June 27, 1939. P. E. WHALEN 2,163,969

HYDRAULIC LASH ADJUSTER

Filed July 2, 1937

FIG. 1

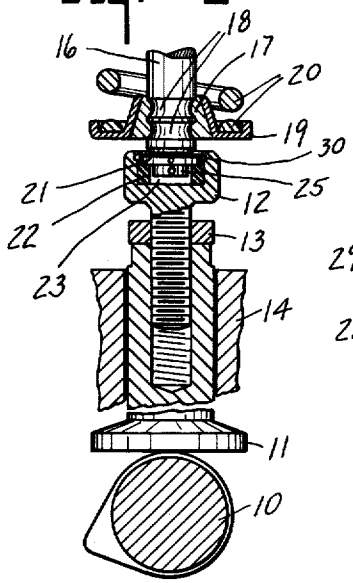


FIG. 2

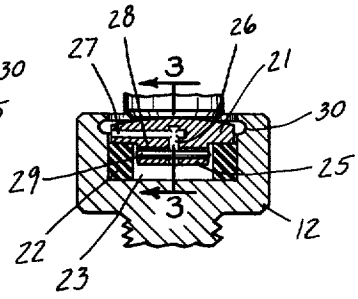


FIG. 5

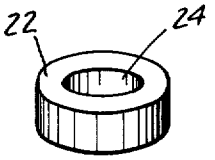


FIG. 3

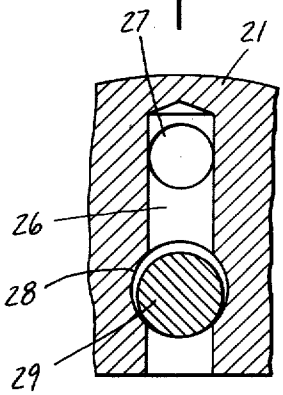


FIG. 4

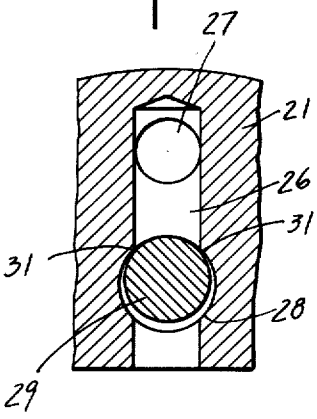
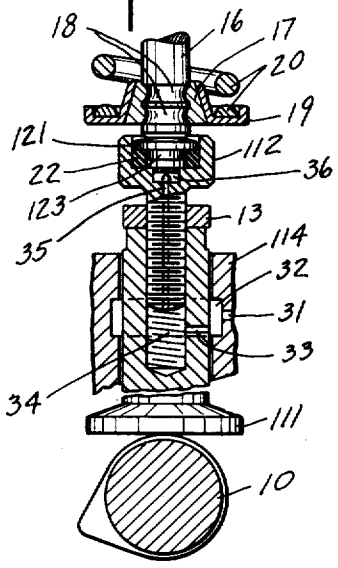


FIG. 6



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HYDRAULIC LASH ADJUSTER

Paul E. Whalen, Bedford, Ind.

Application July 2, 1937, Serial No. 151,577

20 Claims. (Cl. 123—90)

This invention relates to an hydraulic clearance compensator which is particularly applicable to the valve operating mechanisms of internal combustion engines. One object of the present invention is to provide an hydraulic compensator which not only takes up backlash in the train of parts operating the valves of an internal combustion engine, but also compensates for expansion of these parts as they become heated under engine operation.

Another object of the invention is to provide a compensator which may be added as an accessory to cars already built and having adjustable valve tappets of the conventional type.

Other objects of the invention and the features by which these objects are attained will be apparent from the accompanying drawings and the following specification and claims:

Fig. 1 is an elevational view partly in section of a portion of the valve operating mechanism to which a preferred form of the invention has been applied. Fig. 2 is a sectional view on an enlarged scale of parts shown in Fig. 1. Fig. 3 is a sectional view taken substantially on the line 3—3 of Fig. 2. Fig. 4 is a similar sectional view taken on the same line with the parts in a different position. Fig. 5 is a perspective view of a resilient cylinder forming one of the features of the invention. Fig. 6 is an elevational view partly in section showing an alternative form of the invention.

In Fig. 1 of the drawing there is shown, by way of illustration, a preferred form of the invention as applied to a splash lubricated valve mechanism. A cam 10 which may be the conventional form of valve operating cam, engages a tappet 11 which may also be of conventional form and which carries an adjusting screw 12 locked in position by a lock nut 13. The tappet 11 is vertically slidable in a guide 14 carried by the engine body. A valve operating member 16, which may be the stem of the valve itself in case of an L-head engine, or the stem operating the valve rockers in the case of an overhead valve engine, is provided with the usual split keeper 17 engaging grooves 18 formed thereon. A spring seat 19 engages the conical outer surface of the keeper 17 and receives the lower end of a valve spring 20 which serves to close the valve in a conventional manner.

The valve operating member or stem 16 rests upon the upper surface of a metallic cap 21 which in turn rests upon the upper surface of a cylinder 22 formed of a resilient material and snugly fitting a substantially cylindrical bore 23 in the head of the adjusting screw 12. The cylinder 22 is preferably formed of a material commercially known as Duprene or Neoprene, which is a rubber-like substance having the resilient characteristics of rubber but which is not deteriorated by contact with oil. The resilient cylinder 22 is provided with a central opening 24 which receives a downwardly projecting portion 25 of the cap 21. Said portion 25 normally does not extend the full distance to the bottom of the cylinder 22 and thus leaves a cavity which may be contracted and enlarged by the compression and release of the cylinder 22 as pressure is applied to and released from the cap 21.

The cap 21 is provided with a central vertical passage 26 extending upwardly from the bottom of the cap but terminating short of the top thereof. The passage 26 is intersected by a horizontal passage 27 extending to the rim of the cap 21 and by a second passage 28 extending horizontally through the lower portion 25 of the cap. A valve pin 29 of smaller diameter than the passage 28 is carried therein. The upper edge of the bore 23 is provided with a cut recess 30 permitting free communication between the passage 27 and the exterior of the adjusting screw 12.

In the operation of the form of the invention just described, it is assumed that the valve operating mechanism is sufficiently supplied with oil by a splash system so that a quantity of oil may collect in the upper portion of the bore 23 above the cap 21 and particularly in the groove 30. In the upward movement of the valve mechanism the pressure of the cam is transmitted through the cap 21 to the stem 16 and the cap 21 is, therefore, forced against the resilient cylinder 22 and contracts the central cavity therein. In the downward movement, if there is any backlash present in the mechanism, the pressure is released and the central cavity may expand. In this expansion, a small amount of oil is drawn in from the upper part of the bore 23 through the recess 30, the passage 27, the upper part of the passage 26 and through the passage 28 to the interior of the cylinder 22. In this downward movement, the valve pin 29 is in the position shown in Fig. 3 in which oil may freely flow from the passage 26 along the top of the pin 29 and out at each end of the passage 28.

On the next upward stroke of the mechanism, the central cavity is again compressed and oil contained therein is forced upwardly through the lower part of the passage 26 to hold the pin 29 against the upper surface of passage 28, as shown in Fig. 4. Since the pin is of smaller diameter than the passage 28, the upper portion of passage 26 is not entirely closed. A space per-

mitting escape of a very small amount of oil is provided at 31. However, the passage at 31 is so restricted that only a small part of the oil may escape as compared to the amount which may enter on the downward stroke of the mechanism. Repeated upward and downward strokes, therefore, serve to pump a sufficient quantity of incompressible oil into the central cavity to maintain a uniform contact between the cap 21 and the stem 16 and thus to take up whatever backlash there may be in the mechanism. If, however, the tappet 11, stem 16 and other parts expand due to heating, the pressure on the cap 21 is increased and this pressure may be relieved by the escape of the small amount of oil through the opening at 31 since the pressure will be sufficiently great to restrict the inflow of oil on the down stroke. Thus, the compensator adjusts not only for backlash but for excessive pressure due to expansion of the parts. By the use of pins 29 of appropriate diameter, the proper relation between inflow and outflow may be obtained for any given type of valve gear.

In the pumping action it will be seen that the resilient cylinder 22, in addition to its use in providing a central cavity of variable size, serves also to seal the cavity against undesired inflow or outflow of oil even though there may be considerable clearance between the outer edges of the cap 21 and the bore 23. Thus, the relatively unrestricted inflow of oil when required to take up backlash and the relatively restricted outflow of oil is controlled entirely by the action of the valve pin 29.

It will also be apparent that all of the parts described which are not found in the conventional valve mechanism are contained within the head of the adjusting screw 12. In order to fit the invention to an engine already built, it is only necessary to replace the standard adjusting screw with one bored out as described and fitted with the internal parts 21, 22, etc. It will also be apparent that a relatively small amount of oil is required for operation of the device.

In Fig. 6, there is shown a form of the invention applied to a pressure lubricated valve mechanism. In this drawing parts having the same construction and function as those in Fig. 1 are indicated by the same reference numbers. There are also shown a tappet 111, adjusting screw 112, tappet guide 114 and cap 121, each of slightly different construction than the corresponding parts of Fig. 1.

Oil under pressure is supplied to the guide 114 from the central lubricating system of the engine by a passage 31 to a counterbore 32 surrounding the tappet 111. A passage 33 within the tappet communicates with the counterbore and conducts the oil to the central threaded cavity 34 of the tappet. The adjusting screw 112 is provided with a recess 123 containing the resilient cylinder 22 and cap 121 and communicating with the cavity 33 by a passage 35, the upper end of which is closed by a ball check valve 36 of conventional form permitting inflow of oil to the recess 123 but preventing outflow therefrom.

In the operation of this form of the invention the alternate contraction and expansion of the central cavity of the cylinder 22 results in a pumping action as before which fills said cavity with incompressible oil under sufficient pressure to insure that there will be no backlash in the mechanism. If it is desired to adapt this form of the invention to adjust for expansion of the parts, means are provided for the escape of an extremely small quantity of oil at each compression stroke. This means is preferably contained in the cap 121 and may be of the general form previously described, except that a shorter pin 29 is used and the ends of passage 28 are sealed to prevent inflow of oil therethrough. A ball check valve may also be used in this instance instead of the pin.

The foregoing specification describes two preferred forms of the invention but is not to be construed as limiting the scope thereof to these exact forms. Many variations may be made by those skilled in the art without departing from the invention as defined by the appended claims.

The invention claimed is:

1. In combination with a valve tappet and a valve operating member, an adjusting screw carried by said valve tappet and having a cavity formed in the head thereof, a hollow cylinder of elastic material seated in said cavity, a substantially non-elastic closure for said cylinder, said closure engaging said valve operating member, and means for supplying a substantially non-compressible fluid to the interior of said cylinder.

2. In combination with a valve tappet and a valve operating member, an adjusting screw carried by said valve tappet and having a substantially cylindrical bore formed in the head thereof, a hollow cylinder of elastic material snugly seated in said bore, a closure for said cylinder, said closure engaging said valve operating member, and means for supplying a substantially non-compressible fluid to the interior of said cylinder.

3. In combination with a valve tappet and a valve operating member, an adjusting screw carried by said valve tappet and having a substantially cylindrical bore formed in the head thereof, a hollow cylinder of elastic material snugly seated in said bore, the lower end of said cylinder resting on the base of said bore, a closure for said cylinder, resting on the upper end of the same and engaging said valve operating member, whereby pressure exerted on said closure tends to compress said cylinder and to diminish the interior volume thereof, and means for supplying a substantially non-compressible fluid to the interior of said cylinder.

4. In combination with a valve tappet and a valve operating member, an adjusting screw carried by said valve tappet and having a substantially cylindrical bore formed in the head thereof, a hollow cylinder of elastic material snugly seated in said bore, the lower end of said cylinder resting on the base of said bore, a closure for said cylinder, resting on the upper end of the same and engaging said valve operating member, whereby alternate exertion and release of pressure on said closure tends alternately to diminish and increase the interior volume of said cylinder, and valve means movable between an opened condition and a partially opened condition, said valve means being automatically opened during increase of the volume of said cylinder for flow of a substantially non-compressible fluid to the interior of said cylinder and being partially opened during decrease of the volume of said cylinder for escape of said fluid from said cylinder at a greatly reduced rate.

5. In combination with a valve tappet and a valve operating member, an adjusting screw carried by said valve tappet and having a substantially cylindrical bore formed in the head thereof, a hollow cylinder of elastic material seated in said bore, the lower end of said cylinder resting on the base of said bore, a closure for said cylinder,

resting on the upper end of the same and engaging said valve operating member, whereby alternate exertion and release of pressure on said closure tends alternately to diminish and increase the interior volume of said cylinder, and valve means in said closure opened during increase of the volume of said cylinder for flow of a substantially non-compressible fluid to the interior of said cylinder.

6. In combination with a valve tappet and a valve operating member, an adjusting screw carried by said valve tappet and having a substantially cylindrical bore formed in the head thereof, a hollow cylinder of elastic material seated in said bore, the lower end of said cylinder resting on the base of said bore, a closure for said cylinder, resting on the upper end of the same and engaging said valve operating member, whereby alternate exertion and release of pressure on said closure tends alternately to diminish and increase the interior volume of said cylinder, and valve means in said closure movable between an opened condition and a partially opened condition, said valve means being automatically opened during increase of the volume of said cylinder for flow of a substantially non-compressible fluid to the interior of said cylinder and being partially opened during decrease of the volume of said cylinder for escape of said fluid from said cylinder at a greatly reduced rate.

7. In an hydraulic lash adjuster, the combination of a member having a substantially cylindrical bore formed therein, a hollow cylinder of elastic material seated in said bore, a substantially non-elastic closure for said cylinder, and means for supplying a substantially non-compressible fluid to the interior of said cylinder.

8. In an hydraulic lash adjuster, the combination of a member having a substantially cylindrical bore formed therein, a hollow cylinder of elastic material snugly seated in said bore, a closure for said cylinder, and means for supplying a substantially non-compressible fluid to the interior of said cylinder.

9. In an hydraulic lash adjuster, the combination of a member having a substantially cylindrical bore formed therein, a hollow cylinder of elastic material fitted in said bore, one end of said cylinder engaging the inner end of said bore, a closure for said cylinder engaging the opposite end thereof whereby pressure exerted on said closure tends to compress said cylinder and to diminish the interior volume thereof, and means for supplying a substantially non-compressible fluid to the interior of said cylinder.

10. In an hydraulic lash adjuster, the combination of a member having a substantially cylindrical bore formed therein, a hollow cylinder of elastic material fitted in said bore, one end of said cylinder engaging the inner end of said bore, a closure for said cylinder enaging the opposite end thereof whereby alternate exertion and release of pressure on said closure tends alternately to diminish and increase the interior volume of said cylinder, and valve means movable between an opened condition and a partially opened condition, said valve means being automatically opened during increase of the volume of said cylinder for flow of a substantially non-compressible fluid to the interior of said cylinder and being partially opened during decrease of the volume of said cylinder for escape of said fluid from said cylinder at a greatly reduced rate.

11. In an hydraulic lash adjuster, the combination of a member having a substantially cylindrical bore formed therein, a hollow cylinder of elastic material fitted in said bore, one end of said cylinder engaging the inner end of said bore, a closure for said cylinder engaging the opposite end of the same whereby alternate exertion and release of pressure on said closure tends alternately to diminish and increase the interior volume of said cylinder, and valve means in said closure opened during increase of the volume of said cylinder for flow of a substantially non-compressible fluid to the interior of said cylinder.

12. In an hydraulic lash adjuster, the combination of a member having a substantially cylindrical bore formed therein, a hollow cylinder of elastic material fitted in said bore, the lower end of said cylinder engaging the inner end of said bore, a closure for said cylinder engaging the opposite end of the same whereby alternate exertion and release of pressure on said closure tends alternately to diminish and increase the interior volume of said cylinder, and valve means in said closure movable between an opened condition and a partially opened condition, said valve means being automatically opened during increase of the volume of said cylinder for flow of a substantially non-compressible fluid to the interior of said cylinder and being partially opened during decrease of the volume of said cylinder for escape of said fluid from said cylinder at a greatly reduced rate.

13. In an hydraulic lash adjuster, the combination of a member having a recess formed therein, a hollow cylinder of elastic material seated in said recess, a cap seated on said cylinder, said cylinder providing sealing means preventing escape of liquid from the interior thereof between said recessed member and said cap, and means for introducing a liquid into the interior of said cylinder.

14. In an hydraulic lash adjuster, the combination of a member having a recess formed therein, a hollow cylinder of elastic material seated in said recess, and a cap seated on said cylinder, said cylinder serving to resiliently resist relative movement between said recessed member and said cap, and means for introducing a liquid into the interior of said cylinder.

15. In an hydraulic lash adjuster, the combination of a member formed of resilient material and having an internal cavity, a pair of relatively movable members substantially enclosing said resilient member and adapted by their relative movement to alternately expand and contract said internal cavity, one of said members having a passage leading to said internal cavity for introduction of a fluid thereto, and a valve in said passage movable between an opened and a partially closed condition, said valve being opened during expansion of said cavity for relatively free inflow of fluid thereto and partially closed during contraction thereof for relatively restricted outflow therefrom.

16. In an hydraulic lash adjuster, the combination of a pair of relatively movable members defining a compression chamber, sealing means for said chamber, one of said members having a passage admitting fluid to said chamber, and a valve in said passage movable between an opened and a partially closed condition, said valve being opened for relatively free flow during inflow of fluid thereto and partially closed for relatively restricted flow during outflow therefrom.

17. In an hydraulic lash adjuster, the combination of a pair of relatively movable members

defining a compression chamber, sealing means for said chamber, one of said members having a passage communicating with said chamber and a second passage admitting fluid to the first passage, and a valve pin in said first passage of smaller diameter than said passage, movable in one direction by compression of said chamber to partially close the intersection of said passages and movable in the other direction by expansion of said chamber to free said intersection for passage of fluid into said chamber.

18. In an hydraulic lash adjuster, the combination of a member having a recess formed therein, a cap relatively movable within said recess, resilient means retaining said cap in spaced relation to the bottom of said recess to form a compression chamber therein, said cap having a passage therein communicating at both ends with said chamber and a second passage intersecting said first passage and admitting fluid thereto, and a valve pin in said first passage of smaller diameter than said passage, movable in one direction by compression of said chamber to partially close the intersection of said passages and movable in the other direction by expansion of said chamber to free said intersection for passage of fluid into said chamber.

19. In an hydraulic lash adjuster, the combination of a member having a substantially cylindrical bore formed therein, a hollow cylinder of elastically compressible material seated in said bore, a cap seated on said cylinder and forming with the interior thereof a closed compression chamber, said cap having a passage therein communicating at both ends with said chamber and a second passage intersecting said first passage and admitting fluid thereto, and a valve pin in said first passage of smaller diameter than said passage, movable in one direction by compression of said chamber to partially close the intersection of said passages and movable in the other direction by expansion of said chamber to free said intersection for passage of fluid into said chamber.

20. In an hydraulic lash adjuster, the combination of a pair of relatively movable members defining a compression chamber, sealing means for said chamber, at least one of said members being provided with passages admitting flow of fluid to and from said chamber, and valve means adapted to open said passages for relatively free flow of fluid and to partially close the same for relatively restricted flow, said valve means opening said passages for relatively free inflow of fluid thereto during expansion of said chamber and partially closing said passages for relatively restricted outflow therefrom during compression of said chamber.

PAUL E. WHALEN.

DISCLAIMER

2,163,969.—*Paul E. Whalen*, Bedford, Ind. HYDRAULIC LASH ADJUSTER. Patent dated June 27, 1939. Disclaimer filed June 16, 1941, by the patentee.

Hereby enters this disclaimer to claims 16 and 20 of said specification.

[*Official Gazette July 8, 1941.*]

defining a compression chamber, sealing means for said chamber, one of said members having a passage communicating with said chamber and a second passage admitting fluid to the first passage, and a valve pin in said first passage of smaller diameter than said passage, movable in one direction by compression of said chamber to partially close the intersection of said passages and movable in the other direction by expansion of said chamber to free said intersection for passage of fluid into said chamber.

18. In an hydraulic lash adjuster, the combination of a member having a recess formed therein, a cap relatively movable within said recess, resilient means retaining said cap in spaced relation to the bottom of said recess to form a compression chamber therein, said cap having a passage therein communicating at both ends with said chamber and a second passage intersecting said first passage and admitting fluid thereto, and a valve pin in said first passage of smaller diameter than said passage, movable in one direction by compression of said chamber to partially close the intersection of said passages and movable in the other direction by expansion of said chamber to free said intersection for passage of fluid into said chamber.

19. In an hydraulic lash adjuster, the combination of a member having a substantially cylindrical bore formed therein, a hollow cylinder of elastically compressible material seated in said bore, a cap seated on said cylinder and forming with the interior thereof a closed compression chamber, said cap having a passage therein communicating at both ends with said chamber and a second passage intersecting said first passage and admitting fluid thereto, and a valve pin in said first passage of smaller diameter than said passage, movable in one direction by compression of said chamber to partially close the intersection of said passages and movable in the other direction by expansion of said chamber to free said intersection for passage of fluid into said chamber.

20. In an hydraulic lash adjuster, the combination of a pair of relatively movable members defining a compression chamber, sealing means for said chamber, at least one of said members being provided with passages admitting flow of fluid to and from said chamber, and valve means adapted to open said passages for relatively free flow of fluid and to partially close the same for relatively restricted flow, said valve means opening said passages for relatively free inflow of fluid thereto during expansion of said chamber and partially closing said passages for relatively restricted outflow therefrom during compression of said chamber.

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