Nov. 23, 1954 G. T. RANDOL 2,695,013

HYDRAULIC VALVE TAPPET

Filed July 8, 1953

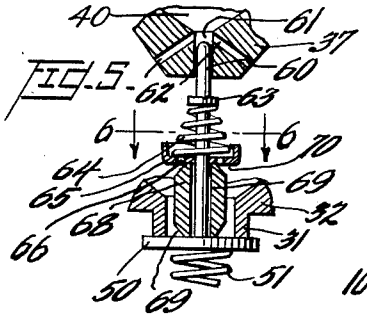


FIG. 5.

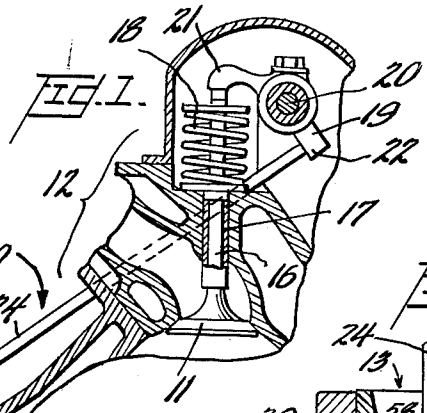
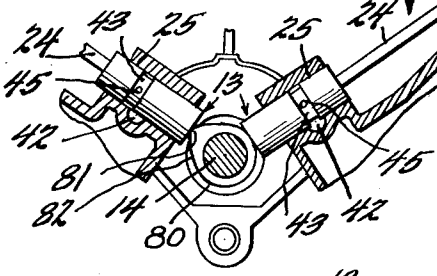


FIG. 1.



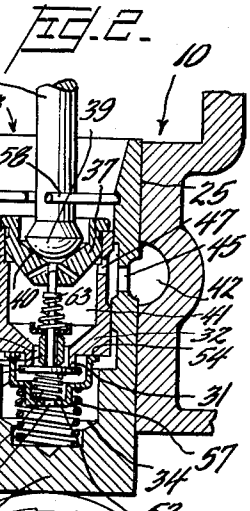


FIG. 2.

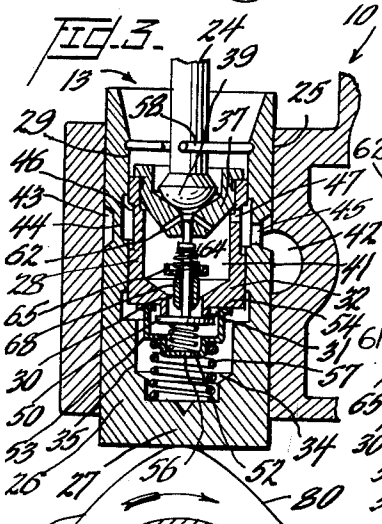


FIG. 3.

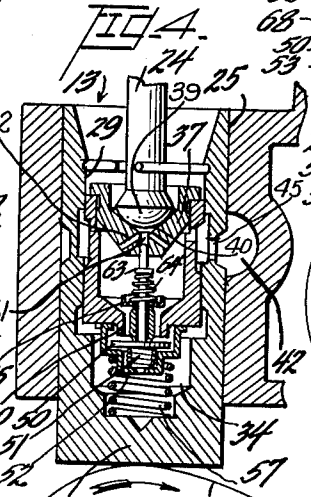
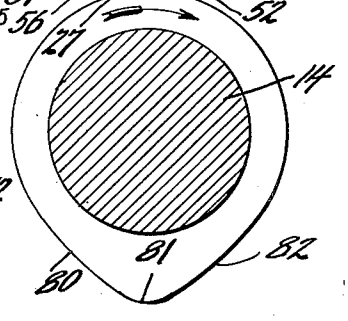


FIG. 4.



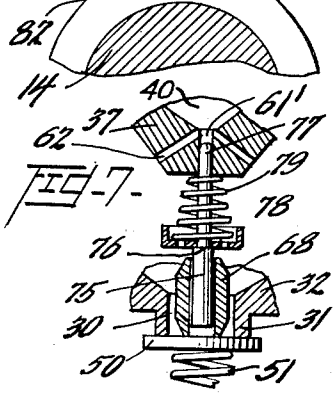


FIG. 7.

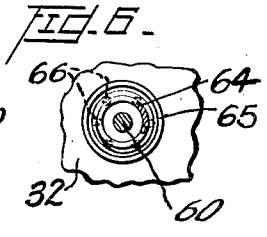
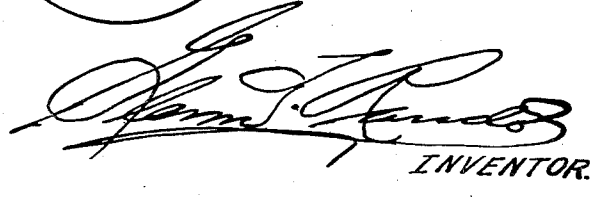


FIG. 6.



INVENTOR.

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2,695,013

HYDRAULIC VALVE TAPPET

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Application July 8, 1953, Serial No. 366,687

25 Claims. (Cl. 123—90)

The present invention relates to valve tappets or lifters adapted to maintain automatically substantially zero clearance in the valve drive train of an internal-combustion engine. The invention particularly relates to hydraulic valve tappets of improved operation and construction.

Mechanical valve lifters presently used commercially do not provide automatic adjustment of the valve drive train, nor automatic elimination of backlash in the valve operating mechanism of an internal-combustion engine. As an example, in mechanical tappet equipped drive trains of overhead valve engines, initial clearance is provided between the rocker arm of a drive train and the stem of the valve. As the engine is operated, the clearance is increased due to impact and wear of the engaging parts. Increased clearance between the rocker arms and valve stems results in inefficient and noisy operation of the engine and requires a partial disassembly of the engine to adjust the tappets; that is, to temporarily correct the clearance between the rocker arms and valve stems by effecting a manual adjustment in the drive train.

To avoid the necessity of frequent tappet adjustment and to eliminate noisy and inefficient operation of the engine, some commercial engines are equipped with hydraulic valve lifters which attempt to effect automatic adjustment of the valve drive train to maintain zero clearance in the train, so that in effect, the train functions as a solid body in opening the valves in the engine.

The general object of the present invention is to provide an improved valve lifter mechanism or tappet capable of constantly and consistently maintaining substantially zero clearance thereby eliminating backlash in the valve drive train of an internal-combustion engine.

The primary object of the invention is to provide for incorporation in the valve drive train of a conventional internal-combustion engine, an improved automatically adjustable valve tappet of the hydraulically operated type.

Another object of the invention is to provide an improved hydraulic valve tappet particularly adapted for use with a conventional valve operating cam, which tappet provides for maintaining silence of operation and affords long life for the cam itself and the mechanism operated thereby.

Still another object of the invention is to provide an improved hydraulic valve tappet assembly that may be readily substituted for any and all valve lifter mechanisms presently used commercially, whether mechanical or hydraulic.

It is a further object of the invention to facilitate the attainment of the recited primary objective by the provision of novel hydraulic tappet mechanism of the compensating type which automatically adjusts to shorten or lengthen the valve drive train to maintain or establish substantially zero clearance therein, so that when actuated by a cam, on the engine camshaft, is adapted to intermittently effect the cyclic opening and closing of a conventional engine poppet valve silently and efficiently at all operating speeds and thermal conditions of the engine.

A still further object of the invention is to provide an improved hydraulic valve tappet that is economical to manufacture, compact, readily assembled and disassembled, substantially uniformly actuated into and out of engagement irrespective of the relative disposition of the members thereof, and effective to compensate for any relative movement between the members of the valve lifter train.

An important object of the present invention is to incorporate novel valve means for controlling fluid communication to the fluid pressure chamber of the tappet, said valve means comprising a movable element spring biased in one direction to closed position and held there by increase in fluid pressure in said chamber and by the action of an inertia hammer or weight in its upward throw, said weight being opposed by a snubber spring carried by said valve element to transmit the weight force to said element to assist in holding the same closed, and to accelerate the downward movement of said weight into impact with the valve element to open the same upon the engine valve becoming closed notwithstanding the then existent pressure differentials across opposite sides of the valve element tend to oppose such valve opening action of the inertia hammer.

An object related to the object immediately above, is to incorporate in said tappet mechanism novel and improved valve means controlled by a weight or inertia hammer in such manner that the motion of the tappet assembly operates to throw the weight, on the opening cycle of the engine valve, in a direction to supplement a spring and a modulated pressure of fluid trapped between the tappet body members by the closing of said valve, to firmly seat the valve while the engine cam is opening the engine valve; while upon the tappet assembly reaching substantially engine valve closed position the weight is moved downwardly into impact relation with the valve to open the same to enable the engine valve mechanism to adjust according to the backlash condition which may exist, said spring acting to restore the valve and inertia mechanism to lightly seated relationship with respect to the port controlling fluid communication into the pressure chamber of the tappet assembly; the tappet unit engaging the base circle of the engine cam during the spring restorative action whereby fluid communication is provided into the pressure chamber of the tappet unit in readiness for another engine valve opening cycle.

It is the object of another embodiment of the invention to provide tappet mechanism in which the opening only of the check valve is assisted by the operation of an inertia sleeve sliding on a fixed stem and cooperating with a spring for increasing its velocity toward valve opening position whereby the check valve is positively apertured at the proper time in the engine valve cycle for the tappet to compensate for backlash and changes due to wear or thermal conditions in the valve train.

In accomplishing the objects of the present invention, I provide a valve tappet mechanism having some similarity to commercial hydraulic valve lifters and including substantially all of the elements of commercial hydraulic valve lifters. In particular, the valve tappet mechanism of the present invention comprises a pair of relatively movable body members defining a fluid pressure chamber therebetween, passage means, including a port in one body member, for conducting fluid under pressure to and from the chamber, and a check-valve positioned within the chamber and adapted to close the port to close the pressure chamber. The fluid in the chamber is substantially incompressible and as a result prevents relative movement between the body members in one direction when the check-valve is closed. The body members are, in effect, locked together for conjoint movement to open the engine valve. While some reliance is placed upon the hydraulic impact principle, supplemented by spring action in certain types, as utilized in commercial hydraulic valve lifters to seat and hold the check-valve in closed position, the present invention provides improved additional mechanism operable by inertia force produced by a weight associated with said check-valve and in the nature of a sleeve operating on a stem operatively associated with the check-valve to open or to hold the valve in closed position in response to tappet movement. The sleeve of the present invention in one embodiment surrounds and slides on a stem secured to the low pressure side of the check-valve, which stem is fitted with a buffer spring to cushion the sleeve in "valve closing" movement and to assist it in movement to "valve opening" position. In another embodiment the stem is fixed to the part of the tapped body providing the valve port and is independent of the check-valve whereby the weight and its spring act only to open the check-valve.

Other and further objects and features of the present

invention will become more apparent to those skilled in the art upon a consideration of the accompanying drawing and following specification wherein are disclosed two embodiments of the invention with the understanding that such changes may be made therein as fall within the scope of the appended claims without departing from the spirit of the invention.

In said drawings:

Figure 1 is a fragmentary transverse vertical section through a V-type internal-combustion engine showing the overhead valve operating mechanism incorporating self-adjusting hydraulic valve tappets constructed in accordance with the present invention;

Figure 2 is an enlarged longitudinal central section through a tappet in the reposed or engine valve closed position;

Figure 3 is a view similar to that of Figure 2 but showing the tappet in engine valve open position;

Figure 4 is a view similar to Figures 2 and 3 but showing the tappet at the termination of an engine valve closing;

Figure 5 is a fragmentary view similar to Figure 2 but on a still larger scale and illustrating the inertia weight, its spring and the check-valve;

Figure 6 is a fragmentary horizontal section taken on line 6—6 of Figure 5; and

Figure 7 is a view similar to Figure 5 but illustrating a further embodiment.

Referring now to the drawings, and particularly to Figure 1, the invention is shown incorporated in a conventional internal-combustion engine **10** having a plurality of poppet valves one of which is shown at **11**. A valve drive train, indicated generally at **12**, is provided for each valve of the engine, and is conventional in all respects except for the valve tappet mechanism of the present invention, which is embodied therein. The valve drive train **12** extends between the valve **11** and the cam shaft **14** of the engine. The valve **11** may be of any known construction and that selected for illustration includes a stem portion **16**, guided in a collar part **17**, and having spring means **18** associated therewith normally tending to close the valve. A rocker arm **19** pivotally mounted intermediate its ends on a suitable rock shaft **20** is adapted to bear at one end **21** thereof against the free end of stem **16** when rotated in a counterclockwise direction, as viewed in the figure, to open valve **11** against the force of spring means **18**. The other end **22** of the rocker arm **19** has a hemispherical recess, not shown, in its under surface to accommodate the outer end of a push rod **24**, the other ends of which bears against a dished fitting in the upper hollow end of a valve tappet **13**, which will be later described.

The valve tappet, which is generally cylindrical in contour, is illustrated as slidably mounted in a bore **25** radially disposed, in respect to the axis of the cam shaft **14**, in the block of the engine **10** so that the inner end of the tappet **13** bears on the surface of the cam allotted thereto.

Referring now to Figure 2 for a more complete understanding of the construction and functioning of the valve tappet **13**, it will be seen that each of these comprises an outer shell or sleeve **26** having a working fit in the bore **25** in the block of the engine, and having a closed bottom **27** which is adapted to bear on the surface of the cam as seen in the figure. The second principal element of the tappet comprises the plunger **28** of cup-like form, the outer cylindrical surface thereof sliding with a substantially oil-tight fit in the bore **29** in the shell part. The plunger is closed at the bottom except for a port **30** of circular form having a projecting spout **31** extending downwardly below the bottom wall **32** of the plunger. A space or chamber **34** is seen to be confined between the walls of the smaller bore **35** at the lower portion of the tappet shell and the lower end of the plunger, which chamber when appropriately filled with oil and closed by a valve member over the port **30** functions as a solid element to cause lift of the valve train by the cam acting on the bottom of the shell. The plunger supports with a snap fit the push rod cup **37** fitting within its bore and having a flange overlying the plunger end. The dished upper surface of the cup provides accommodation for the ball end **39** of push rod **24**. For convenience in construction the part engaging the ball end **39** is a conical taper as shown at **40**. This provides for a line contact between the end of the push rod and the upper face of the cup which serves more or less to seal against the outflow of oil in an upward direction.

There is thus formed a more or less tight reservoir **41** beneath the thimble **37** and above the bottom **32** of the plunger **28**. This is constantly supplied with an excess quantity of oil from the pressure lubricating system of the engine, the pump of the system providing oil through a suitable conduit to the channel **42** in the wall of bore **25** in the engine block. This is in continuous communication with the circumferential groove **43** in the outer wall of the tappet shell which connects in turn to an inner channel **44** by way of radial bore **45**. The cylindrical outer surface of the plunger is circumferentially grooved at **46** to provide a passage for oil which communicates through bore **47** with the reservoir **41** in the plunger.

A thin, flat circular valve disc **50** serves to close the port **30** in the bottom of the plunger, acting at all times under the urge of a light helical spring **51** bearing on its lower surface and itself abutting against the bottom wall **52** of valve cage **53**. The normal pretensioned status of the spring **51** is sufficient to hold the valve disc **50** in its upper closed position (Figure 2) and counterbalance the static weight of novel inertia mechanism operably associated therewith which is to be described later, when the fluid pressure forces on opposite sides of the valve disc are equal; but the valve disc is readily moved downwardly against said spring action upon the pressure forces of the liquid in the passage **30** slightly exceeding those of the liquid below the disc valve in the chamber **34**. The said cage is in the nature of a cup having its open upper end equipped with a radial flange to provide a wide base seating at **54** against the flat bottom of the tappet plunger surrounding the bead on neck **31** against which it may have a snap fit if desired by appropriate inturned tongue construction. The inner diameter of the upper portion of the valve disc retainer provides a free clearance for the valve disc while the lower portion is reduced in diameter to form a seat to maintain the helical expansion spring **51** centralized in respect to the valve disc. This combined disc retainer and spring abutment is provided with a relatively large central aperture **56** to accommodate the free flow of oil therethrough in its movement from reservoir **41** via passage **30** to chamber **34** and vice versa.

The plunger **28** is constantly biased outwardly tending to enlarge chamber **34**, by helical spring **57** the upper end of which bears on the shoulder at the junction of the two diameters of the valve disc retainer cup and the lower end of which fits in the small diameter bore at the lower end of the tappet body. This bore and the small diameter portion of the valve disc retainer cup centralize this helical spring **57**. To prevent separation of the two parts of the valve tappet when it is not incorporated in an engine, a suitable snap ring **58** fits in an appropriate internal groove near the upper end of the bore of the tappet shell and limits outward movement of the plunger cup.

Referring now to Figure 5 for an enlarged view of the parts directly associated with the valve disc **50**, it will be noted that against the upper side of this disc and centrally thereof is secured the stem **60** extending normally therefrom and having a loose sliding fit in the central bore **61** in the lower part of the push rod cup **37**. Since there is a possibility of a fluid tight fit of the ball end **39** of the push rod in the upper surface of this cup, which might make the end of stem **60** act as a piston or plunger and retard its movement, relief bores **62** extending from near the top of the hole **61** through the lower surface of the push rod cup are provided as seen in this figure.

Fixed on the stem **60** at a suitable distance beneath the lower end of cup **37** is an abutment washer **63** against which the upper end of a conical spring **64** abuts as shown. The lower end of the spring is received in a cup washer **65** having a central bore slidably fitted over stem **60**. To provide for a free flow of oil so that none may be trapped when the spring is being compressed, the bottom of cup washer **65** is provided with a circular series of holes **66** extending through it between the central stem and the last turn of the spring. This cup washer **65** bears lightly under the pressure of the spring against the top surface of an inertia weight or sleeve **68** having a central bore **69** enabling it to slide loosely on the stem **60**. The upper and lower ends of this tubular weight are chamfered as at **69** and **70** to facilitate its high speed movement through the mass of oil surrounding it. Obviously the weight may move relative to the stem **60** from its own inertia and

the rapid movement of the valve tappet, causing compression of the spring as the sleeve moves upward relatively thereto. When the forces are in the opposite direction the weight is moved downwardly toward the valve disc with increased speed over that resulting from inertia and stem movement, the additional energy being supplied by the expanding action of the buffer spring **64**. When the weight strikes the upper surface of the disc **50** it drives the latter away from its seat, releasing the modulated pressure in the compartment **34** beneath it for purposes to be later described.

In the modification of Figure 7, the general arrangement of parts is identical with that already described in connection with Figures 2 and 5 and similar reference characters have been applied to corresponding parts. In this case the valve disc **50**, however, is free of any operative attachment to a stem. It is held closed solely under the action of spring **51**. The stem which in the earlier embodiment is secured to the upper face of the valve disc is in this case tightly fitted in bore **61'** in the lower end of push rod cup **37**, preferably by a press fit. This stem or guide rod stops just short of the plane of the face of the valve seat and is formed to two diameters, the largest part **75** accommodating the bore in the inertia weight **68** to provide it with a sliding fit. The upper portion **77** of the stem is reduced in diameter to provide a shoulder **76** on which rests a cup washer **78** perforated to slide freely over portion **77**. It serves to support the lower end of tapered spring **79**, the upper end of which abuts the lower face of the push rod cup **37**. The spring may be under some initial tension or may be relaxed in accordance with design factors, the cup stopping against the shoulder **76**, serving to provide for any desired compression thereof.

In the construction shown in Figure 7 the inertia weight **68** when resting on the seated valve disc **50** clears the under surface of the movable cup washer by a small amount in order that it may achieve a certain degree of upward movement before coming up against this washer and starting to compress the buffer spring. Likewise this precludes any of the energy from spring **79** being imparted through the weight continuously against the valve with a tendency to bias it toward open position such as might happen if all the adjustments were not accurately made at the time of initial assembly. In contrast with the operation of the first described embodiment, which uses the weight of both to assist in holding the valve closed on its seat and in opening it under certain circumstances, this latter embodiment as shown in Figure 7 makes use of the inertia weight solely for moving the valve disc **50** off of its seat at the time when the valve tappet is riding on the base circle of the cam.

The construction of the devices under both embodiments of the invention is such as to provide a continual but slow flow and change of oil within the valve tappets. The sliding fit of the tappet body in the bore **25** in the block of the engine is such that a certain small leakage takes place to maintain lubrication. The sliding fit between the plunger and bore in the tappet body likewise provides a slight leak-by loss of oil. The engagement between the lower ball end of the push rod and the tapered upper surface of the push rod cup is such that there may be a slight leakage here sufficient at least to maintain lubrication, the oil escaping into the cup from reservoir **41** through the vent holes **62**. The operation of the tappet in the manner about to be described facilitates a slow but constant change of oil in the closed cavity **34** between the plunger and the tappet body since the check-valve is opened once per cycle of the valve linkage and at each time lets in and out a small quantity of the trapped oil.

The operation of the valve lifter mechanism **13** of the first embodiment of the invention is as follows:

With the engine valve in closed position the various elements of the mechanism assume the relative positions illustrated in Figures 1 and 2. Here the helical spring **57** between the tappet body **26** and plunger **28** expands the tappet in length between the push rod **24** and the base circle of the cam or shaft **14** so that the lower end **27** of the tappet beas thereon with substantially the force exerted by spring **57**. The entire assembly is charged with oil from the lubricating system of the engine, as previously explained, any air initially trapped in the chamber **34** being slowly vented through leakage between the plunger and the bore of the tappet body and being slowly replaced by oil during operation. The strength of spring **51** is barely enough to maintain the valve disc **50** against its seat.

As cam **14** rotates in a clockwise direction as viewed in the figures, the opening ramp **80** thereon which merges the base circle with the lift, operatively engages the under end face of the tappet body and begins to lift the same either with a quick lift, if the cam is designed for the conventional type of hydraulic valve tappet, or with a slower more gentle lift if the cam is especially designed for tappets of the type of the present invention. Under these circumstances the movement of the tappet being resisted by the engine valve spring **18** through the push rod **24**, tends to compress the solid mass of oil in the compartment **34** between the tappet body and plunger which imparts a pressure or hydraulic impact to the under surface of the vave disc which is already lightly seated and forces it tightly closed, thereby imprisoning the liquid within the compartment **34** in a sufficiently solid acting mass to cause the parts of the valve tappet to move in unison and lift the engine valve as if a solid tappet were in place. The engine valve train clearance having been substantially zero at the position indicated in Figure 2 because of the action of expanding spring **57** between the two tappet body parts, the action in operating the valve drive train is that of a mechanical lifter with substantially zero-lash present.

When the cam valve opening ramp first strikes the under face of the tappet all parts associated therewith are given a rapid upward thrust including the inertia weight **68** solidly seated in the tightly closed valve disc which may also be slightly flexed by the hydraulic impact. Being unrestrained in its movement except by the light spring **64**, the sleeve moves more rapidly than the other parts of the tappet under the initial impetus and compresses the spring **64** so that the weight moves up to the position illustrated in Figure 3 wherein its lower face is seen to be spaced well away from the valve disc **50**. This condition holds at least until the cam reaches its position of maximum lift as illustrated in Figure 3 and all the time the weight is compressing spring **64** the latter reacts through its abutment **63** on the stem **60** to assist the helical spring **51** and the fluid pressure in the compartment **34** to hold the valve tightly against its seat under any tendency, such as might come from vibration or the like, to unseat it, thus insuring operation for this part of the cycle with substantially zero backlash and absolutely quiet operation of the valve train.

As the cam progresses from the maximum lift point **81** to the release or valve closing ramp **82** the tappet is lowered and with it the engine valve is closed by action of spring **18**. Under these circumstances the downward movement of the tappet leaves the inertia weight lifted in the Figure 3 position continually imparting lift to the stem and the valve disc whereby to maintain it tightly on its seat until the valve tappet rides off of the ramp at **82**. Here conditions reverse themselves, the downward movement of the tappet ceases, the inertia of the weight no longer is sufficient to overcome the expanding action of its spring **64** and the weight, both under the action of gravity and the pressure of the spring, moves rapidly downwardly, striking the upper face of the valve disc **50** and thus driving it from its seat as shown in Figures 4, in spite of the still considerable fluid pressure which may be behind it, thereby re-establishing fluid communication between compartment **34** and oil reservoir **41** whereby an appropriate movement of oil in the required direction takes place. The springs **51** and **64** are so weighted that at periods of rest the former predominates to lightly close the valve **50** but can be readily overcome by augmentation of the effect of spring **64** responsive to the action of the inertia weight **68**.

If there has been over compensation to reduce the clearance to less than zero (excess pressure on the base circle) then a certain amount of the oil may transfer back into reservoir **41**, or if as the result of temperature changes or wear in the valve train, there has been an accumulated backlash this is immediately taken up under the action of spring **57** forcing the tappet to elongate and again reducing the clearance to substantially zero. The slight tendency of the valve disc **50** to open resulting from its own momentum is very materially augmented by the action of the hammer blow of the inertia weight moving under the impetus of its spring and thus complete opening of the valve is assured under all circum-

stances so that full compensation may be made for proper clearance adjustment.

The valve disc 50 is held open under the conditions shown in Figure 4 during a substantial degree of arc during which the tappet body is riding on the base circle of the cam, but the momentum exect of the hammer weight is lost prior to approaching the opening ramp 80 so that the valve disc has lightly closed under the action of its spring 51 in readiness for the hydraulic impact when the tappet is lifted on this ramp to open the engine valve 11.

With the functioning of the first embodiment of the invention, it is clear that maximum efficiency of the hydraulic valve tappet is assured under all circumstances and that substantially zero-lash is achieved in the valve train during the whole time that the engine valve is opening and closing. After the engine valve closing and when the tappet valve disc 50 is open there is some slight relief of pressure on the heel or base circle of the cam so that minimum wear results on the contacting parts. With the tappet valve opening and closing once per cycle careful modulation and adjustment of the whole valve train is achieved that many times, so that the backlash or clearance in the whole train is maintained as near zero as is feasible and desirable, all with the addition of only a few very small and low priced parts to what has been considered as the normal or commercial type of hydraulic valve tappet.

In the embodiment of the invention illustrated in Figure 7 obviously the weight has no effect in serving to close and hold shut the valve disc 50 since it is wholly independent thereof, as is the stem 75. Spring 51 is of such weight as to counterbalance the hammer 68 and the valve 50 so that the latter is lightly seated in closed position, as shown in the figure. When the weight is actuated by inertia it is cushioned in its upward movement during the engine valve opening cycle by the spring 79 which spring then adds to its acceleration on its downward movement to insure opening of the valve disc 50. Note that in this arrangement the upper end of the spring 79 is fixed whereas in the first embodiment the upper abutment for corresponding spring 64 moves with the valve disc. Thus the effectiveness of the spring 79 in Figure 7 is much greater and the hammer blow imparted to the valve disc under the action of its own and the momentum given it by this spring is such as to insure opening the valve disc in spite of a relatively high pressure of fluid within the chamber 34 beneath it.

In both embodiments there is some bias of the valve 50 toward open position when the fluid pressure resulting from the engine oil circulating pump continually driving oil into the reservoir 41 under the not inconsiderable pressure resulting from the engine speed, slightly exceeds fluid pressures in the chamber 34. This pressure, of course, is relatively inconsequential compared with that built up in chamber 34 under the lift action of the cam and the resistance of the engine valve spring 18, but it is quite effective when the engine valve is seated to assist in lifting the disc 50 from its seat when fluid pressure differences occur on opposite sides of the valve disc 50 whereby fluid communication is established via passage 30 between the reservoir 41 and chamber 34 enabling relative adjustments between the tappet body members 26, 28 as desired.

In Figure 7 the spring 51 is so rated as to substantially prevent the valve disc 50 from seating during the valve tappet engagement with the base circle of the engine cam, thus accommodating the lifter adjustment as required; i. e., shortening or lengthening the valve actuating linkage as required.

It will be noted that two elements operate to eliminate any backlash in the valve train, and both function during the time that the tappet is riding on the base circle of the cam. The first of these is the expansion spring 57 tending to separate the two body parts or actually to elongate the tappet, and the second is the pressure of the oil from the engine circulating system endeavoring to enter the compartment 34 after lifting the check-valve from its seat.

The present invention is particularly adapted to be utilized in the replacement of all valve tappet mechanisms whether mechanical or hydraulic. While it is preferred that the cam design be conventional, as shown in the drawing, it is clear that the present invention will operate satisfactorily with the particular cam design presently used for commercial hydraulic valve tappets where the ramp gives a rapid rise to the tappet in order to provide the hydraulic impact to insure the closing of the tappet valve substantially at the instant of initial tappet lift.

It will be apparent that various changes, modifications and rearrangements can be made in the particular apparatus described herein without departing from the scope of my invention. Obviously one body member of the tappet need not be arranged within the other and the various parts and elements of the construction may be redesigned to fit particular installations or designs, and obvious substitutes may be used for the various parts shown.

I claim as my invention:

1. A hydraulic valve tappet comprising a pair of relatively movable members defining a chamber therebetween, a source of liquid, a spring for biasing said pair of members apart, a valve port in one of said members establishing communication between said source of liquid and said chamber, a check-valve adapted to close said port against pressure in the chamber, a spring for biasing said check-valve to close said port, and inertia means operatively associated with said valve, said means being adapted for actuation in response to tappet movement for supplementing said last named spring to hold said valve against said port during the lift portion of the tappet cycle.

2. The valve tappet of claim 1 in which said inertia means comprisises a weight and means providing a lost-motion connection between said weight and valve whereby the weight assists the spring to close the valve during engine valve open phases of the cycle and the weight opposes the spring to open the valve during valve closed phases of the cycle.

3. The valve tappet of claim 2 in which a buffer spring resists movement of the weight toward valve closing action and in which the buffer spring imparts momentum to the weight toward valve opening position.

4. A hydraulic valve tappet comprising a pair of relatively movable members defining a chamber therebetween, a source of liquid, a valve port in one of said members establishing communication between said source of liquid and said chamber, a check-valve adapted to close said port against pressure in the chamber, a spring for biasing said check-valve to close said port, an expansion spring biasing said pair of members apart, inertia means comprising a weight slidable longitudinally of the tappet in respect to the ported member, and means guiding the weight to strike the check-valve to open the same against its biasing spring when tappet motion stops after downward movement.

5. The tappet of claim 4 in which spring means are positioned to be compressed by said weight during upward movement of the tappet.

6. The tappet of claim 5 in which said spring means is operably interposed between an abutment immovable on the said ported member and a movable seat normally engaging a shoulder formed on said guiding means in spaced relation with respect to said check-valve.

7. The tappet of claim 6 in which the spring seat when engaging said shoulder provides a predetermined lost-motion movement of the weight between said spring means and the check valve.

8. The tappet of claim 7 in which said spring means comprises a conical spiral spring surrounding said guiding means on which the weight is slidable.

9. A hydraulic valve tappet comprising a cup-like body portion adapted for cam actuated reciprocation in a motor block, a cup-like plunger reciprocably nested in said body portion to define a chamber therebetween, an expansion spring in said chamber tending to enlarge it, a push rod cup nesting in said plunger to form a reservoir therein adapted to be connected to a source of liquid, a port in the bottom of said plunger connecting the chamber and reservoir, a check-valve disc cooperating with said port and located in the chamber, a spring biasing said disc to close the port, an inertia weight adapted to bear on said disc when the tappet is at rest and means in said reservoir guiding said weight for reciprocation on the axis of movement of the tappet.

10. The tappet of claim 9 in which the weight is a sleeve and the guide means is a rod entering a hole in said push rod cup.

11. The tappet of claim 10 in which the ends of the weight are tapered to facilitate its movement through said liquid.

12. The tappet of claim 9 in which a buffer spring is mounted on said rod and a top abutment for said spring whereby it is compressed when inertia causes a relative movement of the weight against it.

13. The tappet of claim 12 in which the said rod is rigidly attached to said disc and slides in said hole in the push rod cup.

14. The tappet of claim 13 in which the spring abutment is secured to the rod and the spring normally engages the weight with a light pressure.

15. The tappet of claim 10 in which the rod is rigidly secured to the valve disc and has a sliding fit in said push rod cup hole.

16. The tappet of claim 10 in which the rod is rigidly secured in the hole in the push rod cup and the free end thereof is spaced from the disc.

17. The tappet of claim 16 in which a spring is mounted on said rod, an abutment for the upper end of said spring, the lower end of the spring being free of engagement with the said weight.

18. The tappet of claim 17 in which the spring is preloaded by a washer forming its lower abutment, having a sliding fit on the rod and normally biased against a shoulder thereon.

19. The tappet of claim 18 in which the spring is a conical coil spring.

20. The tappet of claim 14 in which the spring is a conical coil spring.

21. In a hydraulic compensating valve tappet for internal-combustion engines including a cam-actuated tappet body having a longitudinal cylindrical bore closed at one end and open at the other, a hollow plunger reciprocable in said bore and providing a liquid reservoir, a source of liquid, spring means for axially elongating said tappet body and plunger assembly relatively to each other, a liquid chamber formed between the closed end of said tappet body and the inner end of said plunger, a valve port in the inner end of said plunger forming a valve seat for interconnecting said liquid reservoir and chamber, an inwardly opening valve element engageable with said valve seat to close the valve port, spring means for biasing said valve element into engagement with said valve seat to close said valve port, and inertia means operably associated with said valve element responsive to tappet body movement for supplementing the biasing action of said last-named spring means to maintain said valve port closed during a lift portion of the tappet cycle.

22. The hydraulic compensating tappet according to claim 21 in which said inertia means include a movable element responsive to tappet motion, and spring means operably associated therewith and operatively energized thereby during the lift portion of the tappet cycle for accelerating the downward motion of said movable element into impact with said valve element to open the same substantially at the arrested point of tappet motion.

23. The hydraulic compensating tappet according to claim 22 in which the said inertia means includes means limiting the effectiveness of said last-named spring means on said movable element to accelerate the same as aforesaid.

24. The hydraulic compensating tappet according to claim 22 in which the second-named spring means is effective to counterbalance the third-named spring means and the static weight of said movable element at substantially closed position of said valve element.

25. The hydraulic compensating tappet according to claim 23 in which the second-named spring means is effective to counterbalance the static weight only of the said inertia movable element at substantially closed position of said valve element.

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