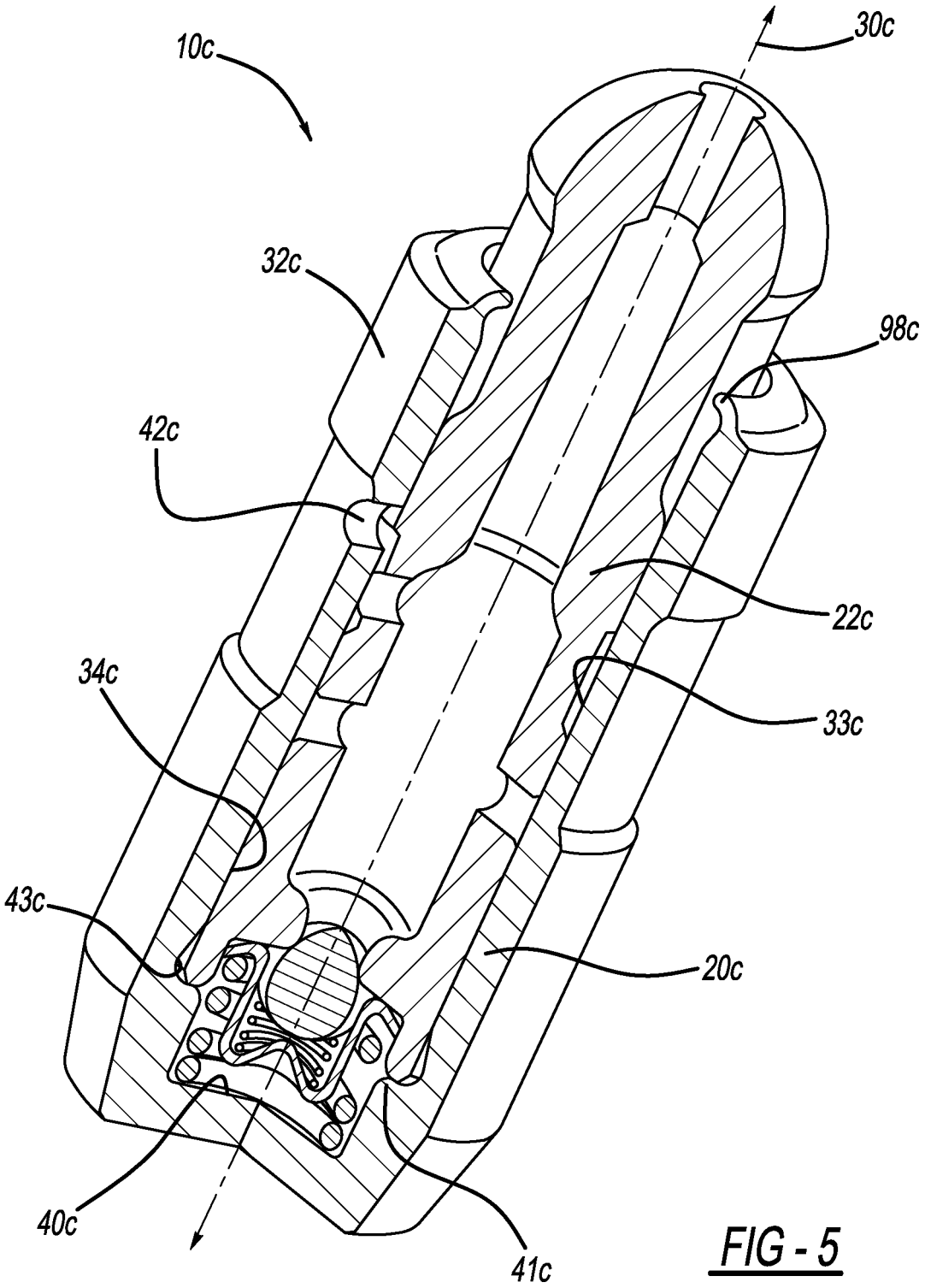

FIG - 5

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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