United States Patent

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[33] **Japan**
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[54] **DEVICE FOR DRIVING POPPET VALVES OF AN ENGINE**
2 Claims, 7 Drawing Figs.

[52] **U.S. Cl.** **123/190.19,** 123/90.27
[51] **Int. Cl.** **F24c 3/00**
[50] **Field of Search** ..... 123/90(H), 90(H-1), 90(H-3), 90(H-4)

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ABSTRACT: A low noise device for driving poppet valves of an overhead cam engine. The poppet valves are actuated by rocker arms selectively rotated by cam means. A bias spring is provided for each rocker arm so as to keep the rocker arm always in contact with the cam means, so as to eliminate a noise source due to the collision between the cam means and rocker arms.

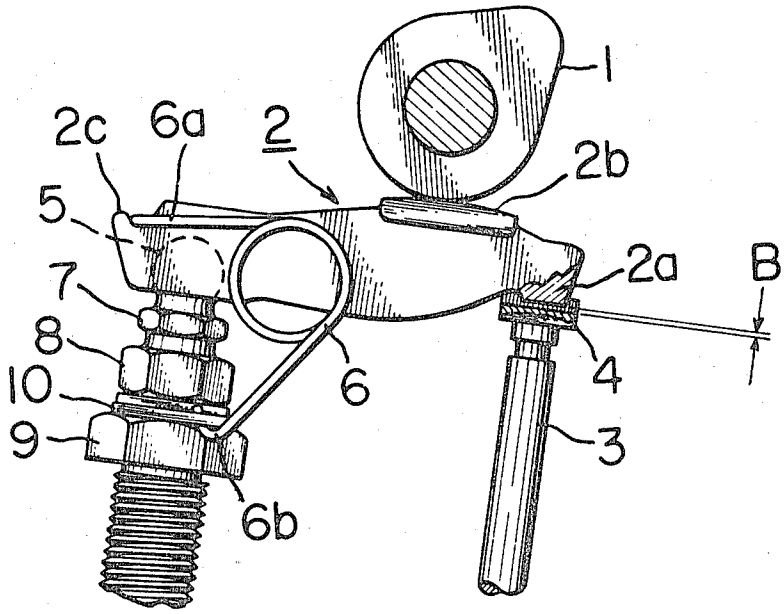


Fig. 1

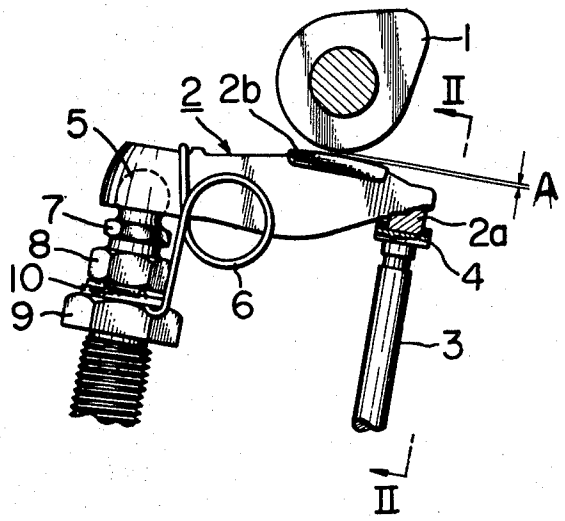


Fig. 2

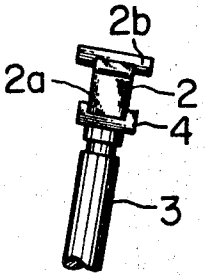


Fig. 3

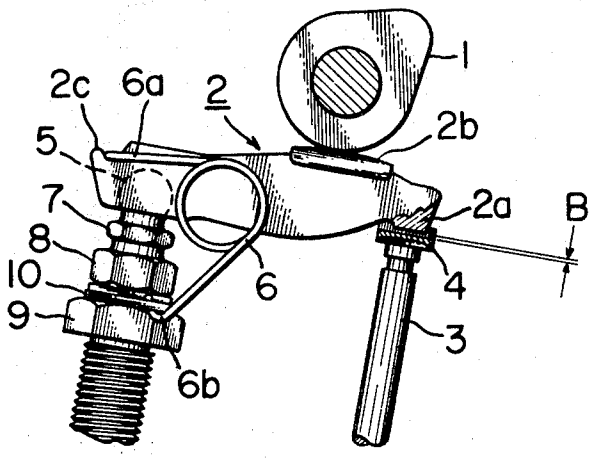


Fig. 4

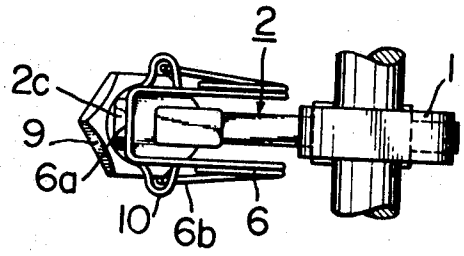


Fig. 5

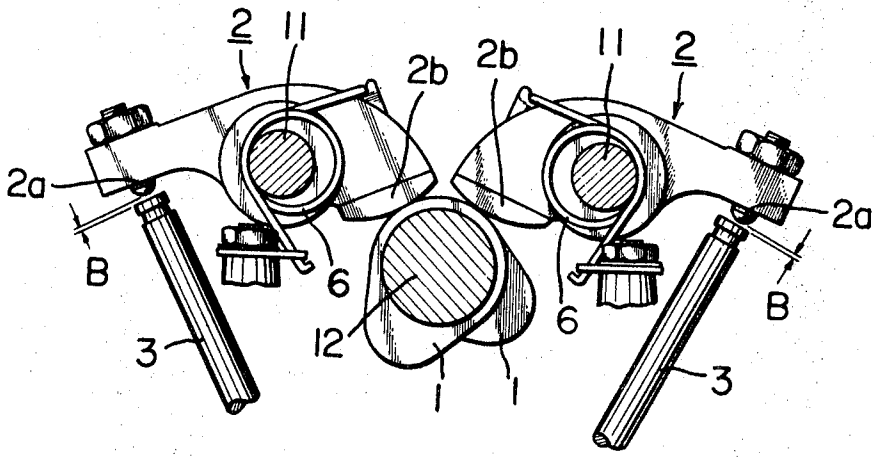


Fig. 6

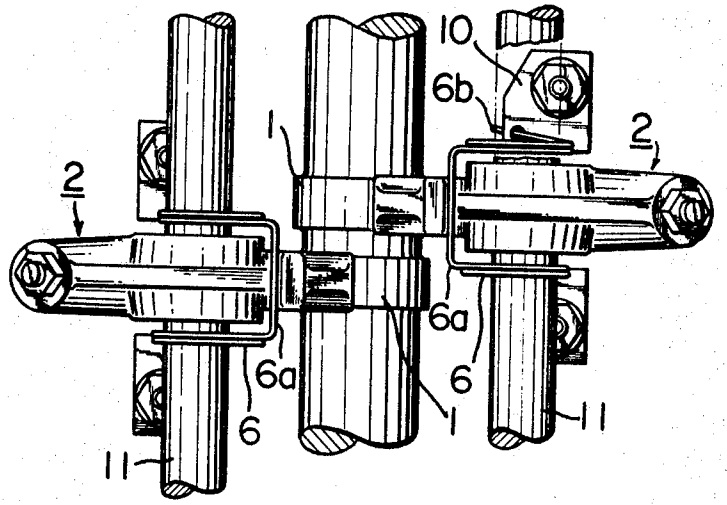
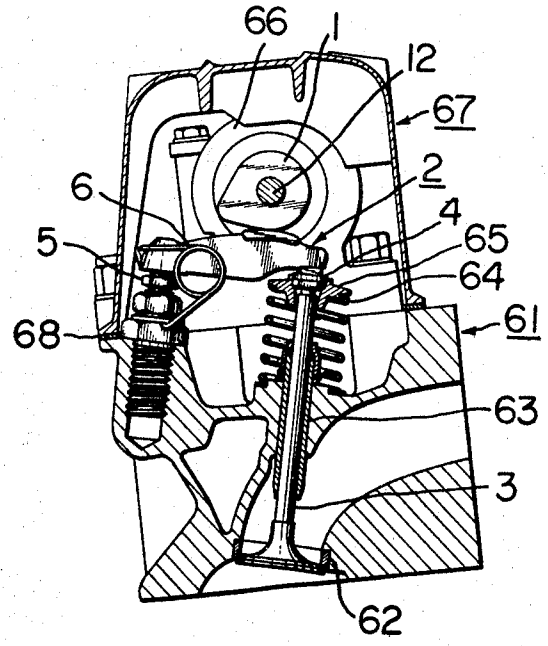


Fig. 7



DEVICE FOR DRIVING POPPET VALVES OF AN ENGINE

This invention relates to a device for driving poppet valves of an engine, more particularly to a device for driving poppet valves of an overhead cam engine which is characterized by having a reduced operative noise.

In an overhead cam engine, poppet valves are driven by rocker arms, which rocker arms are in turn rotated around pivotal supporting means by cams located above a cylinder head. In order to absorb the thermal expansion of the poppet valves due to fuel combustion in the engine cylinder, there are usually provided suitable gaps in the driving mechanism of the poppet valves. Such gaps often cause the so-called tappet noise problem due to the frequent collision between the cams and the rocker arms, or between the rocker arms and the poppet valves.

To eliminate such tappet noise, it has been proposed to use a hydraulic lifter, which is intended to remove all the collision among the cams, rocker arms and the poppet valves. However, such hydraulic lifter requires very special skill to manufacture it, and hence, it has been difficult to use mass-production technique for making the hydraulic lifter at a reasonable low cost.

Therefore, an object of the present invention is to minimize the noise level of the poppet valve driving mechanism due to collisions of various parts thereof, by providing a new poppet valve driving device which is much simpler than the hydraulic lifter, yet capable of materially reducing the noise level.

In a poppet valve driving device, according to the present invention, a bias spring is mounted on each rocker arm, in such manner that each rocker arm is always kept in slidable tight contact with the corresponding cam.

For a better understanding of the invention, reference is made to the accompanying drawings, in which:

FIG. 1 is an elevation, partly in section, of a known poppet valve driving mechanism;

FIG. 2 is a partial side view of the poppet valve driving mechanism, taken from the direction as shown by arrows II–II of FIG. 1;

FIG. 3 is an elevation of a device for driving poppet valves, according to the present invention;

FIG. 4 is a plan view of the device of FIG. 3;

FIG. 5 is an elevation similar to FIG. 3, illustrating another embodiment of the present invention;

FIG. 6 is a plan view of the device of FIG. 5; and

FIG. 7 is a sectional view of the device according to the present invention, shown in the state as mounted on an engine cylinder head.

Like parts are designated by like numerals and symbols throughout the drawings.

Referring to FIG. 1, there are theoretically three different sources of tappet noises; namely, gaps between poppet cams 1 and rocker arms 2, gaps between rocker arms 2 and the poppet valves 3, and gaps at each supported portion of the rocker arm 2. The last mentioned gaps can be comparatively easily eliminated by careful work in finishing both supporting members, such as a pivot head 5, and the supported portion of the rocker arms. Thus, noise due to the gaps at the supported portion of rocker arms can be effectively suppressed for normal operation, except for the case when the rocker arms make abnormal vibration. However, the first two gaps are indispensable for absorbing thermal expansion of the poppet valves, unless the hydraulic lift is adopted. When hydraulic lifter is not used, if gaps are provided neither between the poppet valve and the rocker arms nor between the cams and the rocker arms, then there is a danger of serious troubles due to thermal expansion of the poppet valves 3. Thus, with such indispensable gaps, it is impossible to completely eliminate the collision noise either between the cams and the rocker arms or between the poppet valves and the rocker arms.

In a known poppet valve driving mechanism, as depicted in FIG. 1, a spring 6 is mounted on each rocker arm 2 in such manner that the rocker arm 2 is biased in a clockwise direction around a pivot 5. Accordingly, the poppet valve actuating portion 2*a* of each rocker arm is always kept in tight contact with the upper end of the poppet valve 3. On the other hand, there can be produced a gap A between the cam contact surface 2*b* of the rocker arm 2 and the cam 1 during each operative cycle of the engine. Such gap A is indispensable for absorbing the thermal expansion of the stem of the poppet valve 3, due to the high temperature rise at the engine cylinder by fuel combustion therein. In this case, the tappet noise is generated by the collision between the cam 1 and the rocker arms 2.

As shown in FIG. 2, with such known poppet valve driving mechanism, the actuating portion 2*a* is always kept in contact with a cap 4 secured to the upper end of the poppet valve 3. Accordingly, no noise is produced at this actuating portion of the rocker arm. In the figure, only the stem and the upper end portion of the poppet valves are shown. An adjusting screw 7 is provided to facilitate the adjustment of the gap A by reciprocating itself along a guide cylinder 9, and 8 is a lock nut to prevent loosening of the adjusting screw 7. A clip 10 is associated with each rocker arm 2, to hold end portions of the spring 6.

FIGS. 3 and 4 illustrate a device for driving poppet valves, according to the present invention. The improvement achieved by the present invention is in the particular manner of mounting a spring 6 on a rocker arm 2. More particularly, the spring 6 is used so as to apply a bias force to the rocker arm 2 in a direction to keep the rocker arm 2 always in contact with a driving cam 2, while allowing a gap B between the poppet valve actuating end portion 2*a* of the rocker arm 2 and a cap 4 secured to the upper end of each poppet valve 3. In the particular embodiment, as shown in FIGS. 3 and 4, the rocker arm 2 is biased in a counterclockwise direction around a pivot head 5. The spring has a pair of coiled portions bonded together by an intermediate portion 6*a*. Both end portions 6*b* of the spring 6 are operatively held by a clip means 10 secured to a guide cylinder 9 supporting the pivot head 5. The intermediate portion 6*a* of the spring 6 engages a shoulder 2*c* of the rocker arm 2, which shoulder 2*c* is formed at one end of an elongated portion of the rocker arm 2, which end of the elongated portion is located at a position over the pivot head 5. The position of the shoulder 2*c* is opposite to the poppet valve actuating end portion 2*a*, with respect to the pivot head 5, as actually shown in FIG. 3 and FIG. 4. Due to the counterclockwise bias force of the spring 6, a cam contact surface 2*b* of the rocker arm 2 is always kept in operative contact with the driving cam 1 throughout the entire rotation thereof. Thus, a gap B can be provided between the poppet valve actuating end 2*a* of the arm 2 and the cap 4 secured to the tip of the poppet valve 3, when the actuating portion 2*a* is brought to the proximity of its uppermost operative position thereof. As a result of it, the thermal expansion of the poppet valve 3 can safely be absorbed by such gap B between the actuating end portion 2*a* of the rocker arm 2 and the cap 4 secured to the tip of the poppet valve 3.

With such construction of the poppet valve driving device, according to the present invention, when the poppet valves are operated, the rocker arm 2 is struck only by individual poppet valves 3 at the gap B, while in the case of known poppet valve drive mechanism, the rocker arm 2 is struck at the gap A by the driving cam 1 integral with a journal shaft carrying a number of such cams. Due to the fact that the mass of an individual poppet valve 3 is far smaller than that of the driving cam means inclusive of the journal shaft having all the cams 1 integrally secured thereto, the energy of noise caused by striking of the rocker arms by individual poppet valves in the device of the present invention is greatly reduced, as compared with the corresponding noise energy of known driving mechanism caused by striking of the same rocker arms by much heavier driving cam means. The inventors confirmed such reduction in the noise level by carrying out a number of experiments.

Furthermore, the reduction in the mass of members striking the rocker arms also results in a mitigation of abrasion of those

portions of the rocker arm which are struck repeatedly by the poppet valves during engine operation.

The use of the aforesaid construction of the poppet valve driving device of the invention is not limited to the rocker arms rotatable around pivot heads, as shown in FIGS. 3 and 4, but it can be incorporated in any other type rocker arms.

For instance, FIGS. 5 and 6 show another embodiment of the poppet valve driving device, according to the present invention, including rocker arms rotatably carried by rocker shafts **11**. In this embodiment, rocker arms **2** are rotatably mounted in two rows along a pair of rocker shafts **11**, respectively. A spring **6** is inserted between a stationary portion of the poppet valve driving device and each rocker arm **2**, so as to apply a bias force to the rocker arm **2** in such direction that the cam contact surface **2***b* of each rocker arm **2** is always kept in slidable tight contact with the corresponding cam **1**, respectively. Thus, a gap B can be formed between the poppet valve actuating portion **2***a* of each rocker arm **2** and the upper end of the poppet valve **3**, when the actuating portion **2***a* is brought into the proximity of its uppermost position. Accordingly, the level of the operating noise caused by the collision of the rocker arms **2** with individual poppet valves **3** is kept low.

FIG. **7** shows a typical manner in which a poppet valve driving device, according to the present invention, is mounted on an engine cylinder head. Each poppet valve **3** is slidably fitted in a valve guide **63** mounted on an engine cylinder head **61**, so that the disk-shaped lower end valve portion of the poppet valve **3** can selectively engage the corresponding valve seat **62**, which is integrally formed on the cylinder head **61**. A valve spring retainer **65** is secured to the upper end of each poppet valve **3**, so as to retain a valve spring **64** inserted between the valve spring retainer **65** and a valve spring seat formed on the upper surface of the cylinder head **61**.

A pivot head **5** is secured atop a threaded bolt, which is in turn screwed in a tapped boss formed on the upper surface of the cylinder head **61**, so that each rocker arm **2** can be pivotally supported by the pivot head **5**. A cam shaft **12** to

carry driving cams **1** is supported by a cam bracket **66** secured to the cylinder head **61** by a suitable means, such as bolts. The poppet valve driving device including such rocker arms **2** and cams **1**, as well as other parts associated therewith, are covered by a rocker cover **67**, which is fastened to the cylinder head **61** with a gasket **68** inserted therebetween.

We claim:

1. A device for driving poppet valves of an overhead cam engine comprising, in combination:

a. a poppet valve;

b. a rocker arm having a poppet valve actuating portion at one end of said rocker arm, a middle portion, and an elongated end portion having a pivot head and guide cylinder on one side thereof, said rocker arm rotatably engaging said pivot head inside said elongated portion;

c. a cam contact surface formed on said middle portion of said rocker arm;

d. a shoulder formed on a side of said elongated end portion opposite the side rotatably engaging said pivot head and guide cylinder;

e. a cam means rotatably supported on a cam shaft and engageable with said cam contact surface to move said poppet valve actuating portion into either a valve opening or closing position;

f. a cap secured to the upper end of said poppet valve and spaced from said actuating end portion by a gap;

g. a clip means secured to said guide cylinder; and

h. a spring having the ends thereof operatively held by said clip means and an intermediate portion thereof engageable with said shoulder to bias said rocker arm cam contact surface into constant engagement with said cam means to provide said gap, whereby upon said cam means moving said poppet valve actuating portion into a valve closing position, said poppet valve can expand into said gap upon thermal expansion of said poppet valve.

2. The device as defined in claim 1, wherein said spring has a pair of coiled portions joined at said intermediate portion.