Aug. 18, 1936. C. VOORHIES 2,051,232

VALVE TAPPET

Filed April 25, 1930

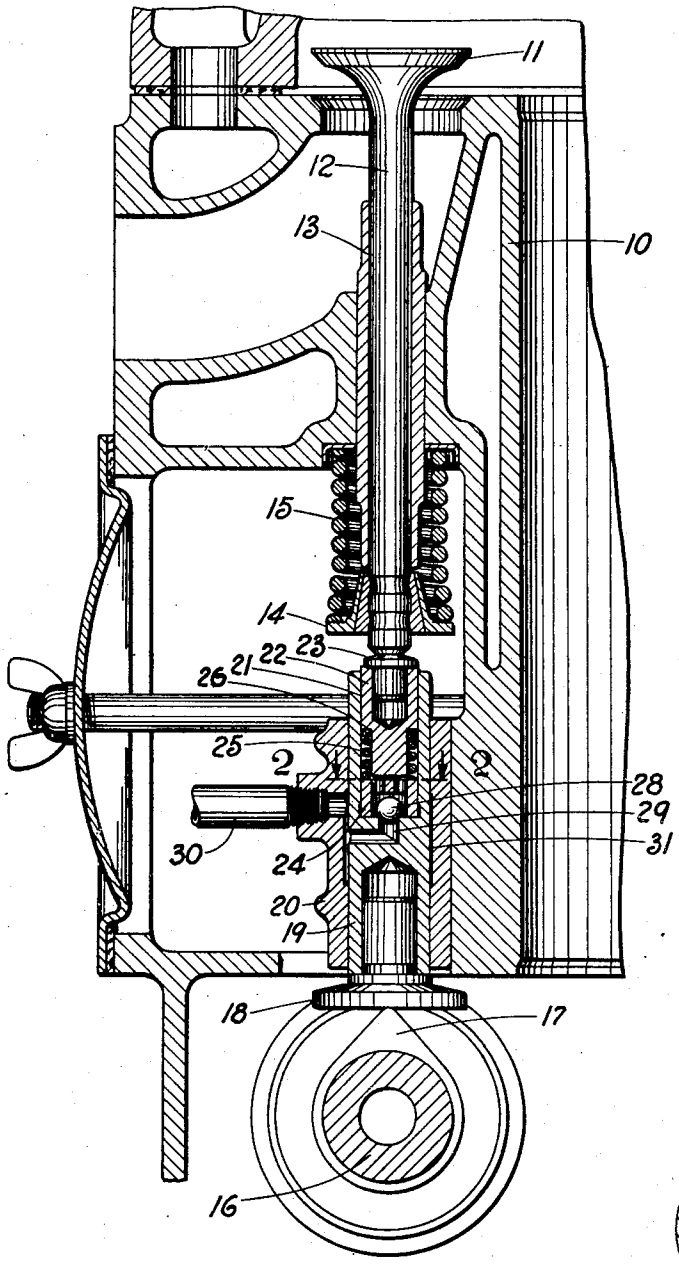

Fig. 1

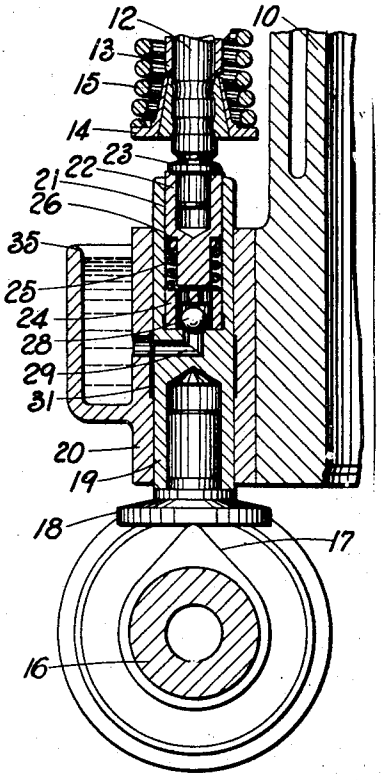

Fig. 3

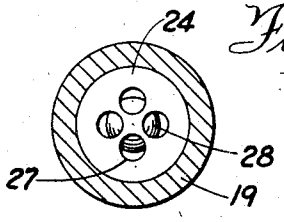

Fig. 2

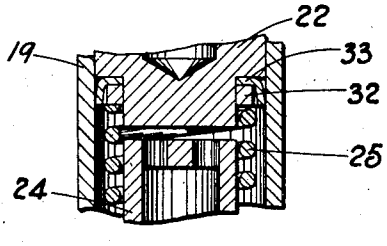

Fig. 4

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VALVE TAPPET

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8 Claims. (Cl. 123—90)

This invention relates to internal combustion engines and particularly to the poppet valves which are operated by valve tappets riding on cams on a cam shaft.

Heretofore it has been customary to provide a poppet valve which is separated from the end of the valve stem by a clearance to permit an expansion of the valve stem due to the heat from the engine, the clearance being adjusted to provide for the conditions under which the engine operates. When the engine is cold, this clearance is greatest with a corresponding increase in the noise of operation, and when the clearance is too close there is a loss of efficiency due to a reduced valve opening period and a variation in the timing of the valve opening period. If the adjustment is too close, the valve will be prevented from seating, especially when the valve stem has become expanded due to the heat from the engine and oftentimes the valves are burned out due to the close adjustment.

Therefore my present invention has for its object to provide a valve operating mechanism which will eliminate the clearance in question and with it any noise produced by the valve tappet striking the valve.

A further object is to provide a column of liquid under pressure between the valve tappet and a plunger slidably supported therein to always maintain the latter in contact with the valve stem, with the result that the noises are eliminated and the quietness of the engine is improved.

The above being among the objects of the present invention, the same consists of certain features of construction and combination of parts to be hereinafter described with reference to the accompanying drawing, and then claimed, having the above and other objects in view.

In the accompanying drawing which illustrates a suitable embodiment of the present invention,

Figure 1 is a fragmentary sectional view of an internal combustion engine, showing the valve in raised position and my invention associated therewith.

Figure 2 is a transverse sectional view taken on the line 2—2 of Figure 1.

Figure 3 is a view similar to Figure 1, showing a modified form of invention.

Figure 4 is an enlarged detail view showing the oil seal between the valve tappet and plunger supported therein.

In the drawing in which like numerals refer to like parts throughout the several views, 10 indicates the engine casing provided with the usual poppet valve 11 having a stem 12 extending downwardly therefrom passing through the valve stem guide 13. The valve stem 12 has the usual spring support 14 thereon adjacent to its lower end supporting the customary valve spring 15 positioned between the support 14 and a portion of the engine 10 to urge the valve 11 toward its seated position. The cam shaft 16 has a cam 17 thereon engaging with a push rod base 18 secured in the push rod 19 slidable in the guide 20 secured in the usual manner in the engine 10. The push rod 19 is bored out at 21 to receive the plunger 22 having a hardened head 23 mounted therein adapted to always engage with the end of the valve stem 12. A bushing 24 is seated in the bottom of the bore 21 on which is positioned a spring 25 seating against a shoulder 26 on the plunger 22 to constantly urge the hardened head 23 in the plunger 22 against the end of the valve stem 12. The bushing 24 is preferably cup-shaped, the end wall thereof being provided with openings 27 therein to provide a cage for the check valve 28 normally seating on the push rod 19 to close the port 29 therein for a purpose to be hereinafter described. The inner surface of the end wall of bushing 24 serves to limit movement of the check valve 28 away from its valve seat to a slight distance. The lower end of the plunger 22 is spaced from the bushing 24 to provide clearance therebetween and is maintained in that position by liquid, which is preferably oil, forced into the chamber through the pipe 30 from the engine oil pump, not shown. However, in the event that the liquid fails to sustain the plunger in such spaced relation, due to such causes as failure of the liquid supply or leakage of liquid by the check valve 28, the outer surface of the end wall of bushing 24 serves as a stop for limiting inward movement of the plunger 22 into the bore 21 of push rod 19, the bushing 24 also serving at all times to prevent both the plunger 22 and check valve 28 from interfering with the action of each other. The guide 20 for the push rod 19 is preferably bored out to provide a chamber 31 extending around a portion of the push rod 19 as is clearly shown in Figure 1, the chamber 31 communicating with the pipe 30 and the passageway 29 to permit oil to be pumped from the pipe 30 to the chamber within the push rod 19.

During the operation of the engine, the cam 17 on the cam shaft 16 will raise the push rod base 18 as is shown in Figure 1, thus moving the push rod 19 upwardly and forcing the valve 11 to open position against the compression of the spring 15. As the cam 17 rotates, the valve 11

will move toward its seated position due to the expansion of the spring 15 and the valve stem 12 will follow downwardly in contact with the head 23 in the plunger 22. The oil pressure in the chamber in the push rod 19 will always force the plunger 22 into contact with the valve stem 12 and oil pressure will be maintained in the chamber by the check valve 28.

I preferably position the pipe 30 above the check valve 28 so that any leakage of oil out of the chamber in the push rod 19 will flow into the chamber 31 and be trapped therein and will not flow back into the pump through the pipe 30. This construction has an advantage because of the fact that when the engine has been at rest for sometime, there is a tendency for the oil to leak out of the chamber in the push rod 19 so that upon the starting of the engine there normally would be some noise due to a clearance that might develop between the plunger 22 and the valve stem 12 until such time as the pump would build up the oil pressure. By this device the pressure in the chamber is not materially reduced and the plunger 22 is properly maintained in contact with the valve stem 12.

As oil is likely to leak out between the plunger 22 and the push rod 19, I preferably provide a ring 32 around the lower portion of the plunger 22 against which is seated a metal cup-shaped washer 33 to form an oil seal, these members being held in operative position by means of the spring 25.

In Figure 3 I have shown the construction heretofore described to which the same numerals have been applied, excepting that the guide 20 for the push rod 19 is provided with an oil receptacle 35 whereby the oil is permitted to flow by gravity into the chamber in the push rod 19 to maintain the pressure therein in the same manner as previously described.

It is necessary to prevent to the greatest possible degree air or gases from entering the hydraulic compression chamber 21 in the tappet body for the reason that the inclusion of air therein renders the hydraulic medium compressible in this chamber, thereby making it impossible to control, as precisely as necessary, the amount the poppet valve 11 is raised from its seat. So long as the hydraulic medium admitted to or contained in the compression chamber 21 is incompressible, the timing and degree of opening the valves can be closely controlled. This is essential to efficient operation. The construction and placement of the oil reservoir 31 and the relative position of the valve control passage 29 leading from the compression chamber in the tappet to the oil reservoir 31 and the position of the oil inlet 30 are therefore very important factors in the control of air and gases included in the oil delivered through the oil line 30 and the prevention of the entry of such air or gases into the compression chamber 21 in the tappet body. The oil reservoir 31 comprises an annular recess formed in the tappet guide 20 which is stationary. The peripheral surface of the tappet body 19 is smooth and unrelieved and slides past this oil reservoir 31 without disturbing or churning the oil contained in the reservoir, thereby permitting air or gases carried in through the oil line 30 to collect at the top of the annular recess 31 and remain there until they are worked out upwardly between the exterior surface of the tappet body and the guide. The passage 29 in the tappet body leading from the oil reservoir 31 in the tappet guide to the compression chamber 21 in the tappet body is so positioned and placed that during the entire reciprocation of the tappet it remains substantially below the upper limits of the annular recess or oil reservoir 31 in the tappet guide, and therefore never comes into communication with the air or gases collected in the upper portion of the oil reservoir 31, consequently preventing the induction of such air or gases into the compression chamber in the tappet body. The compression chamber 21 in the tappet body is sealed by the washer 33 at the upper end and the only communication it may have with the outside of the tappet is through the valve control passage 29 which is maintained out of the region of the collected air and gases in the upper part of the oil reservoir 31 during the entire reciprocation of the tappet.

The use of tappets constructed in accordance with the present invention serves to eliminate the valve noises and the loss of efficiency caused by wear and excessive lost motion and still the tappet contains its compensating mechanism within itself to operate in an effective manner.

While I have described certain embodiments of my invention in detail it is to be understood that formal changes and changes relating to details of construction and manufacture may be resorted to without departing from the spirit and substance of my invention, the scope of which is commensurate with the appended claims.

What I claim is:

1. A hydraulic tappet organization comprising a tappet body having an unrelieved peripheral surface and having a hydraulic chamber in the upper end thereof, a spring mounted plunger and sealing means therefor in said chamber, a single valve controlled passage leading from said chamber to the outside of said tappet body, a cylindrical guide for said tappet having an annular recess therein forming a stationary oil reservoir, and an oil passage leading outwardly from the upper portion of said recess, said tappet body and valve controlled passage leading into the hydraulic chamber therein being so arranged with reference to said annular oil reservoir as to maintain said valve controlled passage out of communication with the upper portion of said oil reservoir during the entire reciprocatory movement of said tappet body whereby the upper portion of said oil reservoir remains as an air trap at all times out of line of communication with said tappet hydraulic chamber.

2. In a hydraulic tappet organization, the combination of a stationary oil reservoir in the tappet guide comprising an elongated annular recess in the inner surface thereof, an unrelieved tappet body reciprocable in said guide without churning the oil in said reservoir, a sealed compression chamber in said tappet body and a valve controlled passage in said tappet body communicating said compression chamber only with the lower portion of said oil reservoir, whereby the oil in said reservoir is relatively undisturbed during reciprocation of said tappet body and free from included air in the region of communication with said compression chamber passage, and the upper portion of said reservoir is maintained as an air trap at all times out of communication with said tappet chamber.

3. In a hydraulic tappet organization, the combination of a tappet guide, a tappet body reciprocable in said guide, an oil settling and gas separation chamber arranged exteriorly of said tappet body, a compression chamber in said tappet body, a valve controlled passage leading from

said compression chamber to the outside of said tappet body and communicating with said gas separation chamber at points below the upper end of the latter during the entire reciprocatory movement of said tappet body, whereby the upper portion of said gas separation chamber serves as a gas trap at all times out of communication with said valve controlled passage, and means for venting gas from the upper end of said gas separation chamber.

4. In a hydraulic tappet organization, the combination of a tappet guide, a tappet body reciprocable in said guide, an oil settling and gas separation chamber arranged exteriorly of said tappet body, a compression chamber in said tappet body, a spring mounted plunger in said compression chamber for drawing oil into the latter, a valve controlled passage leading from said compression chamber to the outside of said tappet body and communicating during reciprocation of said tappet body with the lower portion of said gas separation chamber but out of communication at all times with the upper portion of the gas separation chamber, whereby the upper portion of said gas separation chamber serves as a gas trap at all times out of line communication with said valve controlled passage, the upper end of said gas separation chamber being vented to atmosphere through the clearance between said tappet body and said tappet guide.

5. In a reciprocating self-adjusting hydraulic valve operating device of the class described, the combination of a valve seat, a free non-return valve for opening and closing said seat under the action of gravity and its own inertia, a plunger reciprocable in said device, and means for limiting the travel of said free valve away from its seat and for limiting inward movement of said plunger into said device.

6. In a reciprocating hydraulic tappet of the class described, a hollow cylinder, a non-return valve controlled fluid port in the bottom of said cylinder, a ball valve for said port and free to open and close the latter under the action of gravity and its own inertia, and an apertured cage member for limiting the movement of said non-return valve relative to said port and for guarding the non-return valve against interference with said plunger.

7. In a reciprocating hydraulic tappet of the class described, the construction comprising the combination of a cylinder having a fluid port at one end thereof, a plunger reciprocable in said cylinder, a valve in the bottom of said cylinder free to open and close said port under the action of gravity and its own inertia, a valve seat for said valve, and an apertured cage member secured in said cylinder for limiting movement of said valve away from its seat and for guarding said valve from interference with said plunger.

8. In a reciprocating hydraulic tappet of the class described, the construction comprising the combination of a cylinder having a fluid port at one end thereof, a plunger reciprocable in said cylinder, a ball valve in the bottom of said cylinder free to open and close said port under the action of gravity and its own inertia, a valve seat for said ball valve, and an inverted cup-shaped and apertured cage member secured in said cylinder for limiting movement of said ball valve away from its seat and for guarding said ball valve from interference with said plunger.

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