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(54) Intake valve device for preventing adhesion of deposits

Einlassventileinrichtung zur Verhinderung der Haftfestigkeit von Ablagerungen

Soupape d'admission empêchant l'adhésion de dépôts

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(56) References cited:

DE-A- 3 719 077 **FR-A- 2 078 676**
JP-A- 7 332 038 **US-A- 5 465 691**

- **PATENT ABSTRACTS OF JAPAN vol. 9, no. 7 (M-350), 12 January 1985 & JP-A-59 158363 (HINO JIDOSHA KOGYO KK), 7 September 1984,**
- **PATENT ABSTRACTS OF JAPAN vol. 18, no. 613 (M-1709), 22 November 1994 & JP-A-06 235308 (FUJI OOZX INC), 23 August 1994,**
- **PATENT ABSTRACTS OF JAPAN vol. 17, no. 671 (M-1525), 10 December 1993 & JP-A-05 223041 (NISSAN MOTOR CO LTD), 31 August 1993,**

EP 0 802 307 B1

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Description

The present invention relates to an intake valve device for preventing adhesion of deposits.

In poppet valves in engines of automobiles and ships, especially, in intake valves which has relatively low heat load, if high boiling point organic substances in lubricating oil leaked from a gap between a valve guide and a valve stem adhere to a valve head and adjacent area, they will be carbonized at of 200 to 300°C of the intake valve, gradually aggregated and developed, thereby forming sludges or bulk of deposits. In the deposits, corrosion ingredients may be contained, which causes corrosion in the valve head and adjacent area.

To overcome the disadvantages on the surface of the valve head and adjacent area, an intake valve is suggested as mentioned Japanese Patent Laid-Open Pub. No.6-235308, wherein a coating layer which has oxidation catalytic function is formed on the valve head and adjacent area, thereby preventing high boiling point organic substances from adhering on the valve head and adjacent area owing to oxidation catalytic reaction thereof. However, in the intake valve in this publication, an engine runs for a long time at low load and speed, so that the surface of catalyst is partially covered with high boiling point organic substances in the lubricating oil owing to oil-down until the intake valve becomes reaction temperature of the catalyst, and the catalyst is blocked against air or oxygen. Thus, oxidization catalytic reaction may not be achieved enough.

JP-A-5-223041 discloses the features of the first part of claims 1 and 3 and is concerned with increasing the filling efficiency of intake air that flows into a combustion chamber and to atomize the wall film flow of fuel deposited on the valve head.

To solve this problem, this document discloses an intake valve device in which the valve stem is housed within an air nozzle hole trough which assist air is fed to the back of the valve head.

FR-A-2078676 is concerned with the problem of lubricating the surface of a valve stem and of its bearing guide, avoiding excessive leakage of oil from the guide. The solution disclosed is to adopt a double spiral groove: a first groove 22 is wide enough to provide a relatively free passage for the oil and a second groove 24 is smaller and such as to enable building up of carbon deposits within its last two loops in order to block the groove and retain the oil in the groove. The same deposits of carbon on the valve head also have the function of limiting the descent of oil from the bigger groove.

US-A-5,465,691 is concerned with the problem of ensuring that some lubricant is always present on valve stem and guide and yet that the amount of lubricant that finally reaches the combustion chamber is minimal. The solution disclosed is to provide the bearing surface of the valve guide with a spiral groove 18 that has a specially shaped cross-section. Groove 18 extends along

the bearing part of the valve but it does not extend to the bottom of the valve guide, i.e. to the intake port of the valve device.

It is an object of the present invention to provide a valve device in which oil-down is directed toward a fuel injection device to prevent deposits from adhering to a valve head and adjacent area and catalyst surface from being covered by lubricating oil.

According to one aspect of the present invention, there is provided an intake valve device for preventing adhesion of deposits in an internal combustion engine according to claim 1.

According to another aspect of the present invention there is provided an intake valve device for preventing adhesion of deposits in an internal combustion engine according to claim 3.

According to the present invention, lubricating oil owing to oil-down is guided to the valve head through the annular and elongate grooves or the spiral groove and washed down by fuel injected by the fuel injection means, thereby avoiding the lubricating oil from adhering to the intake valve.

The features and advantages of the invention will become more apparent from the following description with respect to embodiments as shown in appended drawings wherein:

Fig. 1 is a sectional view of the first invention;
 Fig. 2 is an enlarged horizontal sectional view taken along the line II-II in Fig. 1;
 Fig. 3 is an enlarged horizontal sectioned view taken along the line III-III in Fig. 1;
 Fig. 4 is an enlarged horizontal sectioned view of of a valve guide of the second invention;
 Fig. 5 is an enlarged vertical sectioned view of an embodiment of the present invention; and
 Fig. 6 is an enlarged view of a coating layer.

The first invention is illustrated in Fig. 1, in which the numeral 1 denotes an intake valve which is molded from martensitic heat resisting steels and which comprises a valve stem 1a and a valve head 1b at the lower end thereof. The valve stem 1a of the intake valve 1 is slidably inserted in a cylindrical valve guide 2 which is pressed in a cylinder head 3, and the intake valve 1 is moved up and down by pushing the upper surface of a cylindrical tappet 5 at the upper end of the valve stem 1a by a cam 6. 4 denotes a valve spring.

At the upper end of the valve guide 2, a lip seal 7 is engaged over the outer circumferential surface of the valve stem 1a, thereby preventing excessive lubricating oil 8 from running into a gap between the valve stem 1a of the intake valve 1 and the valve guide 2.

In the vicinity of the intake valve 1, an injector 9 for injecting gasoline in vapour is provided in the cylinder head 3, and an injection port 9a is directed to the surface of the valve head 1b in the intake port 10. On the surface of the valve guide 2 which contacts the intake valve 1,

there is formed an annular groove 2a and an elongate groove 2b which communicates with the annular groove 2a at the upper end and which extends to the lower end of the valve guide 2. The lower end of the elongate groove 2b opens toward the intake port 10, which is also shown in Figs. 3 and 4.

The function of the embodiment as above will be described. The lubricating oil 8 which runs in the gap between the valve stem 1a of the intake valve 1 and the valve guide 2 is temporarily held in the annular groove 2a. The lubricating oil 8 in the annular groove 2a runs into the lower end of the valve stem 1a of the intake valve 1 in the intake port 10 and reaches the valve head 1b in the vicinity of the injector 9 via the elongate groove 2a. The gasoline 11 is blown to the lower end of the valve stem 1a of the intake valve 1 and the head 1b by the injector 9, so that the lubricating oil 8 which adheres thereon is washed down by the gasoline 11 and sucked into the cylinder 12. Therefore, the lubricating oil 8 hardly adheres on the surface of the intake valve 1 in the intake port 10.

In the above embodiment, the annular groove 2a and the elongate groove 2b are both formed on the valve guide 2, but may be formed on the intake valve 1.

Preferably, the annular groove 2a may be formed as low as possible. So far as the lubricating oil 8 invaded in the gap between the valve guide and the intake valve 1 is held in the annular groove 2a, the lubricating oil does not reach the contact surface lower than the annular groove 2a. It is for preventing lubrication decrease.

An embodiment of the second invention will be illustrated in Fig. 4. Difference between the above and present embodiments is only a groove in the inner circumferential surface of the valve guide 13, and the other illustration will be omitted. A spiral groove 14 is formed on the whole inner circumferential surface of the valve guide 13, and an opening 14a at the lower end of the spiral groove 14 communicates with the intake port 10 in the vicinity of the injector 9 similar to the elongate groove 2b in the foregoing embodiment.

The lubricating oil 8 invaded into a gap between the intake valve 1 and the valve guide 13 runs into the spiral groove 14 and reaches the valve head 1b of the intake valve 1 in the vicinity of the injector 9 similar to the foregoing embodiment. The oil 8 which adheres on the valve head 1b is washed down by the gasoline 11 from the injector 9. This embodiment achieves similar advantage to the foregoing embodiment, and the spiral groove 14 provides excellent oil-maintenance capability compared with the elongate groove 2b, and increases lubricating properties of contact surfaces of the intake valve 1 and the valve guide 13.

The spiral groove 14 may be formed from a suitable position on the inner circumferential surface of the valve guide 13 to the lower end of the valve guide 13. The spiral groove 14 may be formed on the intake valve 1.

Another embodiment of the present invention will be illustrated in Fig. 5, in which a coating layer having

oxidation catalytic function is formed on a portion of the intake valve 1 in the intake port 10, i.e. on the lower end of the valve stem 1a and the head 1b on which high boiling point organic substance is likely to adhere. As enlarged in Fig. 6, the surface of the intake valve 1 is coated with ceramic porous carrier 17 having a limitless number of micropores 16, into which active substances such as Pt, Pd and Rh are dissolved and carried, thereby forming the coating layer 15. The porous carrier 17 may be preferably made of oxide ceramics such as Al_2O_3 , ZrO_2 and cordierite, and may be coated by surface treatment means such as thermal spray and coating. If the surface of the intake valve 1 is made rough, peeling resistance of the porous carrier 17 will be increased. If the porous carrier 17 comprises two layer structure which comprises treating layer of Al_2O_3 and wash-coat layer of $\gamma-Al_2O_3$ applied thereon, the surface area of the micropores 16 will become larger, thereby increasing carrying capability of the active substance.

The high boiling point organic substance included in the lubricating oil 8 which is not washed down by the gasoline 11 and in the lubricating oil 8 which is scattered by up-and-down movement of the intake valve 1 onto the opposite surface of the valve head 1b in the vicinity of the injector 9 is absorbed on the active substance 18 in the coating layer 15. When the intake valve 1 becomes a predetermined temperature of 200 to 350° C, oxidation catalytic reaction occurs from heated portion, thereby leaving the high boiling point organic substance from the active substance 18 and dispersing it, so that high boiling point organic substance is neither carbonized nor deposited on the surface of the valve head 1b.

The present invention may be applied to internal combustion engines other than gasoline engine.

The foregoing merely relate to preferred embodiments of the invention. Various changes and modifications may be made by person skilled in the art without departing from the scope of claims wherein:

Claims

1. An intake valve device to prevent adhesion of deposits in an internal combustion engine, comprising:
 - an intake poppet valve (1) which comprises a valve head (1b) and a valve stem (1a);
 - a valve guide (2) in which the valve stem (1a) is slidably inserted;
 - fuel injection means (9) which injects fuel toward the valve head (1b);
 - a contact surface of the valve stem (1a) or the valve guide (2) having groove means, a lower end of the groove means opening toward an intake port in the vicinity of the fuel injection means (9),

characterised in that

- said groove means consists of an annular groove (2a) and an elongate groove (2b),
- said elongate groove communicates with said annular groove and opens toward said intake port,
- said deposits comprise lubricating oil (8), and
- a lip seal (7) is provided at the upper end of the valve guide (2) to engage the valve stem (1a) thereby preventing excessive lubricating oil (8) from running into a gap between the valve stem and the valve guide.

2. An intake valve device as defined in claim 1, wherein the annular groove (2a) is formed at a lower portion at the contact surface of the valve guide (2).

3. An intake valve device to prevent adhesion of deposits in an internal combustion engine, comprising:

- an intake poppet valve (1) which comprises a valve head (1b) and a valve stem (1a);
- a valve guide (2) in which the valve stem (1a) is slidably inserted;
- fuel injection means (9) which injects fuel toward the valve head (1b);
- a contact surface of the valve stem (1a) or the valve guide (2) having groove means, a lower end of the groove means opening toward an intake port in the vicinity of the fuel injection means (9),

characterised in that

- said groove means is formed as a spiral groove (14),
- said deposits comprise lubricating oil (8), and
- a lip seal (7) is provided at the upper end of the valve guide (2) to engage the valve stem (1a) thereby preventing excessive lubricating oil (8) from running into a gap between the valve stem and the valve guide.

4. An intake valve device as defined in any preceding claim, wherein a coating layer having an oxidation catalytic function is formed on at least a portion of the intake poppet valve (1), which portion works in the intake port.

Patentansprüche

1. Einlaßventilvorrichtung zum Verhindern des Anhaftens von Ablagerungen bei einem Verbrennungsmotor, umfassend:

- ein Einlaß-Tellerventil (1), das einen Ventilkopf (1b) und einen Ventilschaft (1a) umfaßt;
- eine Ventilführung (2), in welche der Ventilschaft (1a) gleitbar eingeführt ist;
- eine Kraftstoffeinspritzeinrichtung (9), die Kraftstoff gegen den Ventilkopf (1b) spritzt;
- eine Kontaktfläche des Ventilschaftes (1a) oder der Ventilführung (2a) mit Nuten, wobei ein unteres Ende der Nuten gegen eine Einlaßöffnung im Bereich der Kraftstoffeinspritzeinrichtung (9) mündet,

dadurch gekennzeichnet,

- daß die Nuten aus einer Ringnut (2a) und einer langgestreckten Nut (2b) bestehen;
- daß die langgestreckte Nut mit der Ringnut kommuniziert und in der Einlaßöffnung mündet;
- daß die Ablagerungen Schmieröl (8) umfassen, und
- daß eine Lippendichtung (7) am oberen Ende der Ventilführung (2) vorgesehen ist, um den Ventilschaft (1a) zu erfassen und damit zu verhindern, daß ein Überschuß von Schmieröl (8) in einen Spalt zwischen den Ventilschaft und der Ventilführung läuft.

2. Einlaßventilvorrichtung nach Anspruch 1, dadurch gekennzeichnet, daß die Ringnut (2a) an einem unteren Bereich an der Kontaktfläche der Ventilführung (2) gebildet ist.

3. Einlaßventilvorrichtung zum Verhindern eines Anhaftens von Ablagerungen bei einem Verbrennungsmotor, umfassend:

- ein Einlaßtellerventil (1), das einen Ventilkopf (1b) und einen Ventilschaft (1a) umfaßt;
- eine Ventilführung (2), in welche der Ventilschaft (1a) gleitbar eingeführt ist;
- eine Kraftstoffeinspritzeinrichtung (9), die Kraftstoff gegen den Ventilkopf (1b) spritzt;
- eine Kontaktfläche des Ventilschaftes (1a) oder der Ventilführung (2) mit Nuten, wobei ein unteres Ende der Nuten gegen eine Einlaßöffnung im Bereich der Kraftstoffeinspritzeinrichtung mündet,

dadurch gekennzeichnet, daß

- die Nuten als eine Spiralnute (14) gebildet sind;
- die Ablagerungen Schmieröl (8) umfassen und
- am oberen Ende der Ventilführung (2) eine Lippendichtung (7) vorgesehen ist, die den Ventilschaft (1a) erfäßt und damit verhindert, daß überschüssiges Schmieröl (8) in einen Spalt zwischen dem Ventilschaft und der Ventilführung

rung läuft.

4. Einlaßventilvorrichtung nach einem der vorausgegangenen Ansprüche, dadurch gekennzeichnet, daß eine Beschichtung, die eine katalytische oxidierende Funktion hat, auf wenigstens einem Teil des Einlaßstellerventils (1) gebildet ist, und daß dieser Teil in der Einlaßöffnung arbeitet.

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Revendications

1. Dispositif à soupape d'admission empêchant l'adhérence de dépôts dans un moteur à combustion interne, comportant:

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- une soupape d'admission à champignon (1) qui comporte une tête de soupape (1b) et une tige de soupape (1a);
- un guide de soupape (2) dans lequel la tige de soupape (1a) est insérée avec liberté de coulissement; et
- des moyens (9) d'injection de carburant qui injectent du carburant en direction de la tête de soupape (1b);
- une surface de contact de la tige de soupape (1a) ou du guide de soupape (2) présentant des moyens formant rainure, une extrémité inférieure des moyens formant rainure s'ouvrant en direction d'un orifice d'admission au voisinage des moyens (9) d'injection du carburant,

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caractérisée par le fait

- que lesdits moyens formant rainure consistent en une rainure annulaire (2a) et une rainure allongée (2b),
- que ladite rainure allongée communique avec ladite rainure annulaire et s'ouvre en direction dudit orifice d'admission,
- que lesdits dépôts comportent de l'huile de lubrification (8) et
- qu'un joint à lèvres (7) est prévu à l'extrémité supérieure du guide de soupape (2) pour venir en prise avec la tige de soupape (1a), évitant ainsi que de l'huile de lubrification (8) en excès ne passe dans un jeu existant entre la tige de soupape et le guide de soupape.

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2. Dispositif à soupape d'admission comme défini dans la revendication 1, dans lequel la rainure annulaire (2a) est formée à une portion inférieure de la surface de contact du guide de soupape (2).

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3. Dispositif à soupape d'admission empêchant l'adhérence de dépôts dans un moteur à combustion interne, comportant:

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- une soupape d'admission à champignon (1) qui comporte une tête de soupape (1b) et une tige de soupape (1a);
- un guide de soupape (2) dans lequel la tige de soupape (1a) est insérée avec liberté de coulissement; et
- des moyens (9) d'injection de carburant qui injectent du carburant en direction de la tête de soupape (1b);
- une surface de contact de la tige de soupape (1a) ou du guide de soupape (2) présentant des moyens formant rainure, une extrémité inférieure des moyens formant rainure s'ouvrant en direction d'un orifice d'admission au voisinage des moyens (9) d'injection du carburant,

caractérisée par le fait

- que lesdits moyens formant rainure sont sous forme d'une rainure en spirale (14),
- que lesdits dépôts comportent, de l'huile de lubrification (8) et
- qu'un joint à lèvres (7) est prévu à l'extrémité supérieure du guide de soupape (2) pour venir en prise avec la tige de soupape (1a), évitant ainsi que de l'huile de lubrification (8) en excès ne passe dans un jeu existant entre la tige de soupape et le guide de soupape.

4. Dispositif à soupape d'admission comme défini dans l'une quelconque des revendications précédentes, dans lequel une couche de revêtement ayant une fonction d'oxydation catalytique est formée sur au moins une portion de la soupape d'admission à champignon (1), portion qui travaille dans l'orifice d'admission.

FIG. 1

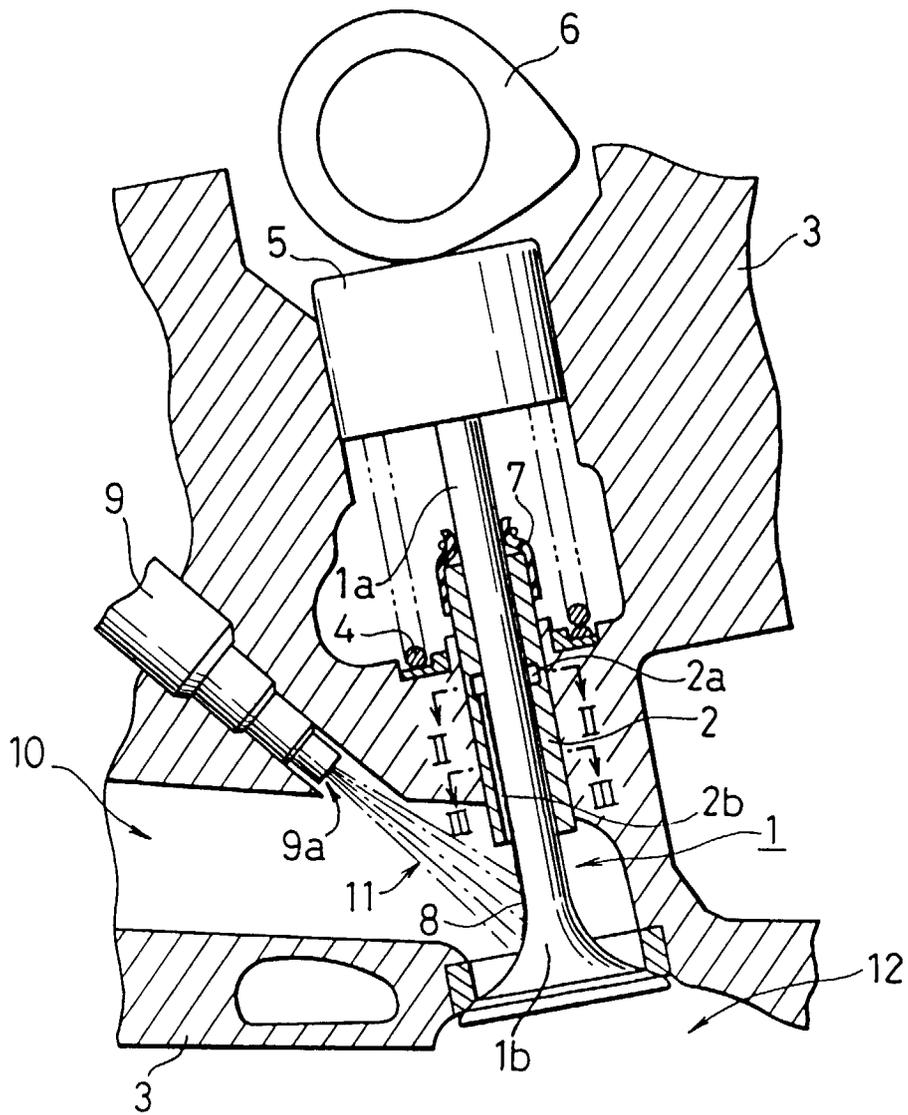


FIG. 2

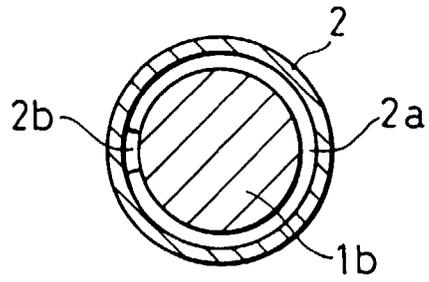


FIG. 3

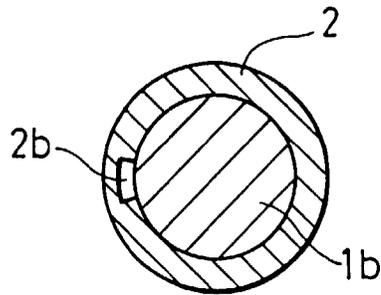


FIG. 4

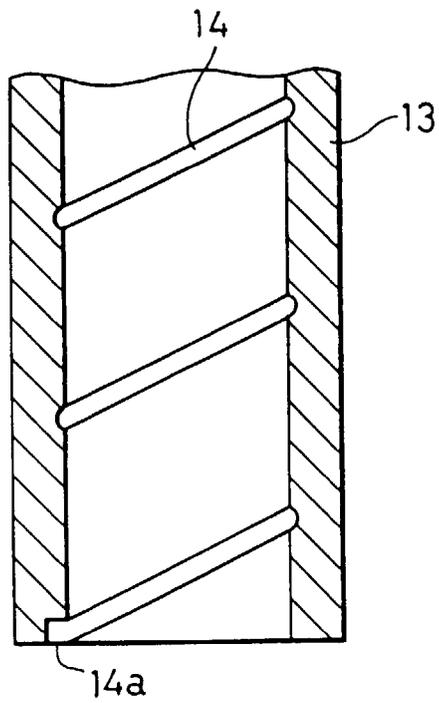


FIG. 5

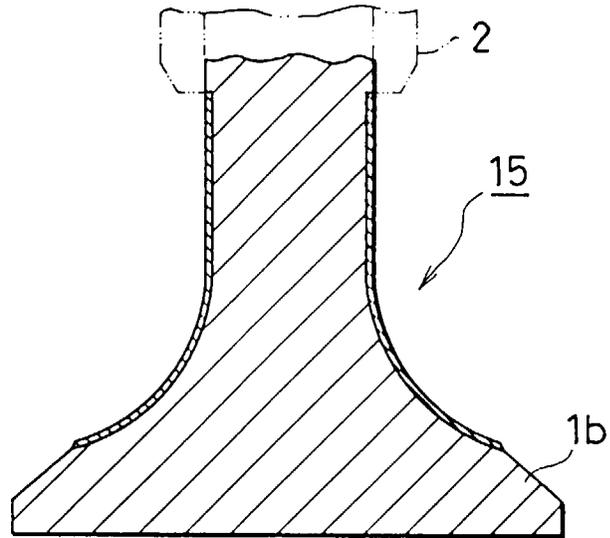


FIG. 6

