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COMPENSATING VALVE OPERATING DEVICE

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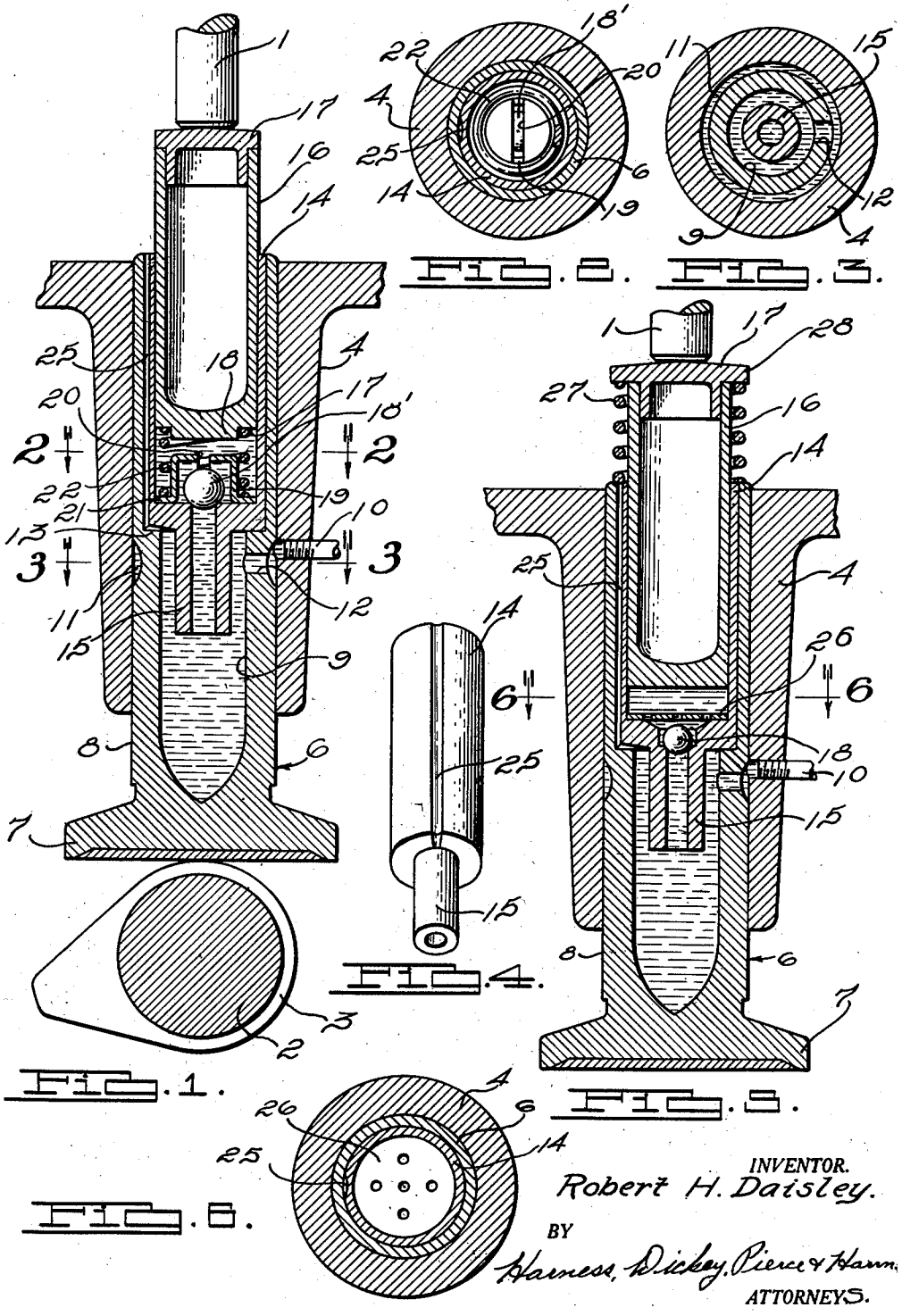

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COMPENSATING VALVE OPERATING DEVICE

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10 Claims. (Cl. 123—90)

My invention relates to automatic compensating tappets for operating valves of internal combustion engines, and particularly to improvements in the construction of hydraulic tappets of such character.

One object of my invention is to provide an improved and simplified construction for such tappets and specifically to provide a separate cylinder member therefor for receiving a reciprocable plunger, which may be manufactured separately and applied as a unit to the tappet body.

The type of tappet to which my invention relates comprises usually a mushroom-shaped device, having an enlarged head which contacts the cam, and a tubular body which extends therefrom to contact with the valve stem. It is usual to provide such a tappet with a bore which forms a reservoir or well to contain oil or other hydraulic medium, and to fit a reciprocable plunger in the upper end of the bore, to provide a spring or other resilient means to urge the plunger outwardly of the bore and against the valve stem, and to provide a valve controlled trap into which the oil or other hydraulic medium is inducted upon the outward movement of the plunger to provide a hydraulic column against which the end of the plunger will bear when it is forced downwardly into the tappet body.

Various problems have been encountered in attempts to manufacture this type of device, one of which is the problem of accurately boring the tappet body to provide a suitable cylinder for the plunger. The tappets are generally made of cast iron or steel and considerable difficulty has been experienced in providing a sufficiently accurate bore to provide the desirable close fit for the reciprocable plunger. Another has been to provide adequate means for relieving or bleeding air or compressible gas from the hydraulic medium carried in the reservoir of the tappet, in order that the trapped hydraulic column upon which the plunger rests will be as nearly as possible incompressible when the plunger is forced against the valve stem.

I have solved this problem by providing a separate and unit cylinder member which may be manufactured separately from the tappet and then inserted as a unit therein, thus relieving the necessity of accurately boring the tappet body to provide a close fitting cylinder for the plunger. I have also provided for a novel and efficient means for bleeding or venting air from the oil reservoir in the tappet body which will prevent any substantial or material amount of air or gas from entering the trapped hydraulic column which is relied upon to support the plunger.

With the above and other objects in view, my invention consists of the construction and arrangement of the parts hereinafter described and claimed.

In the drawing,

Fig. 1 is a longitudinal cross-sectional view of the tappet embodying my invention, shown positioned between a valve stem and cam.

Fig. 2 is a cross-sectional view taken on line 2—2 of Fig. 1.

Fig. 3 is a cross-sectional view taken on line 3—3 of Fig. 1.

Fig. 4 is a perspective view of the separate and insertable cylinder unit embodied in my invention.

Fig. 5 is a longitudinal cross-sectional view of a modified form of tappet embodying my invention.

Fig. 6 is a cross-sectional view taken on line 6—6 of Fig. 5.

The numeral 1 represents the end of the stem of the conventional poppet valve which is spring urged downwardly to its seat in the well known conventional manner (not shown). The numeral 2 indicates a conventional camshaft with the cam 3 mounted thereon. The numeral 4 represents the usual conventional tappet guide sleeve provided in the cylinder block of the engine. The numeral 6 represents a mushroom-type tappet of the conventional shape provided with an enlarged cam contacting head 7 and an elongated tubular body 8. The body 8 shown is provided with a hollow bore 9 closed at the lower end and which provides a reservoir for oil, which is supplied through the side of the guide 4 by the pipe 10 connected with the usual lubricating system. The body of the tappet 8 is also provided with a circumferential groove 11 into which the oil supplied by the pipe 10 flows. An oil inlet aperture 12 is provided in the tappet body 8 leading from the groove to the interior of the tappet body through which the oil flows into the reservoir 9. The bore in the upper part of the tappet body 8 is enlarged as shown and an abutment shoulder 13 is provided at the lower end of the enlarged portion of the bore. Inserted in the enlarged portion of the bore is a cylinder sleeve member 14 shown in perspective in Fig. 4, which comprises a cylindrical member having an enlarged bore in its upper portion and a reduced tubular extension 15 at its lower end, which, when the member 14 is inserted in the enlarged bore of the tappet body 8, extends below the oil

inlet aperture 12 and well down into the oil reservoir 9 in the lower part of the tappet body.

Positioned in the cylinder sleeve 14 is a plunger 16 having a hardened plug 17 in its upper end which contacts the end of the valve stem 1. The lower end of the plunger 16 is closed and provided with a reduced projection 18 and a shoulder 17 which provides a spring seat. Positioned in the lower end of the cylinder 14 is a ball 18' seating against and covering the upper end of the opening through the tubular projection 15. Surrounding the ball is a retaining cage member 19 having an aperture 20 in its upper end, and having a lateral outwardly extending flange 21 around its lower end. Positioned around the cage member 19 and resting upon the flange 21 is a coil spring 22 having its lower end bearing against the lateral flange 21 on the cage 19 and its upper end encircling the projection 18 on the plunger and bearing against the shoulder 17 thereon.

The operation of the device is as follows:

As the cam rotates and the tappet head rides upon the dwell portion of the cam, the tappet body moves downwardly in its guide under the influence of the spring pressed valve stem 1. Normally and in a rigid and non-extensible type of tappet, the pressure of the valve stem against the end of the tappet would cease shortly before the tappet reached the dwell portion of the cam, thus relieving substantially all the pressure of the valve upon the tappet. In the device disclosed, however, when the pressure of the valve stem ceases, the coil spring 22 will urge the plunger 16 outwardly and maintain its contact with the valve stem. This outward movement of the plunger 16 will reduce the pressure in the space between the end of the plunger 16 and the bottom of the cylinder 14 and permit the ball 18' to raise from its seat, under the relatively greater pressure in the oil reservoir 9, and permit oil in the reservoir 9 in the lower part of the tappet to flow past the ball and fill the space between the end of the plunger 16 and the bottom of the cylinder 14. Then as the tappet moves upwardly through rotation of the cam and with the ball in closed position the oil in the chamber in the bottom of the cylinder 14 will be trapped, thus providing an incompressible hydraulic column which will maintain the plunger 16 in firm contact with the valve stem 1 during the entire stroke of the tappet. The pressure of the plunger 16 against the trapped oil in the bottom of the cylinder 14 normally may cause a slight leakage of the oil outward around the sides of the plunger and the oil so eliminated will be replaced as the cycle of operation repeats and the pressure of the valve stem upon the plunger is relieved when the tappet rides upon the dwell portion of the cam and permits the spring 22 to force the plunger outwardly, thus permitting the ball to rise from its seat and admit more oil into the space between the end of the plunger 16 and the bottom of the cylinder 14, as previously described.

Difficulty has been experienced in attempting to bore the tappet body 8 with sufficient accuracy to obtain the desired fit for the plunger 16. As previously stated, the tappet body is usually made out of cast iron or steel and the fit of the plunger 16 should be close and accurate to prevent the escape of sufficient oil around the plunger to permit any reduction of the hydraulic column during the pressure interval between the valve stem and the tappet.

I have solved this difficulty by providing the separate cylinder member 14 which may be made from brass or bronze or other suitable material more easily and accurately machinable than the material of the tappet body. This cylinder member 14 may be made and machined separately and then inserted as a unit into the tappet body. It is not necessary that the bore in the tappet body which receives the cylinder 14 be as accurate as would be necessary to receive the reciprocating plunger, and it is only necessary that the cylinder 14 be press fitted therein so that it will not fall out or work loose.

Difficulty has also been experienced in preventing air or compressible gas from working into the hydraulic column under the plunger 16 which will compress when the pressure is exerted upon the plunger 16 and thereby introduce lost motion. It is essential that the hydraulic column beneath the plunger 16, be as incompressible and as rigid as possible in order to permit accurate and dependable adjustment and timing of the valve operation. There is inevitably some air and gas contained in the oil which is pumped into the reservoir 9 in the tappet and this will rise to the top of the reservoir, and it is necessary that some means be provided for permitting it to escape at a point where it will not enter the chamber beneath the plunger 16. I have accomplished this by providing a groove 25 in the side of the cylinder 14. This groove 25 runs longitudinally in the cylinder as shown in Figs. 1 and 4 and continues at an angle to the horizontal beneath the end thereof to the reduced tubular portion 15, thus providing an escape vent or aperture in the very top of the reservoir 9 of the tappet when the cylinder 14 is positioned therein, thus air and gases contained in the oil which will separate therefrom and rise to the top of the oil body in the tappet reservoir 9 will promptly escape outwardly through the groove 25.

In Fig. 5 I have shown modified construction in which the upper end of the tubular projection 15 of the cylinder 14 is countersunk to provide a cage for the ball 18'. This brings the top of the ball below the surface of the bottom of the cylinder 14, and an apertured plate 26 is press fitted against the bottom of the cylinder 14 and retains the ball in its countersunk cage.

The apertures in the plate 26 permit the oil escaping upwardly past the ball to flow into the chamber in the bottom of the cylinder 14. This construction eliminates the necessity for the raised ball cage 19 shown in Fig. 1 and clears the space in the bottom of the cylinder 14 so that it may be more completely filled with oil than with the construction shown in Fig. 1. It also eliminates to the greatest possible degree the members in the compression chamber beneath the plunger which are liable to break and interfere with operation of the plunger. In this form the spring for urging the plunger upwardly consists of a coil spring 27 encircling the outer end of the plunger, bearing at one end against the end of the tappet body and at the other end against the underside of a lateral flange 28 formed on the hardened plug 17 fitted in the end of the plunger. A construction similar in certain respects is disclosed and claimed in a pending application of Robert C. Russell, Serial No. 629,474.

Formal changes may be made in the specific embodiment of the invention described without departing from the spirit or substance of the broad invention, the scope of which is commensurate with the appended claims.

I claim:

1. A hydraulic valve tappet comprising a cast metal tappet body having a longitudinal bore closed at its lower end and adapted to receive a liquid, a separate cylinder composed of a more easily machinable metal and disposed in said bore, a valve in the lower portion of the cylinder and adapted to allow liquid to flow upwardly from the lower part of the bore into the cylinder, but to prevent the liquid from flowing in the opposite direction, a plunger slidably mounted in the cylinder, and means for maintaining liquid in the bore.

2. A hydraulic valve tappet comprising a cast metal tappet body having a longitudinal bore closed at its lower end and adapted to receive a liquid, a separate cylinder composed of a more easily machinable metal and disposed in said bore, a valve in the lower portion of the cylinder and adapted to allow liquid to flow upwardly from the lower part of the bore into the cylinder, but to prevent the liquid from flowing in the opposite direction, a plunger slidably mounted in the cylinder, means normally urging the plunger upwardly, and means for maintaining liquid in the bore.

3. A hydraulic valve tappet comprising a tappet body having a longitudinal bore closed at its lower end to receive liquid, a separate cylinder disposed in the upper part of the bore, a tubular projection on the lower part of the cylinder and extending into the bore, valve means controlling the passage through said projection so as to allow liquid to flow upwardly therethrough and into the cylinder but substantially prevent a return of the liquid, a plunger in the cylinder, and means for introducing liquid into the bore at a point above the lower end of said projection.

4. A hydraulic valve tappet comprising a tappet body having a longitudinal bore closed at its lower end to receive liquid, a separate cylinder disposed in the upper part of the bore, a tubular projection on the lower part of the cylinder and extending into the bore, valve means controlling the passage through said projection so as to allow liquid to flow upwardly therethrough and into the cylinder but substantially prevent a return of the liquid, a plunger in the cylinder, means normally urging the plunger upwardly, and means for introducing liquid into the bore at a point above the lower end of said projection.

5. A hydraulic valve tappet comprising a tappet body having a longitudinal bore closed at its lower end and adapted to receive a liquid, a separate cylinder press fitted in the upper part of the bore, a plunger in the cylinder, a tubular element projecting from the lower end of the cylinder into the lower portion of the bore in spaced relation to the wall of the latter, a valve for normally allowing liquid to flow from the lower portion of the bore into the cylinder, means for introducing liquid into the lower part of the bore at a point above the lower end of said tubular element, and means for enabling air to escape from the lower portion of the bore, said last mentioned means comprising a vent passage communicating with the lower portion of the bore closely adjacent the lower end of the cylinder.

6. A hydraulic valve tappet comprising a tappet body having a longitudinal bore closed at its lower end and adapted to receive a liquid, a separate cylinder in the upper part of the bore, a plunger in the cylinder, a tubular element projecting from the lower end of the cylinder into the lower portion of the bore in spaced relation to the wall of the latter, a valve for normally allowing liquid to flow from the lower portion of the bore into the upper portion thereof, means for introducing liquid into the lower part of the bore at a point above the lower end of said tubular element, and means for enabling air to escape from the lower portion of the bore, said last mentioned means comprising a vent communicating with the lower portion of the bore closely adjacent the lower end of the cylinder and directed at an angle to the horizontal to facilitate removal of the air.

7. A hydraulic valve tappet comprising a tappet body having a longitudinal bore closed at its lower end to receive liquid, a separate cylinder press fitted in the upper part of the bore and having a tubular portion of reduced size at its lower end, a plunger in the cylinder, a valve for closing the passage through the tubular portion on the lower end of the cylinder, means for introducing liquid into the lower part of the bore at a point above the lower end of said tubular portion of the cylinder, and an upwardly directed vent passage for enabling air to escape from the region around the extreme upper end of said tubular portion.

8. A valve tappet of the hydraulic type comprising a tappet body having a bore, and a separate cylinder in the bore and terminating in a reduced tubular portion, said cylinder having a longitudinal groove in its outer surface, which communicates with the bore around the reduced tubular portion.

9. A hydraulic valve tappet comprising, in combination, a tappet body having a longitudinal bore closed at its lower end and having an oil passage in its side wall above the closed end, and a sub-assembly unit comprising a cylinder having a tube of reduced size extending from one end thereof, a valve at the inner end of said tube, and a piston slidably contained and operable in said cylinder, said sub-assembly being received within and substantially closing the upper portion of said tappet body and supported in spaced relation to the closed end thereof and above the oil passage therein with its reduced tube portion extending below the level of said oil passage.

10. A hydraulic valve tappet comprising, in combination, a tappet body having a longitudinal bore closed at its lower end and having an oil passage in its side wall above the closed end, and a sub-assembly unit comprising a cylinder having a tube of reduced size extending from one end thereof, a valve at the inner end of said tube, a piston slidably contained and operable in said cylinder, and spring means for biasing said plunger outwardly of said cylinder, said sub-assembly being received within and substantially closing the upper portion of said tappet body and supported in spaced relation to the closed end thereof and above the oil passage therein with its reduced tube portion extending below the level of said oil passage.

ROBERT H. DAISLEY.