Feb. 7, 1939. E. F. PIERCE 2,146,550

HYDRAULIC VALVE TAPPET

Filed Oct. 16, 1937

Fig. 3.

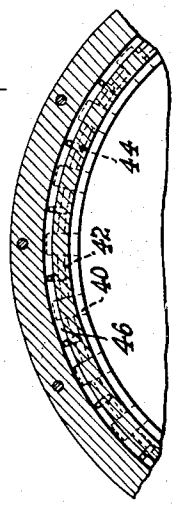


Fig. 2.

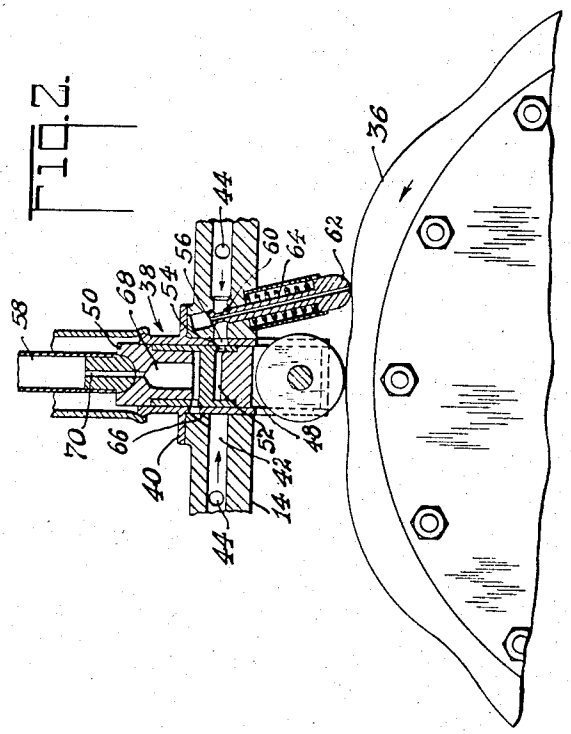
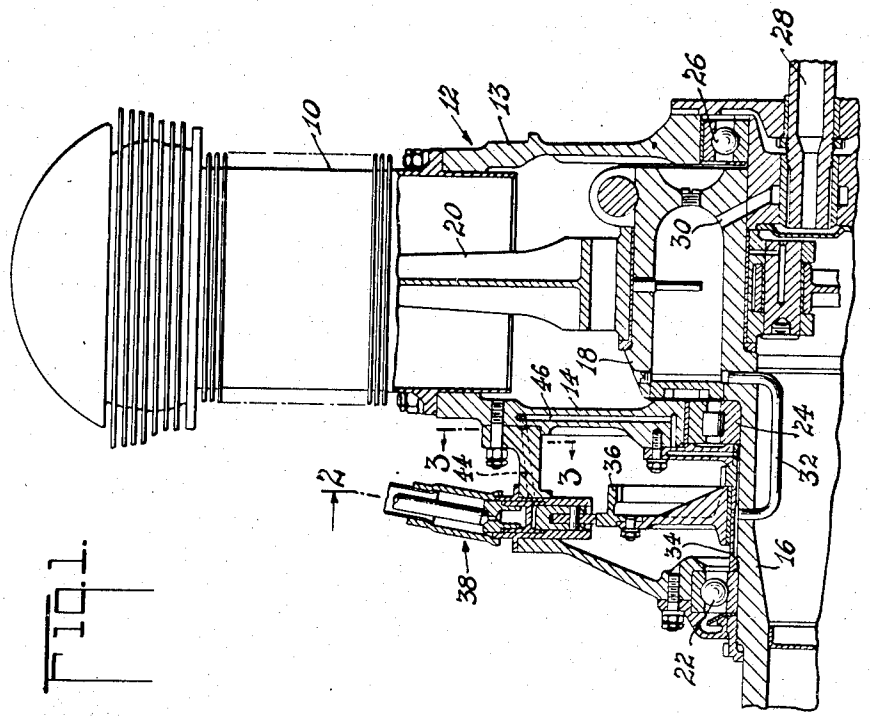


Fig. 1.



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HYDRAULIC VALVE TAPPET

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10 Claims. (Cl. 123—90)

This invention relates to internal combustion engines, and has particular reference to improved means for automatically maintaining zero clearance between the engine valve and the operating cam therefor. In the prior art, it is known that both hydraulic and mechanical systems have been suggested for maintaining zero valve clearance throughout the entire range of engine operating temperatures, and the present invention contemplates the provision of a hydraulic system which is positively operated and is not subject to inertia effects under high speed operating conditions, which effects have been found detrimental in the operation of the hydraulic systems of the prior art.

An object of the invention is to provide a positively operated hydraulic valve clearance adjusting system.

A further object is to provide cam operated valve means for controlling a hydraulic cell between a valve tappet and a cam follower and subsequently, to provide means responsive to cam follower movement for opening the cell to externally imposed hydraulic pressure.

Still another object is to coordinate a hydraulic valve tappet adjusting system with an automatic valve lubricating system, to the end that the number of extraneous parts incident to both systems will be minimized.

Further objects will be apparent from a reading of the subjoined specification and claims, together with an examination of the accompanying drawing, in which similar numbers indicate similar parts, and in which:

Fig. 1 is an axial section through part of a radial cylinder internal combustion engine;

Fig. 2 is an enlarged section on the line 2—2 of Fig. 1; and

Fig. 3 is an enlarged section on the line 3—3 of Fig. 1.

The drawing shows an engine cylinder 10 bolted to a crankcase 12 including a rear half 13 and a front half 14, which crankcase supports a crankshaft 16 having a crankpin 18 upon which is mounted a connecting rod 20, the shaft 16 being supported in bearings 22, 24 and 26. The crankshaft, as shown, is hollow, oil being fed to a rearward portion 28 thereof, which oil passes through a conduit 30 to the crankpin 18, and thence through a conduit 32 to a cam bearing 34 on which is mounted a cam 36 of the concentric multi-lobe type driven from the engine crankshaft by suitable gearing means (not shown). One or more cam follower and tappet assemblies 38 are provided for each cylinder 10, the valve gear of the cylinder, since it is not a specific part of this invention, not being shown. The assembly 38, better shown in Fig. 2, comprises a cam follower guide 40 mounted in a portion of the front crankcase half 14, the latter having a circumferential conduit 42 interrupted by the several guides 40. Between each adjacent pair of guides an axial bore 44 is formed in the crankcase section, all communicating with an oil feed line 46 fed with oil under pressure from the conduit 32. The guide 40 embraces a cam follower 48 and a tappet 50, these two elements being fitted as a plunger-cylinder assembly which defines a cavity 52 therebetween, said cavity being open, through a port 54, to a port 56 in the guide 40 in constant registry with the duct 42. The tappet 50 drives a push-rod 58 which serves to operate the conventional cylinder head rocker arm and valve.

With oil under pressure fed to the duct 42, it will be apparent that when the follower 48 is in its lowermost position, between cam lobes, the cavity or cell 52 will be open to fluid pressure, and this fluid pressure will separate the follower 48 from the tappet 50 to take up any clearance or backlash existing therebetween. As soon as a cam lobe starts to raise the follower 48, the pressure between the follower and the tappet exceeds the normal oil pressure, and the follower 48 would tend to raise a slight amount prior to lifting the tappet 50. Accordingly, I provide a shut-off valve 60 in the bore 42 at a point close to the port 56, this valve having a cam-contacting element 62 rotationally in advance of the cam follower 48, the valve being held in a normally open position by means of a spring 64. Now, as the cam rotates, the valve 60 will be closed before the cam lobe raises the cam follower 48, thus trapping fluid within the cavity 52 so that raising of the cam follower will raise the tappet 50 without loss of oil from the cavity 52. The valve 60 will, of course, open before the cam follower 48 leaves the cam lobe, but the operating pressure of the follower upon the tappet will not result in loss of fluid from the cell 52, since the ports 54 and 56 will not be in registry until the cam follower leaves the cam lobe. When these two parts 54 and 56 come into registry, any slight excess pressure, over the normal oil pressure, will be relieved, but the normal oil pressure will simultaneously be imposed upon the cell to replenish any leakage and to take up the coacting cam follower and tapper elements to provide zero valve clearance.

In certain hydraulic valve tappet arrangements of the prior art, a spring-loaded relief valve was incorporated in the cam follower and tappet system, permitting of the admission of oil under pump pressure to separate the follower and tappet when the follower was not being acted upon by a cam lobe. Then, the check valve would prevent loss of fluid when the follower was raised. Slight leakage between the several elements would compensate for the changes in adjustment necessary between the elements under varying

engine temperature conditions. This type of arrangement is generally satisfactory at low engine operating speeds, but under high speed conditions the check valve would not seat promptly when the cam follower was raised, resulting in a loss of fluid between the cam follower and tappet with consequent maladjustment in valve timing and degree of valve opening. The subject invention overcomes these inertia effects by providing the positively operated shut-off valve **60** whereby no fluid may be lost when the cam follower is raised.

It has been conventional practice for some time to provide for automatic valve gear lubrication through the medium of a hollow tappet and push-rod arrangement. This is included in the present disclosure in coordination with the tappet adjusting mechanism. Oil may flow from the opposite side of the cam follower guide **40**, through a passage **66** to the hollow **68** of the tappet **50**, whence it passes to the hollow push-rod through a drilling **70** in the end thereof. In Fig. 3 it will be seen that there is an axial passage **44** between each cam follower guide **40**, fluid moving through the passage **42** to the right and to the left of the passage **44**, respectively, for valve gear lubrication and valve gear adjustment, all of the several cam follower and tappet assemblies being thus taken care of on a radially arranged engine such as that illustrated.

While I have described my invention in detail in its present preferred embodiment, it will be obvious to those skilled in the art, after understanding my invention, that various changes and modifications may be made therein without departing from the spirit or scope thereof. I aim in the appended claims to cover all such modifications and changes.

I claim as my invention:

1. In a hydraulic valve tappet mechanism, a support having a bore, a cam follower reciprocable therein, a valve tappet reciprocable in said bore due to cam follower operation and forming with said cam follower a cavity, a cam for raising said cam follower, a pressure oil conduit opening to said cavity, and valve means operated by said cam in advance of cam follower raising for cyclically opening and closing said cavity relative to said oil pressure conduit.

2. In a valve operating mechanism, a cam, a cam follower raised by the cam, a tappet having variable clearance relation with said cam follower, a support having a bore within which said cam follower and tappet are jointly and relatively reciprocable, the clearance relationship of said tappet and cam follower providing a cavity, an oil pressure conduit in said support communicating with said cavity, and cam-operated means rotationally in advance of the cam follower for opening and closing said conduit.

3. A valve operating mechanism comprising a cam, a cam follower bearing thereon, a guide for said follower, a valve tappet aligned with said follower, a source of fluid under pressure, said guide having a fluid duct opening between said tappet and follower, and a shut-off valve in said duct having a cam engaging operating element rotationally in advance of said cam follower.

4. In a valve operating mechanism, a cam, a follower therefor, a tappet connected with said follower, a plunger-cylinder mechanism forming the connection between said follower and tappet, a fluid pressure conduit opening to said cylinder, and cam-operated valve means for positively closing said conduit in time relation prior to raising of said follower by said cam.

5. In a valve operating mechanism, a cam, a follower therefor, a tappet connected with said follower, a plunger-cylinder mechanism forming the connection between said follower and tappet, a fluid pressure conduit opening to said cylinder, a valve in said conduit, and a valve operating element independent of the cam follower operated directly by said cam prior to contact of said cam with said cam follower.

6. In a cam-operated cam follower-tappet assembly, a hydraulic cell between the follower and tappet, a conduit for pressure fluid leading to said cell, valve means in said conduit responsive to cam follower raising movement for closing and opening said conduit, and a second valve means independent of the cam follower in said conduit operated by said cam for positively closing said conduit in timed relation prior to raising movement of said cam follower due to said cam.

7. In a cam-operated cam follower-tappet assembly, a hydraulic cell between the follower and tappet, a conduit for pressure fluid leading to said cell, and valve means operated by said cam to close off said cell from said conduit prior to follower raising by said cam and to open said cell to said conduit upon cessation of follower raising by said cam.

8. In a cam-operated cam follower-tappet assembly, a follower-tappet guide having a port, said port registering with the zone of contact of said follower and tappet when at rest, said follower, during follower raising by said cam, closing said port; a pressure fluid conduit communicating with said port, and a valve for closing said conduit including an operating element contacting said cam rotationally in advance of said cam follower.

9. In a valve operating mechanism for an engine, a housing having a fluid passage, a cam, a cam follower slidable in the housing, a hollow valve tappet slidable in the housing, concentric with and axially spaced from the follower and movable with and with respect thereto, a hollow pushrod bearing on and operated by the tappet, the hollows of the pushrod and tappet being in communication with one another, and connections from said fluid passage respectively to the hollow of said tappet and to the space between the cam follower and tappet.

10. In a valve operating mechanism for an engine, a housing having a fluid passage, a cam, a cam follower slidable in the housing, a hollow valve tappet slidable in the housing, concentric with and axially spaced from the follower and movable with and with respect thereto, a hollow pushrod bearing on and operated by the tappet, the hollows of the pushrod and tappet being in communication with one another, connections from said fluid passage respectively to the hollow of said tappet and to the space between the cam follower and tappet, a valve in the connection from said passage to said space, and means to move the valve to a connection closing position comprising a cam-engaging element rotationally in advance of said cam follower.

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