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HYDRAULIC TAPPET

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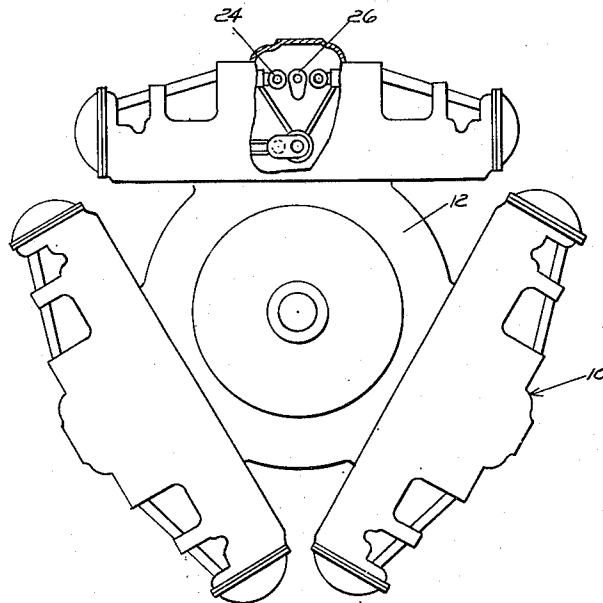


Fig 1

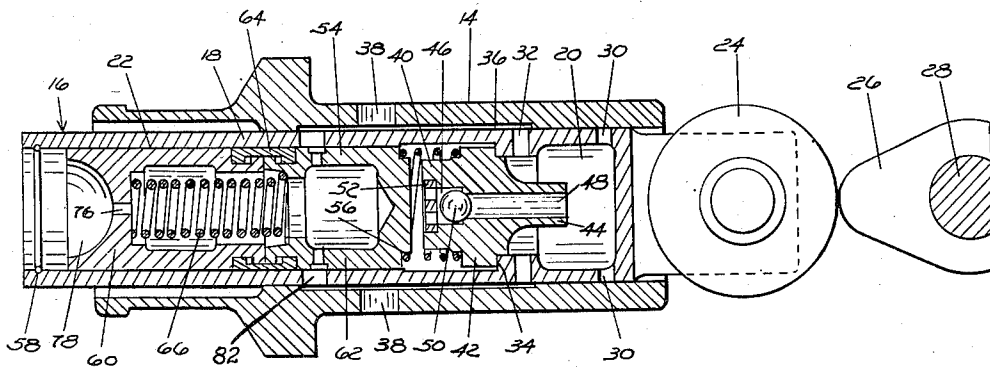


Fig 2

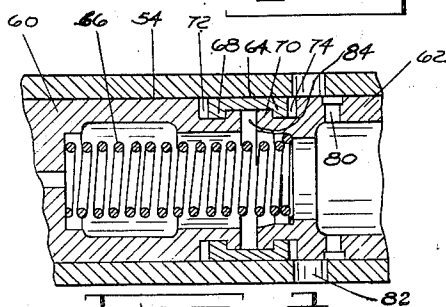


Fig 3

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HYDRAULIC TAPPET

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This invention relates to tappets and more particularly to improvements in fluid supplied automatic compensating tappets for operating valves of internal combustion engines.

Broadly the invention comprehends an automatic tappet construction including a hydraulic chamber disposed within the tappet body having means associated therewith providing for employment of the tappet in an upright, inverted or any desired angular position as operational conditions necessitate and compressive means for compensating for out-of-true surfaces of an operating cam associated with the tappet.

Heretofore, no feasible means has been devised to provide for air free operation of a hydraulic compensating tappet for all positions of installation thereof whether it be upright, horizontal, or inverted, with the consequence that engines requiring other than upright or inverted installation of tappets have not functioned as effectively as possible. The instant invention provides simple, effective means for alleviating this condition.

An object of the invention is to provide a hydraulic automatic compensating tappet adapted for operation in any desired position.

Another object of the invention is to provide a hydraulic compensating tappet construction including a separate element yieldably movable with respect to the tappet body within predetermined limits for offsetting worn or otherwise out-of-true cam surfaces in conjunction with hydraulic compensating means operable with respect to such element to compensate for variations in the length of certain movable elements of an internal combustion engine, such variations being due to different operating conditions of the engine.

Another object of the invention is the provision of a hydraulic tappet adaptable for operation in an engine in any angular position without the necessity of changing or reversing any of the parts thereof.

A further object of the invention is to provide an improved hydraulic automatic compensating tappet construction having a hydraulic chamber disposed in the tappet body and openings through the wall of the tappet body providing air bleed means for the hydraulic chamber for upright, partially or fully inverted positions of the tappet.

A further object of the invention is to provide an improved hydraulic automatic compensating tappet construction adapted to be associated with a valve, cam, and tappet guide, said tappet having a supply reservoir in the body thereof and openings through the wall of the body communicating

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with the reservoir, said openings being masked by the tappet guide for all positions of reciprocation of the tappet and adapted to provide for the bleeding of air or other gases from the hydraulic medium in the reservoir regardless of the positions in which the tappet may be mounted.

Other objects and advantages of the invention will appear from the following description taken in connection with the drawings forming a part of the specification, and in which:

Fig. 1 is an elevational view partly in section of a bank of internal combustion engines embodying tappets incorporating teachings of the invention mounted in various positions;

Fig. 2 is a vertical sectional fragmentary view of an engine illustrating a hydraulic tappet, tappet guide, cam shaft, and cam; and

Fig. 3 is an enlarged partial vertical sectional view of the out-of-true cam compensating means incorporated in the tappet.

In the manufacture of hydraulic compensating tappets it has been found necessary to provide adequate means for separating and bleeding air or other compressible gases from the hydraulic medium carried in the supply reservoir of the tappet so that substantially a gas-free medium may be supplied to the compression chamber of the tappet and thus permit the tappet plunger to bear on a substantially incompressible hydraulic column and furthermore to provide a tappet structure having and retaining said feature regardless of the installation and operational position thereof. It has additionally been found desirable to provide means to compensate for worn or otherwise out-of-true cam surfaces associated with the tappet and also to prevent transmission of vibration within range of the clearance that may occur in the valve gear to the valve so as to increase the over-all operating efficiency of a hydraulic tappet.

The instant invention solves these problems by providing a compensating tappet construction having openings through the wall of the tappet body at the extremities of the supply reservoir for bleeding air or other gases from the hydraulic medium carried by the reservoir so that the tappet may be installed for operation in vertically upright, inverted, horizontal or in any other angular position and yet provide for the induction of solid or substantially incompressible medium into the compression chamber of the tappet. The provision of a tappet, as herein defined, operable in any angular position eliminates the previous necessity of changing or reversing the parts thereof to make the tappet adaptable to all posi-

tions of operation. The tappet here expounded has also been provided with resiliently loaded, limitedly yieldable means for compensating for incorrect cam surfaces such as worn or out-of-true surfaces of the valve operating cam and prevent transmission of valve gear vibration to the valve.

Referring to the drawings for more specific details of the invention, 10 represents generally a plurality of engines each having a pair of opposed banks of cylinders mounted in equi-circumferentially spaced relationship around a transmission drive housing 12.

Fig. 2 illustrates a tappet guide 14 adapted to be fitted in a suitable engine block for the reception of a tappet 16 adapted for reciprocation in the tappet guide. The tappet 16 comprises a cylindrical tappet body 18 provided with a cavity 20 adjacent the closed end of the tappet body constituting the supply reservoir for the reception of a hydraulic operating medium and a concentric bore 22 at the other extremity of the tappet body communicating with the cavity 20.

The closed end of the tappet body is provided with a cam engaging means in the form of a roller 24 adapted to engage a cam 26 mounted on a cam shaft 28. The tappet body has through the wall thereof, communicating with the reservoir 20, a plurality of circumferentially spaced openings 30 at the base of the reservoir and a plurality of circumferentially spaced openings 32 at the top of the reservoir 20 adjacent a narrow annular shoulder 34 formed on the interior wall of the tappet body between reservoir 20 and bore 22.

The openings 30 and 32 provide for separation and bleeding of air or other compressible gases from the hydraulic medium carried by the reservoir 20 for any position of operational installation of the tappet. openings 32, additionally through the communication of annular groove 36 on the exterior wall of the tappet guide providing means for the ingress of fluid to the supply reservoir 20 supplied from the usual lubricating system of the engine or other suitable source through supply ports 38. It is to be noted that the openings 30 and 32 are masked by the tappet guide for all operational positions of the tappet so that no appreciable loss of hydraulic medium will occur past the openings, said openings serving primarily to free the reservoir of any compressible gases finding their way therinto.

A valve assembly 40 for controlling communication between the reservoir 20 and bore 22 is received in the bore 22 and is seated in sealing engagement upon the shoulder 34. The valve assembly comprises an enlarged body portion 42 and a subtended cylindrical portion 44 extending into the reservoir, said body and cylindrical portion having a pair of connected bores 46 and 48 therein. A ball check valve 50 is received in the bore 46 and normally gravitationally or pressure responsive seats over the bore 48 and is restrained from movement out of the bore 46 by a perforated plate 52 mounted in the upper body portion 42 of the valve assembly. The cylindrical portion 44 of the valve assembly provides by way of the bore 48 therein passage means for the flow of fluid from the reservoir to the bore 22 controlled as by ball check valve 50 seated thereover.

A plunger assembly 54 received by the bore 22 and reciprocable in the open end thereof is biased from the valve assembly by a spring 56 inter-

posed between the valve assembly and plunger assembly, the spring assisting in holding the valve assembly in sealing position on the shoulder 34 and extending the plunger to its maximum position as defined by a snap ring 58 fitted in bore 22 inhibiting the movement of the plunger from the bore.

The plunger assembly 54 comprises opposed hollow cylindrical elements 60 and 62 each closed at one end thereof, constituting the means for compensating for out-of-true cam surfaces and prevention of valve gear vibration transmission having limited relative movement determined by an annular member 64 embracing adjacent ends of the elements, said elements being biased by a spring 66 interposed between the elements. The annular member 64 is in the form of a split channel member having the respective legs 68 and 70 of the channel received in suitable grooves 72 and 74 in the respective cylinder elements 60 and 62. The cylindrical element 62 has passage 76 through the closed end thereof providing communication between the hydraulic supply port 38 and push rod socket 78 by way of annular groove 81 communicating with ports 80 in the wall of the cylindrical element 62 and ports 82 in the wall of the tappet body 18 thereby providing lubrication for the push rod, not shown.

Figure 3 illustrates the initial normal relative positions of cylinders 60 and 62 spaced apart a distance represented by the numeral 84 providing the margin of allowable compensation for out-of-true surfaces of the valve operating cam.

The hydraulic compensating mechanism of this tappet construction is adapted to compensate for inequalities in the length of operating parts of the valve actuating mechanism due to the expansion and contraction of the parts during various operating conditions of an internal combustion engine.

In a normal operation of the tappet especially with regards to a horizontal installation, as shown by Figure 2, upon rotation of the camshaft and cam with the roller 24 contacting the dwell portion of the cam, the tappet body moves toward the axis of the cam shaft under the influence of a valve spring, not shown. When the pressure exerted by the valve spring ceases, the coil spring 56 will urge the plunger assembly outwardly and maintain its contact with the valve stem push rod. This outward movement of the plunger will reduce the pressure in the compression chamber between the valve assembly 40 and plunger assembly 54 thus producing a vacuum therein, thereby permitting the ball 50 to move off its seat and thus admit hydraulic medium under a relatively greater pressure in the reservoir to flow through bore 48 past ball 50 into the compression chamber. Upon further rotation of the cam to move the tappet away from the axis of the camshaft, the ball will immediately be pressed to its seat trapping the hydraulic medium in the compression chamber thus providing a substantially incompressible hydraulic column and maintain the plunger assembly in firm contact with the push rod during the valve opening cycle of the entire stroke of the tappet. The pressure of the hydraulic medium in the compression chamber normally will cause a slight leakage of the hydraulic medium outward between the inner wall of bore 22 and the plunger, and the fluid so lost will be replaced as a cycle of operation is repeated and the pressure of the push rod upon the plunger is relieved when the tappet rides upon the base circle of the cam

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and permits the spring 56 to force the plunger outwardly thus permitting the ball to rise from its seat and admit more hydraulic medium into the compression chamber.

Inasmuch as it is inevitable that some air or compressible gas will be entrained in the hydraulic medium pumped into the reservoir of the hydraulic tappet and the fact that the air or gas tends to rise in the reservoir, the openings 30 and 32 provide escape means for the air rising in the reservoir, said air passing out through the openings and out between the exterior wall of the tappet body and the tappet guide bore. In the horizontal installed position of the tappet, as shown by Figure 2, both openings 30 and 32 assist simultaneously in freeing the reservoir of air or gas. For other installed positions of the tappet between the inverted and upright positions thereof, either the openings 30 or 32 will act as the primary source of air escape from the reservoir depending on which opening assumes the highest level to which the air or gas may rise in the reservoir. Because of the masked positions of the openings 30 or 32 the material loss of hydraulic medium employed is restricted but at the same time passage is provided for the lighter more easily escapable air.

Because of the compensatory clearance provided between cylinders 60 and 62, any irregularity in the surface of the cam will be automatically compensated for without disturbing the operation of the valve with which the tappet is adapted to be associated.

Furthermore during the operation of the engine and the consequent operation of the lubricating system and tappet hydraulic medium is supplied directly from supply line 38 through ports 82 groove communicated ports 82 and passage 76 to the push rod sockets 78 providing for continuous effective lubrication of the push rod during the operation thereof.

While this invention has been described in connection with certain specific embodiments, the principle involved is susceptible of numerous other applications that will readily occur to persons skilled in the art. The invention is, therefore, limited only as indicated by the scope of the appended claims.

What I claim is:

1. In a hydraulic tappet, a tappet body having a longitudinal bore closed at one end and opened at the other end, the closed end portion of said body providing a hydraulic fluid reservoir having a set of a plurality of circumferentially spaced openings at opposite extremities thereof, a tappet guide receiving the tappet body for reciprocation therein, and a hydraulic compensating mechanism receivable in the open end of the bore, said tappet guide masking the openings into the reservoir one set continually and the other set periodically regularly upon plunger reciprocation in the tappet body.

2. In combination with a valve operating cam, a tappet comprising a tappet body provided with a longitudinal body closed at one end and opened at the other, hydraulic compensating mechanism including a two-part plunger reciprocably mounted in said body, valve means for admitting and trapping liquid medium within the tappet body so as to extend said plunger outwardly relative to the tappet body, spring means interposed between the plunger and valve means biasing the plunger outwardly with respect to said tappet body, means biasing the two parts of the plunger axially relative to one another and yieldable to

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compensate for out-of-true working surfaces of the valve operating cam and other means limiting the biasing of the two parts from one another.

3. In a hydraulic tappet, a tappet body having a longitudinal bore closed at one end and opened at the other end, providing a fluid reservoir adjacent the closed end of the body, a plunger reciprocable in the open end of the bore, valve means in the bore for admitting and trapping a liquid medium between the plunger and valve means, said tappet body having a set of circumferentially spaced openings through the wall thereof at one extremity of the reservoir and another set of circumferentially spaced openings at the other extremity of the reservoir providing for deaerating the hydraulic medium in the chamber for any position of installation and operation of the tappet.

4. A hydraulic tappet comprising a tappet body having a longitudinal bore closed at one end and opened at the other end providing a hydraulic reservoir adjacent the closed end of the bore, a valve assembly mounted between the reservoir and open end of the bore controlling communication therebetween, a plunger reciprocable in the open end of the bore, a spring interposed between the plunger and valve assembly, and circumferentially spaced air bleed means for the reservoir adjacent the extremities of the reservoir, said air bleed means being operable simultaneously for certain positions of operation of the tappet and independently in other positions of operation.

5. A compensating valve lifter for reciprocable operation in a surrounding guide bushing comprising, a cylinder having an axial bore divided into a hydraulic receptacle at one closed end and a hydraulic compression chamber at one open end, a plunger reciprocable in the compression chamber, a valve means for controlling the compression chamber and hydraulic reservoir and means incorporated in the plunger providing for reduction in the over-all length thereof upon reciprocation of the valve lifter comprising a two piece plunger normally axially biased apart by spring means interposed therebetween and means limiting the axial biasing thereof, said tappet body having two sets of circumferentially spaced openings therethrough communicating respectively with the opposite ends of the hydraulic receptacle substantially continually masked by the tappet guide providing for deaerating the hydraulic medium carried by the hydraulic receptacle for upright, inverted, horizontal, and all other installed operating positions of the tappet.

6. A hydraulic tappet reciprocable in a tappet guide member comprising, a tappet body having an axial bore divided into a hydraulic reservoir at one closed end and a hydraulic compression chamber at an open end, a plunger reciprocable in the compression chamber, a valve means for controlling a communication between the compression chamber and hydraulic reservoir, and means incorporated in the plunger for compensating for the out-of-true working surfaces of a valve operating cam associated with the tappet comprising a two piece plunger normally axially biased apart by spring means interposed therebetween and means limiting the axial biasing thereof, said tappet body having two sets of circumferentially spaced openings therethrough masked by the tappet guide for substantially all operating positions of the tappet in constant direct communication respectively with the opposite ends of the reservoir providing for deaerating the hydraulic medium carried by the reservoir for up-right, in-

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verted, horizontal, and all other installed operating positions of the tappet.

7. A hydraulic tappet reciprocable in a tappet guide comprising a tappet body having an axial bore divided into a hydraulic reservoir closed at one end and a hydraulic compression chamber at one open end thereof, a plunger reciprocable in the compression chamber, and a valve means for controlling the communication between the compression chamber and hydraulic reservoir comprising a valve body including an axial portion subtended in the hydraulic reservoir and having an opening therethrough controlled by a movable valve element, said tappet body having two sets of circumferential spaced openings communicating respectively with the opposite ends of the reservoir at points axially removed from the hydraulic inlet in the subtended portion of the valve means, one set of openings being continually masked by the tappet guide and the other set being masked during a greater portion of the operational movement of the tappet in the guide.

8. A hydraulic tappet, adapted to be located between a cam on an engine cam shaft and the end of the stem of a spring closed poppet valve having a barrel, a piston in the outer end of the barrel, spring means to move the piston outwardly, means for supplying liquid to and trapping it against its return located at the inner end of the piston, a member carried at the outer end of the piston against which the inner end of said valve stem is adapted to bear, said member normally being spaced from the piston a preselected distance when the valve connected with said valve stem is closed, and movable toward the piston when said valve is moved from its seat and having associated yielding resistance means of less strength than the engine valve spring, and of

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greater strength than the spring means lifting said piston.

9. A hydraulic tappet, adapted to be placed between a cam on an engine cam shaft and the end of a spring closed poppet valve, having a barrel, a piston in the outer end of the barrel, spring means to move the piston outwardly, means for supplying liquid to and trapping it against its return located at the inner end of the piston, a spring affected member carried by said piston at its outer portion against which the inner end of said poppet valve is adapted to bear, said spring affected member carried by said piston having a preselected range of movement whereby the outer end of the piston and the end of the valve may be at variable distances from each other within such range of movement, and resisting such movement with a force greater than the strength of said spring means for moving the piston and less than the strength of the valve closing spring.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,792,836	Handwerker	Feb. 17, 1931
1,798,938	Hallett	Mar. 31, 1931
1,977,778	Rice	Oct. 23, 1934
2,119,096	Buckley	May 31, 1938
2,145,484	Johnson	Jan. 31, 1939
2,175,466	Johnson	Oct. 10, 1939
2,203,952	Eshbaugh	June 11, 1943
2,325,932	Banker	Aug. 3, 1943
2,376,182	Peterson, Jr.	May 15, 1945
2,386,317	Jenny et al.	Oct. 9, 1945