No 8.

"Automotive Valve"

Docket No. 9379

Thomas Townsend Brown

AUTOMOTIVE VALVE

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COMMENTS:

Intake and exhaust valves for internal combustion engines generally are of the disc-closure type, so-called "poppet valves", and consist of a metallic disc having a centrally-located stem which is raised and lowered by a mechanical connection with a rotating cam. The valve disc is designed, usually with a 45° rim, so as to engage a 45° seat in the cylinder head. In simplest terms, the action of the average automotive valve is as follows: A rotating cam, by means of a lifter, push-rod, etc., presses against the valve stem which lifts the disc and opens the valve. When the cam rotates (another half turn) to its low point, the stem is pushed down by a spring and the valve is closed.

For ordinary use at low speed, the operation of the valve is satisfactory. But when the engine is running at higher speed, with the cam rotating very rapidly, the valve lifters tend to lose contact with the cam lobe and the valve closes late, and usually "bangs shut".

During the closing half of the cycle, the motion of the valve results entirely from the force of the spring. It is recognized in the art that even with improvement in spring material and compressive strength, it is impossible to maintain contact with the cam lobe rotating at high speed. Under these conditions, the valve is said to "float".

At high speeds therefore, the valve - in the act of closing - may strike the seat with high impact velocity and, because of the elasticity of the steel, may bounce several times. These impact shocks also affect the valve springs, producing travelling waves in the spring which impair its effectiveness during a critical period when maximum compressive strength is needed. This undesirable effect is called spring "surge".

Shock-induced vibration in automotive valves is a serious problem. There appears to have been no satisfactory solution. It is the purpose of this invention to provide built-in damping so as to reduce valve bounce.

The invention relates to valve dampers for internal compustion engines, steam engines which use poppet valves and high-speed pumps for air or other gases.

The operation of such a vibration damper is similar to that described in applicant's Patent No. 2,417,347 "Vibration Damper", wherein the use of a heavy metallic powder is indicated. In the present invention, an elongated cavity is provided in the valve stem. This cavity is almost completely filled with heavy metallic powder, so that the particles are free to move a short distance and not become solidly compacted. A metal plug is used to seal the cavity, preferably at the (small) end of the stem.

The action of the heavy powder within the cavity, called "Coulomb damping", results from interparticle friction and friction of the particles against the walls of the cavity.

In applications to high-speed steam engines or air-pumps, which operate at lower temperatures than internal combustion engines, additional damping can be provided by using metallic powder of high magnetic permeability or by mixing such a powder with a heavy non-magnetic powder such as tungsten. In certain cases where the temperature is not too high, lead powder may be used instead of tungsten. The use of a magnetic powder, especially if the steel sides of the cavity are magnetized, provides additional damping of electromagnetic nature which results from the rapid reorientation of the magnetic particles. Hence, the total effect combines electromagnetic damping with Coulomb damping.

OBJECTS OF THE INVENTION:

1) To provide a valve which, upon closing, will remain fully closed for its proper period and not reopen in successive bounces.

2) To provide a valve which will tend to reduce spring surge.

3) To provide a valve which will minimize burning and thermal erosion by remaining tightly seated during its proper closure.

SPECIFICATIONS:

Referring to the attached drawings, Fig. 1 illustrates the application of poppet valves in two common types of internal combustion engines.

Fig. 2 illustrates a typical valve without vibration damper, and shows a basic or simplified arrangement of (lifting) cam and (closing) spring.

Figs. 3, 4 and 5 show the progress of the elastic distortion of this valve preceding and following impact with the seat. The distortion is exaggerated for the purpose of illustration.

Fig. 6 is a sectional view of a valve similar to that shown in Fig. 1 but containing a built-in vibration damper consisting of a cavity partially filled with massive and/or magnetic powder.

Fig. 7 illustrates an alternate form of the invention. It sets forth a cavity structure similar to that shown in Fig. 6 but contains a magnetized rod or piston which slides freely, but with friction, within the cavity for a short and allowable distance against an air cushion or small spring (not shown) at each end of the cavity. The magnetic piston has magnetic polarity opposite to that of the stem.

In more detail, Fig. 3 shows the undistorted shape of the valve disc as it approaches first-impact closure. Fig. 4 shows the elastic distortion (exaggerated for illustration) following impact with the valve seat. Fig. 5 shows the momentary reopening of the valve due to "bounce".

Fig. 6 illustrates elongated cavity 1 concentrically-located within valve stem 2. This cavity is of such dimensions as to not seriously reduce the mechanical strength of steel stem 2. It is desirable to make this cavity as large as possible so as to contain the maximum amount of powder. Particles 3 of massive material and/or (optionally) particles 4 of magnetic material (which also may be intermixed) almost completely fill cavity 1. To create a magnetic field thruout cavity 1, in order to provide electromagnetic damping between particles 4 and between said particles and the walls of cavity 1, stem 2 is permanently magnetized. While the use of heavy non-magnetic powder alone produces a certain amount of damping, the addition of magnetic powder notably increases the damping factor.

Fig. 7 illustrates a form of damper which includes a movable rod or piston rather than powder. Nickel-iron (Alnico or equivalent) piston 5 is contained in cavity 1 within stem 2. Piston 5 and stem 2 are permanently magnetized with opposite polarities as shown. Any movement (vibration) of stem 2 with respect to piston 5 is electromagnetically resisted so as to provide damping action. In other words, the magnetic piston 5 within the cavity of the oppositely-polarized stem 2 operates as an electromagnetic vibration damper in much the same way as the magnetic particles 4 within cavity 1 of the previous figure. It is to be understood in Fig. 7 that the damping provided by the piston is largely electromagnetic and that frictional damping is minimal, resulting only from the friction between piston 5 and the walls of cavity 1. This form of damper suffers from the fact that it is highly resonant and tends to be effective largely at certain engine speeds, whereas the form shown in Fig. 6 is non-resonant.

However, where speed of the engine is regulated and fixed, this type of damper may be designed for a certain rpm and in this usage may be highly effective. Both forms are illustrated and claimed so that there may be no unnecessary limitation in the scope of the invention.

While in the foregoing description, valves usually used in internal combustion engines are specifically referred to, this is done for the purpose of imparting a clear understanding of the invention. It is to be understood that valves for other purposes, such as "anti-chattering" air or water valves, are equally useful. Other body shapes or valve designs may be utilized without departing from the scope of the claims as follows:

SUGGESTED CLAIMS:

1. Means for damping vibration, bounce or chatter in valve bodies comprising a cavity loosely filled with heavy powder.

2. Means according to Claim 1 including magnetically susceptible powder and cavity walls which are permanently magnetized.

3. Means for damping vibration in a valve body containing a loosely held piston.

4. Means according to Claim 3 wherein said piston and the walls of said cavity are oppositely magnetized.

5. A valve for internal combustion engines comprising a stem with longitudinal cavity therein, said cavity containing massive powder.

6. A valve according to Claim 5 with cavity containing magnetically-susceptable powder and cavity walls possessing permanent magnetism.

7. A valve according to Claim 5 with cavity containing an intermixture of magnetic and non-magnetic particles.

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October 3, 1968
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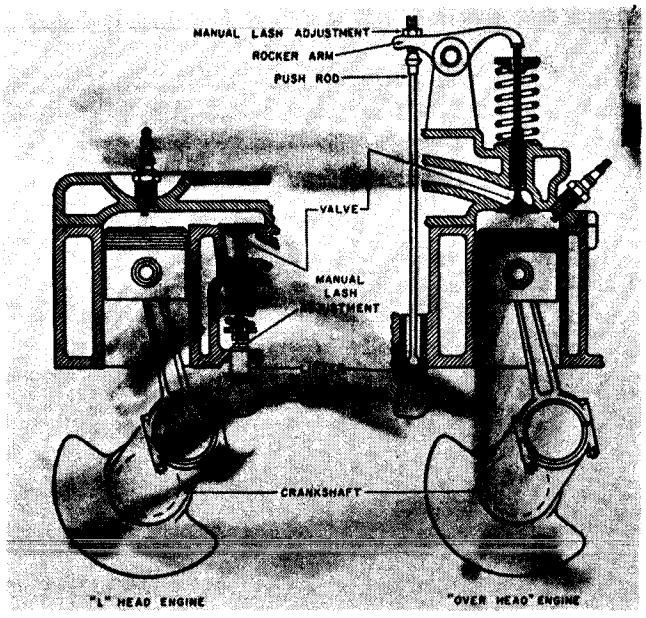

Fig. 1.

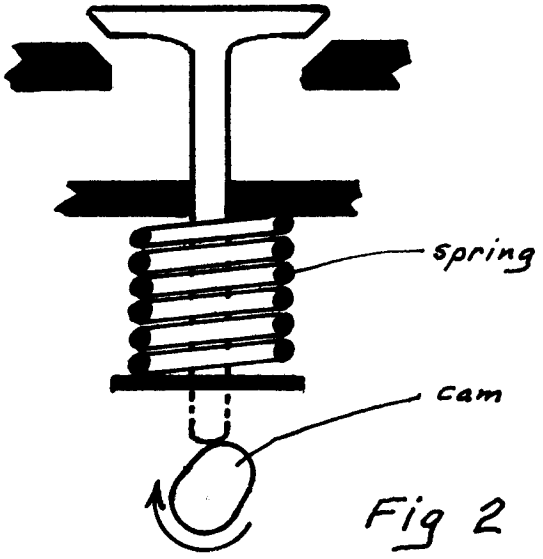

Fig 2

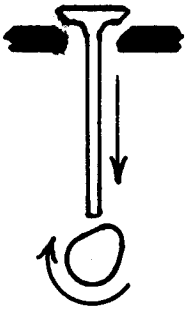

Fig. 3

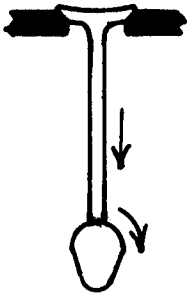

Fig. 4

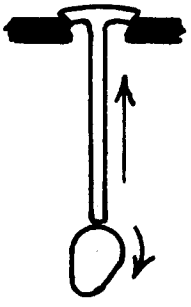

Fig. 5

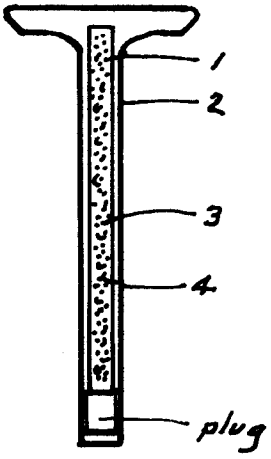

Fig. 6

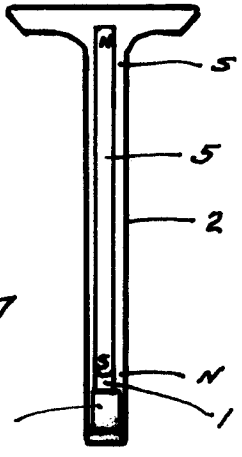

Fig. 7

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