

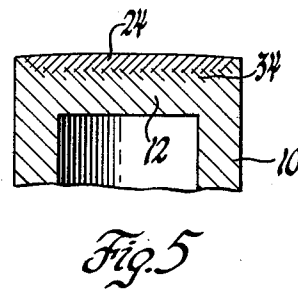
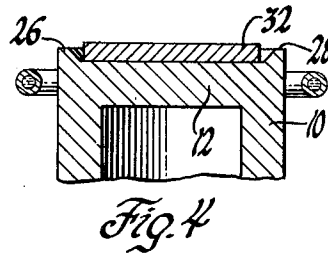
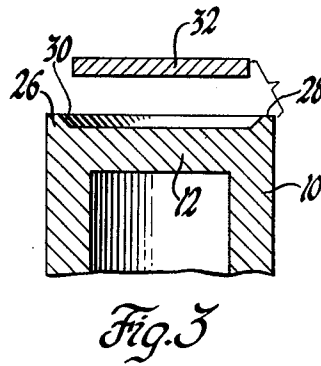
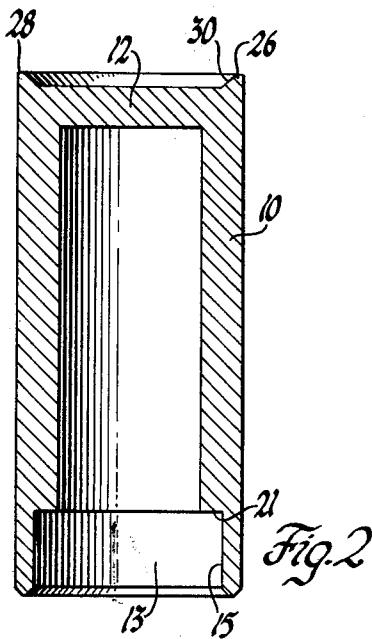
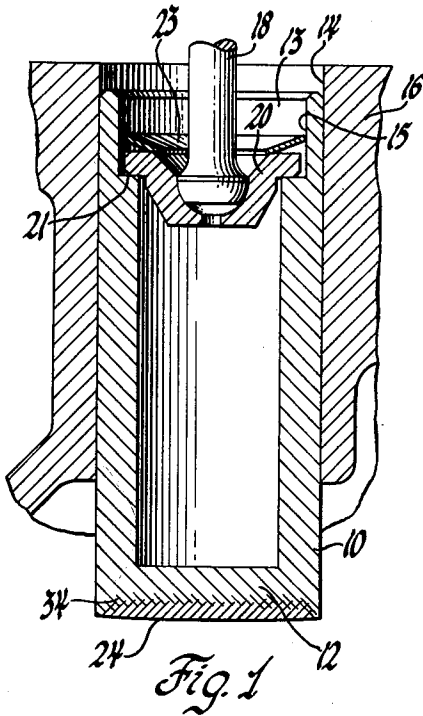
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VALVE LIFTER

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## VALVE LIFTER

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1 Claim. (Cl. 29—156.7)

This invention relates to valve lifters for transmitting movement from a cam or the like to the stem of a poppet valve such as is used in internal combustion engines and more particularly to an improved valve lifter and a method for manufacturing the same.

The design of valve lifters in common present day use comprises a cylindrical main body member closed at one end and open at the other which is slidably reciprocable in a bore provided therefor in the engine crank case to operatively contact the engine driven cam and includes a separately formed member which is thrustably supported within the open end of the cylindrical member and serves to transmit movement from the lifter to the push rod.

It is highly important in valve lifter construction that the valve lifter face or foot as it is frequently called in the art operating against the engine driven cam be formed of a wear-resistant material since these contacting parts are subject to severe wear conditions during engine operation. It is a principal object of this invention to provide an improved valve lifter. A more specific object is to provide an improved method for making a valve lifter having a wear-resistant foot.

These and other objects are accomplished by a process including the steps of providing in powdered form a ferrous base metal which on fusing will form a wear-resistant alloy, compacting the powdered metal to form a briquette or wafer, placing the wafer on the face of the valve lifter and heating the briquette and the adjacent base metal to a temperature and for a time sufficient to cause the metal particles to fuse together and for the constituents of the fused alloy, particularly the carbon, to diffuse into the steel foot to form a strong diffusion bond. To properly locate the briquette on the surface of the steel valve foot face and to control the thickness and character of the alloy coating under production conditions, the valve foot is provided with a peripheral ridge which forms a recess or cavity adapted to receive the powdered metal briquette.

Other objects and advantages of the invention will be apparent from the following detailed description made in conjunction with the accompanying drawing, in which:

FIGURE 1 is a fragmentary view of a valve lifter in its engine environment;

FIGURE 2 is a cross-sectional view of a valve lifter body; and

FIGURES 3, 4 and 5 are fragmentary cross-sectional views illustrating sequential steps in the process of this invention.

As shown in FIGURE 1 of the drawings, a valve lifter consists of a cylindrical-shaped body 10 closed at one end 12 and open at the opposite end 13, which is slidably reciprocable in a bore 14 of an internal combustion engine crank case 16. Within the open end 13 there is received the lower end of a push rod 18 and a push rod seating member 20 positioned on the annular shoulder 21 of the body 10 by which thrust is transmitted between the lifter body 10 and the push rod 18 during engine operation. Overlying the seat member 20 and the shoulder 21 there is provided a thin metal retaining washer 23. This washer is relatively flexible and of somewhat greater diameter than the opening 15 so that on being radially deflected and forced against the opening 15 as shown, it will contract sufficiently to enable it to enter the opening. It may readily be seen that an upward movement

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of the rod 18 causes the washer to lock or wedge and thus to lock the seat 20 within the opening 15.

This invention is concerned with a method of making the lifter body 10 and in particular a method of providing the closed end or foot 12 with a facing 24 of a wear-resistant material. In general the method involves first forming a cup-like member consisting of a cylinder which is closed on one end such as is shown in FIGURE 2 by a simple upsetting or cold extrusion process. Preferably the lifter body is formed of an extrudible low carbon steel such as SAE 1018 steel containing about 0.15% to 0.20% carbon, 0.6% to 0.9% manganese, and a maximum of 0.04% phosphorus and 0.05% sulfur. The dies employed in this operation are also formed to provide the working face of the valve lifter with the peripheral ridge 26 which terminates in a relatively narrow edge 28 and has a side 30 preferably slanting inwardly at an angle of about 45°. As will be hereinafter explained in detail in relation to FIGURES 3, 4 and 5, the process of this invention involves the application of a wear-resistant alloy within the cavity defined by the ridge 26.

After the upsetting operation the recessed surfaces of the lifter within the ridge 26 are preferably grit blasted to clean them. A powdered metal mixture leading to the formation of a wear-resistant alloy is next prepared which may consist of 2.70% carbon, 0.126% manganese, 2.04% silicon, 3.91% chromium and the balance iron. The powdered mixture is preferably made up of materials having a particle size which will substantially pass a 100 mesh screen. The powders are thoroughly mixed and then compressed under a pressure of about 50 tons per square inch into a briquette 32, FIGURE 3, of about 0.2 inch in thickness. Suitable wear-resistant alloys may be formed from powdered metal mixtures in which the carbon is present from 2.50% to 3.50% and the silicon from 1.00% to 3.00%. Chromium, tungsten and molybdenum may be substituted for the iron up to about 20% of each to provide the resulting alloy with a desired wear resistance. Preferably about 1% to 2% of a suitable flux is added to the powdered metal mixture to provide a fluid slag cover for the metal during the subsequent fusing operation. Inorganic minerals such as carbonates, borates, fluorides and oxides of calcium, aluminum and sodium and mixtures of these materials which will form a fluid slag cover may be used. As will be hereinafter described, these powdered materials lead on fusing to the formation of wear-resistant alloy coatings which constitute the wear surface on the foot of the valve lifter. Other ferrous base metals having a relatively high carbon content in the vicinity of 2.5% to 3.5% may be employed.

Preferably the ridge 26 is formed up to about 0.030 inch in height. However, satisfactory coatings may be efficiently applied with the aid of a retaining ridge varying from about 0.01 inch to 0.05 inch in height.

After the briquette has been formed, it is then placed within the confines of the recess created by the retaining lip 26. If desired, the briquette may be formed directly within the recess. The briquette is preferably sufficiently smaller in diameter than the valve lifter body so that it rests flatly on the lifter surface within the ridge 26 as shown in FIGURE 4. The briquette and adjacent valve lifter surface are then heated to a temperature in the vicinity of about 2200° F. to cause a fusion of the metal particles and a diffusion of the alloy, particularly the carbon, into the underlying valve lifter base metal. The heating operation may be accomplished by an acetylene flame torch. Preferably an induction heating coil is employed as shown in FIGURE 4 in a manner such that the heating effect is concentrated at the base metal surface and the innerface of the lifter surface and the briquette. During the heating step heat is transferred from

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the base metal to the briquette and the carbon diffuses into the iron particles of the briquette which in their original form are a relatively pure low carbon composition. The molten alloy flows across the valve lifter surface within the ridge 26 so as to form a relatively smooth alloy coating extending between the extremities of the ridge 26 as shown in FIGURE 5. During the heating step the alloy, especially the carbon thereof, diffuses into the steel body to form a strong uniform diffusion bond.

The method of this invention has a number of important advantages. The use of an iron base high carbon alloy briquette or coating promotes the formation of a strong diffusion bond between the coating and the steel body. In addition the relatively high carbon content of the alloy results in carburization of the underlying steel during the fusion process and thus provides a layer 34 of harder steel for supporting the coating under high contact loads. Typically, the carburized layer is in the order of 0.01 inch to 0.02 inch in thickness.

The presence of the retaining lip 26 is essential in that it serves as a dam while the coating alloy is yet molten and thereby insures that the coating layer will be of a satisfactory thickness which will extend uniformly over the entire area of the valve lifter working surface. The slanted surfaces 30 of the ridge 26 provide the ridge with a relatively heavy base portion which is carburized in the coating process to provide the peripheral edges of the foot coating with a hard support. The method of this invention may be employed to apply wear-resistant coatings of any thickness, but is particularly adapted in the application of relatively thin coatings with negligible waste of the coating materials.

After the fusion cycle the cylindrical sides of the valve lifter as well as the foot are ground to suitable dimensions in the order of 0.01 inch to 0.03 inch and the entire valve lifter is carburized to provide the side walls thereof with a wear-resistant surface.

The term "low carbon steel" as used herein is intended

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to refer to steels such as SAE 1018 steel consisting of 0.15% to 0.20% carbon, 0.60% to 0.90% manganese, a maximum of 0.04% phosphorous and a maximum of 0.05% sulfur, and similar extrusion steels.

Although the embodiment of the present invention as described herein constitutes a preferred form, it is to be understood that other forms may be adopted within the spirit of the invention.

We claim:

A method of making a valve lifter having a wear-resistant foot comprising the steps of extruding a low carbon steel tubular element closed on one end thereof to form a foot and having a peripheral ridge on said foot forming a recess therewithin, applying a powdered metal briquette within said recess, said briquette being formed of a powdered ferrous metal composition leading on fusion to the formation of a wear-resistant alloy and including about 2.5% to 3.5% carbon, heating the briquette at a temperature and for a time sufficient to cause the briquette to fuse and flow across said recess in a uniform layer and to extend only between the extremities of said ridge and for the constituents thereof to diffuse into the low carbon steel body to form a diffusion bond, said diffusion including the carburization of a layer of said foot beneath said coating and co-extensively therewith and including the carburization of a layer of said ridge to provide a hard support for the coating co-extensively therewith.

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