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(54) **Method of treating the surface of a poppet valve**

(57) A poppet valve as used in an internal combustion engine comprises a valve head (10b) and a valve stem (10a). A hardened layer is formed on the surface of the valve stem (10a) and is then pressed by pressure rollers (12) at a portion intended to make sliding contact with a lip seal. Wear in the lip seal is thus decreased.

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Description

BACKGROUND OF THE INVENTION

The present invention relates to a method of treating the surface of a poppet valve.

As shown in Fig. 3, a poppet valve 3 made of heat resistant steel comprises a valve head 1 and a valve stem 2, which is slidably engaged in a valve guide 4 which is a press fit in a cylinder head(not shown). The valve 2 is driven by pressing its end by a rocker arm 5 or a tappet(not shown).

The valve stem 2 always moves up and down at high speed along the valve guide 4 during running of an internal combustion engine, and a lip seal 6 prevents excessive lubricating oil from leakage onto the valve stem 1, so that the valve 3 is subject to severe frictional condition.

Therefore, on the surface of the valve stem 2 in which desired surface roughness is formed by grinding steps in the conventional valve 3, soft nitriding is applied to form hardened layer, or Cr or Ni metal plating is applied, thereby increasing wear resistance of the valve stem 2.

However, when the surface treatment, especially soft nitriding, is applied to the valve stem 2 in the valve 3, the valve stem 2 has relative large amplitude surface roughness as shown in Fig. 4, and there are rigid particles 7 such as coal and nitride on the surface.

To overcome the disadvantages, it is suggested to grind a portion by a grinding wheel in a grinder to decrease surface roughness, the portion slidably contacting the lip seal 6 in the stem 2 to which surface treatment such as soft nitriding is applied. But, the thickness of the hardened layer is too small to provide wear resistance and durability, so that the thickness of the hardened layer must be previously formed larger, taking thickness to be ground into consideration, so that surface treatment takes a lot of time to lead lower productivity, or material for the treatment requires increased cost, which is disadvantageous.

In view of the disadvantages, it is an object of the present invention to provide a method of treating the surface of a poppet valve in which surface roughness of the valve stem is easily decreased to keep wear of a lip seal as little as possible without grinding a hardened layer of the surface.

To achieve the object, there is provided a method of treating the surface of a poppet valve which comprises a valve head and a valve stem, the method comprising the steps of:

forming a hardened layer on the surface of the valve stem;

pressing the surface of at least a portion of the hardened layer by pressure members having flat pressing surfaces, the portion slidably contacting a lip seal.

The hardened layer may be preferably formed by soft nitriding.

The hardened layer formed on the surface of the valve stem is pressed by the pressure members, so that crests which have larger amplitudes on the surface of the hardened layer are collapsed to become flat surfaces having smaller surface roughness. Thus, the lip seal contacts the valve stem in area, so that area pressure of the contact portion decreases.

Surface roughness of the hardened layer of the valve stem increases, so that wear rate of the lip seal decrease and durability increases, thereby preventing oil from dropping at the lip seal. Thus, oil standing and increase in consumption of lubricating oil are avoided. Grinding of the hardened layer is not required, so that wear resistance does not decrease. Surface roughness of the hardened layer decreases by relatively simple means, thereby increasing productivity and decreasing production costs.

BRIEF DESCRIPTION OF THE DRAWINGS

The features and advantages of the present invention will become more apparent based on the following description with respect to the accompanying drawings wherein:

Fig. 1 shows the steps of one embodiment of the present invention, (A) being a longitudinal sectional view in which a hardened layer is formed on a poppet valve, (B) being a longitudinal sectional view in which a portion which slidably contacts a lip seal is pressed by a pair of pressure rollers;

Fig. 2 is an enlarged sectional view which shows surface roughness of the pressed portion ;

Fig. 3 is a partially sectioned longitudinal front elevational view which illustrates a valve operating mechanism to which the present invention is applied; and

Fig. 4 is an enlarged sectional view which shows surface roughness of a conventional poppet valve.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENT

Fig. 1 (A) and (B) illustrate the steps of the present invention. A heat resistant steel valve 10 was finished to desired size by a number of mechanical processing steps, and a valve stem 10a, a valve head 10b and a cotter groove 10c of the valve 10 are formerly ground except a valve face 10d by a grinding wheel of a grinder to have a desired surface roughness such as 1.0 to 10.0 μ m as Rz. The pretreatment steps are not shown. Then, as shown in Fig. 1(A), the surface except the valve face 10d is subject to salt bath soft nitriding to form a hardened layer 11.

The hardened layer 11 is formed by heating a treatment bath which contains KCN, KOCN and Na₄[Fe(CN)₆] to about 600 C, and the formerly treated por-

tions of the valve 10 is immersed in the bath for a predetermined time. The thickness of the hardened layer 11 may be preferably 10 to 20 μ m.

Then, as shown in Fig. 1(B), a portion which slidably contact a lip seal (in Fig. 3) in the valve stem 10a having the hardened layer 11 is put between a pair of pressure rollers 12 and 12 having flat pressing surfaces, and the surface of the hardened layer 11 is pressed with a fixed load such as 5kg/cm², while the rollers 12 rotate with the valve 3. The surface of the hardened layer 11 is changed to have flat surfaces having smaller surface roughness by collapsing crests having larger amplitudes. The lip seal substantially contacts the valve stem 10a in area, so that pressure of the contact surface decreases, thereby decreasing wear rate of the lip seal greatly to prevent oil from dropping at the lip seal. Roots 14 in the roughness of the surface act as oil standing, thereby increasing oil storage of lubricating oil.

In the foregoing embodiment, only the portion which slidably contacts the lip seal is pressed by the pressure rollers 12, but the pressure rollers may press all the surface of the valve stem which slidably contacts a valve guide (as shown in Fig. 3), or the surface of the hardened layer 11 which slidably contacts the upper and lower ends of the valve guide, thereby decreasing wear rate of the valve guide as well as the above.

In order to form the hardened layer 11 in the step of Fig. 1(A), instead of the salt bath soft nitriding, gas nitriding, ionized nitriding, gas cementation nitriding, metal plating, coating and spraying may be used. Means for forming the hardened layer 11 in the present invention are not limited to soft nitriding so far as surface roughness becomes relatively small after formation of the hardened layer 11. The present invention may also apply to Ti or Ti alloy valve as well as the heat resistant steel one.

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

Claims

1. A method of treating a surface of a poppet valve which comprises a valve head and a valve stem, the method comprising the steps of:

forming a hardened layer on the surface of the valve stem;

pressing the surface of at least a portion of the hardened layer that is intended, in use, to make sliding contact with a lip seal, by pressure members having flat pressing surfaces.

2. A method as defined in Claim 1 wherein the hardened layer is formed by soft nitriding.

3. A method as defined in Claim 1 or 2 wherein the pressure members comprises a pair of pressure rollers by which crests of a roughened surface of the said portion of the valve stem are collapsed to decrease surface roughness and thereby to prevent oil standing.

FIG.1(A)

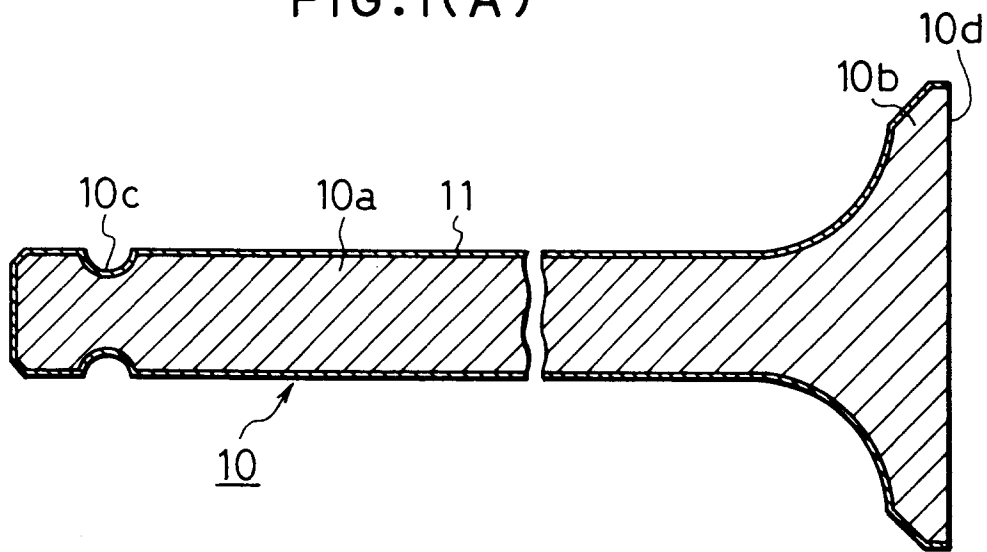


FIG.1(B)

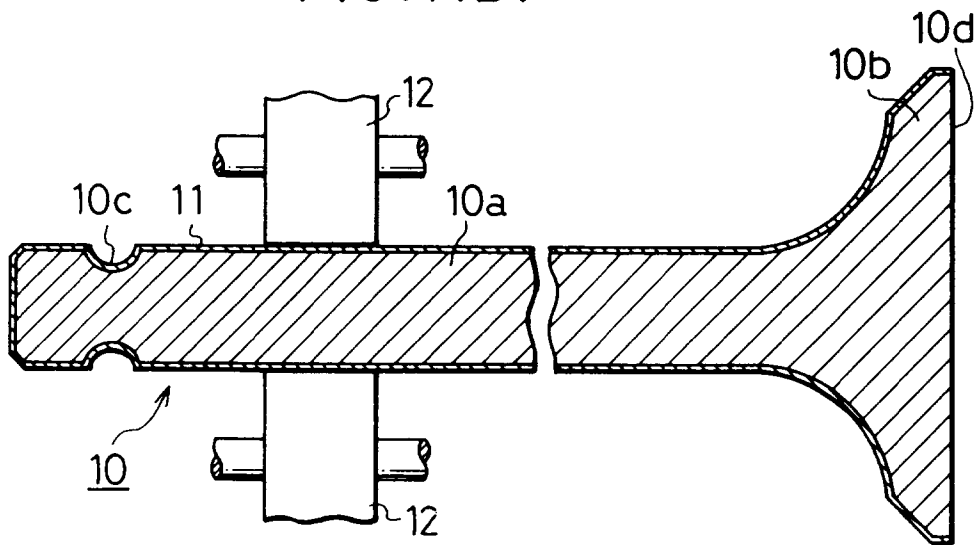


FIG.2

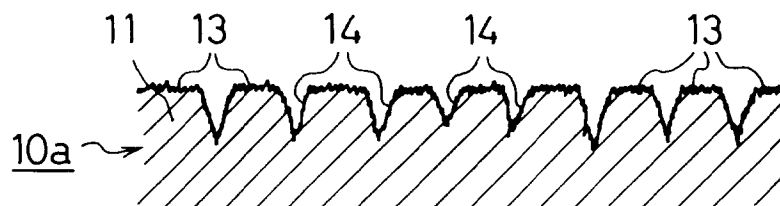


FIG.3

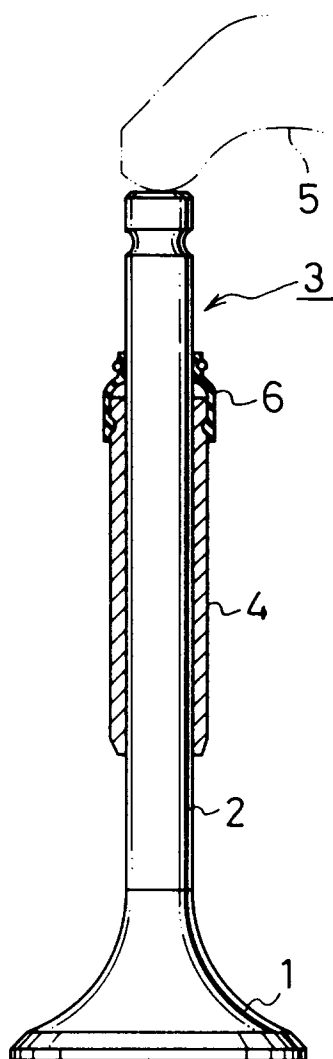
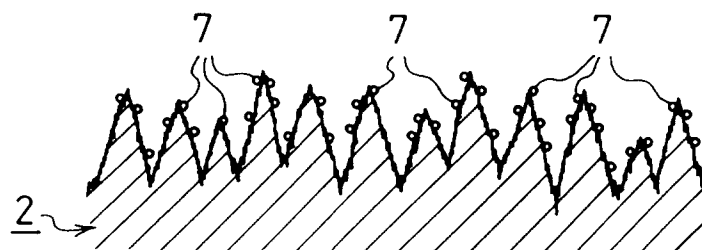


FIG.4





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EUROPEAN SEARCH REPORT

Application Number
EP 95 30 2690

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X	GB-A-1 068 724 (AUTOMOBILES BERLIET) * page 1, line 30 - line 47; claims 1-3 * ---	1-3	C23C8/80 C23C4/18 F01L3/10 C23C10/60
A	PATENT ABSTRACTS OF JAPAN vol. 10 no. 320 (M-530) ,30 October 1986 & JP-A-61 126312 (MITSUBISHI HEAVY IND) 13 June 1986, * abstract * ---	1,2	
A	PATENT ABSTRACTS OF JAPAN vol. 11 no. 200 (C-431) ,27 June 1987 & JP-A-62 020859 (MITSUBISHI HEAVY IND) 29 January 1987, * abstract * ---	1,2	
A	PATENT ABSTRACTS OF JAPAN vol. 17 no. 678 (C-1141) ,13 December 1993 & JP-A-05 222511 (KUBOTA MANABU) 31 August 1993, * abstract * ---	1,3	
A	PATENT ABSTRACTS OF JAPAN vol. 16 no. 413 (C-0980) ,2 September 1992 & JP-A-04 141569 (NKK CORP) 15 May 1992, * abstract * ---	1,3	TECHNICAL FIELDS SEARCHED (Int.Cl.6) C23C F01L
A	US-A-4 569 889 (JOHN S. PRZYBYSZEWSKI) * claims 1-3 * ---	1,3	
A	PATENT ABSTRACTS OF JAPAN vol. 15 no. 38 (C-0800) ,30 January 1991 & JP-A-02 274859 (KAWASAKI STEEL CORP) 9 November 1990, * abstract * -----	1,3	
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 26 September 1995	Examiner Elsen, D
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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