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LASH ADJUSTING DEVICE

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Fig. 1

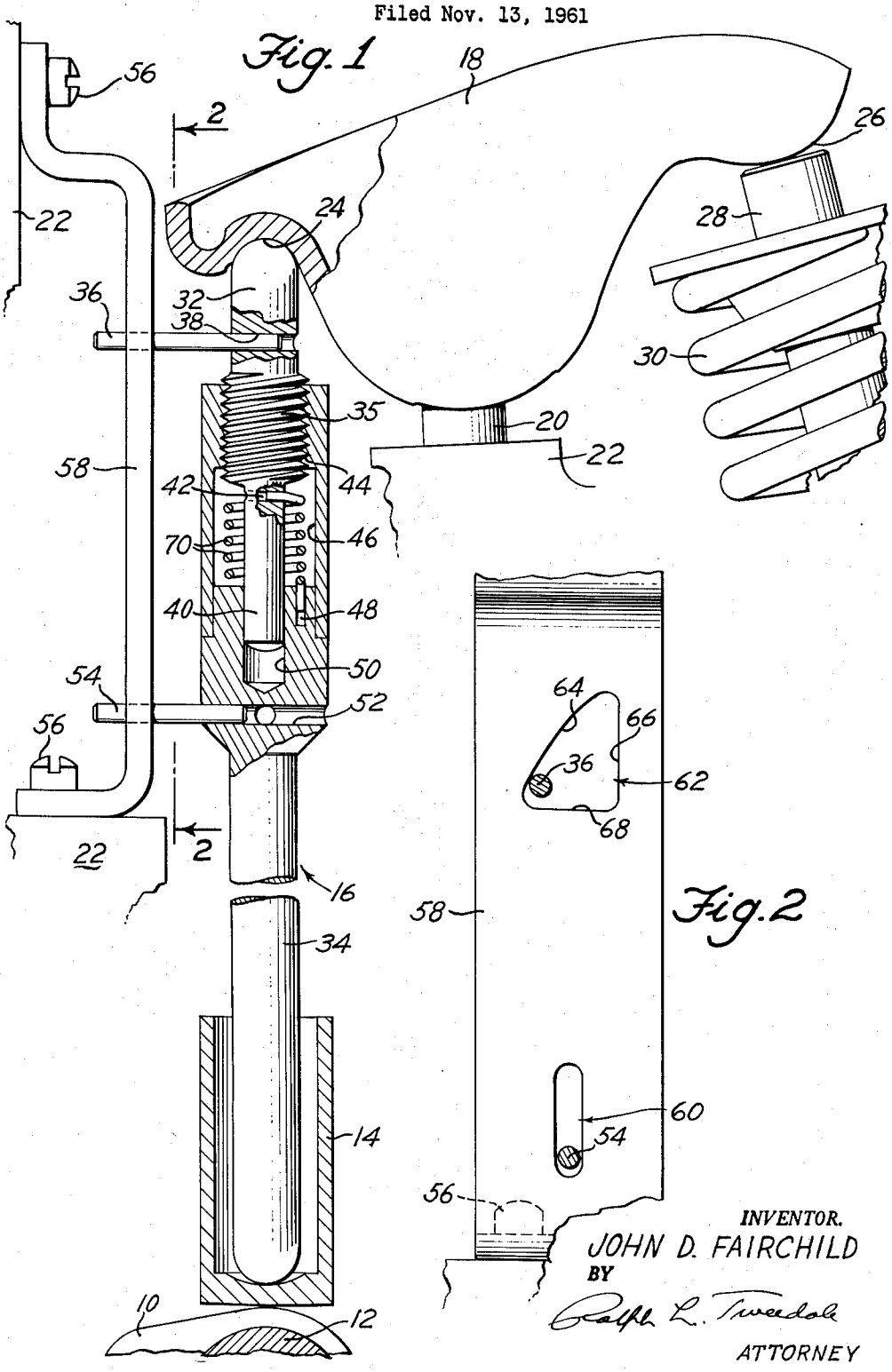


Fig. 2

INVENTOR.
JOHN D. FAIRCHILD
BY
Ralph L. Tweedale
ATTORNEY

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LASH ADJUSTING DEVICE

John D. Fairchild, Ferndale, Mich., assignor to Earl A. Thompson Manufacturing Company, a corporation of Michigan

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This invention relates to mechanical lash adjusting systems for engine valve actuating trains, and more particularly to a type of spring loaded lash adjuster wherein potential lash is deliberately introduced into the valve train by fully compulsive means which is extremely simple and rugged and which is not adversely affected by inertia conditions during engine operation.

Recent developments in the mechanical lash adjuster field for modern automotive engines have taught the desirability of providing a force-multiplying mechanism of the annular or rotary wedge variety having an inherently self-locking angle considerably below the critical friction angle. This mechanism is shifted in a direction to introduce potential lash while the valve is unseated to insure positive, firm seating of the valve; it is then biased in the opposite direction to wipe out such potential lash while the valve is seated to insure quiet operation and full lift on the following unseating stroke. Furthermore, because of the diverse operating conditions of modern automotive engines which render the niceties of critical friction requirements wholly unreliable, the means for shifting the wedge device in the direction of increased lash while the train is loaded must constitute a positive one-way drive including a fully compulsive reaction connection as well as a positive driving connection. For truly successful use in mass production high speed engines, moreover, such positive driving means must be extremely simple for both economic and maintenance reasons as well as being free from adverse influence by inertia forces which change with engine speeds.

Accordingly, it is an object of the present invention to provide a lash adjusting device including a purely one-way abutment drive arrangement for a self-locking rotary wedge which is positive in action because of compulsive driving and reaction connections and absence of critical frictional balances, is extremely simple of structure involving relatively few moving parts, and is designed to minimize adverse influences produced by changing inertia forces.

A more particular object of the present invention is to provide an adjustable push rod comprising a screw member and a nut member threaded together by self-locking threads wherein one of the members is compulsively threaded in the direction of increased lash on the valve opening stroke and biased in the direction of decreased lash after the valve seats.

Further objects and advantages of the present invention will be apparent from the following detailed description, with reference to the accompanying drawings in which like reference characters refer to the same parts throughout the several views, and in which:

FIGURE 1 is an elevational view with parts in section showing a valve actuating train including the lash adjusting mechanism of this invention; and

FIGURE 2 is a sectional view on line 2—2 of FIGURE 1 showing the reaction connection for one of the adjusting members and the one-way drive connection or abutment means for the other of the adjusting members.

Referring in more particularity to the drawings, a conventional valve train is shown comprising a cam 10 rotated by a shaft 12 to actuate a rotatable cam follower or tappet 14 which in turn reciprocates a push rod arrangement 16. A rocker arm 18 fulcrumed about a semi-spherical pivot (not shown) on an upright stud 20 fixed in the engine 22 serves, by means of a push rod abutment 24 at one end thereof, to transfer push rod motion, by means of a valve stem abutment 26 at the other end thereof, to the stem of a conventional valve 28 which is biased upwardly against its seat, not shown, by means of a valve seating spring 30. Semi-permanent adjustments in the effective length of such a valve actuating train may be effected by raising or lowering the fulcrum of the rocker arm.

The push rod arrangement 16 embodies the lash adjusting device of this invention and operates by controlling the relative shifting between a pair of adjusting members. Such a push rod may comprise a screw member 32 cooperating with the push rod abutment 24 of the rocker arm 18, and a nut member 34 cooperating with the tappet 14.

The screw member 32 may include multiple flight threads 35 of an inherently self-locking helix angle spiralled around its mid-section. Above the threaded zone, an operating abutment such as a radius arm 36 may be press fitted into a radial hole 38 in the screw member. Below the threaded zone, the screw member 32 may include a cylindrical portion 40 co-axial with the threads and of reduced diameter which acts as a centering boss. Another radial hole 42 in the screw member may be provided to receive one end of a lash take-up spring, explained below.

The nut member 34 may comprise internal threads 44 on its upper end mating with the threads 35 of a screw member. Below the threads 44, the nut member may form a cylindrical cavity 46, the bottom wall of which may contain a hole 48 to receive the other end of a lash take-up spring, explained below. Co-axial with the threads 44, a cylindrical centering aperture 50 may also be provided in the nut member extending from the lower end of the chamber 46 to receive the centering boss 40 of the screw member to help maintain the screw and nut members in axial alignment. A plurality of alternate radial holes 52 may be provided in the nut member 34, any one of which may lockingly receive a pin or radius arm 54 which cooperates at its outer end with the engine to prevent rotation of the nut portion of the push rod.

Rigidly secured by fasteners 56 to the engine 22 is a guide plate 58 containing a pair of apertures 60, 62 to receive the arms 54, 36, respectively, to control the relative position of the screw and nut member as the push rod reciprocates up and down. The lower aperture 60 may comprise a vertical slot having a width only slightly greater than the diameter of the rotation preventing pin 54 associated with the nut member 34, and having a length somewhat greater than the overall up and down travel of the push rod arrangement 16. The upper aperture 62 may comprise an abutment including a diagonal cam wall 64 designed to swing the operating arm 36 associated with the screw member 32 through a predetermined amount of angular motion. The opposite or non-camming edge of the upper aperture is cut away to provide a vertical wall

66 and a horizontal wall 68. The triangular aperture left by these walls provides room for the abutment arm 36 to travel directly downwardly with the push rod on the valve seating or closing stroke without interference.

A coiled torsion or lash take-up spring 70 may be located in the chamber 46 of the nut member 34 with its upper end anchored in the hold 42 in the screw member and its lower end anchored in the hole 48 of the nut member. The spring is designed to bias the screw and nut members apart in a threading direction which serves to lengthen the push rod; that is, in the direction of decreased lash. Furthermore, this spring is too weak to so bias the members when the valve train is loaded by the force of the valve seating spring 30, but may become operative to rotate the adjusting member 32 relative to the adjusting member 34 after the valve has seated.

In operation, with the parts positioned as shown in the drawings, upward travel of the push rod on the valve opening stroke will bring the abutment or operating arm 36 associated with the adjusting member 32 into contact with the stationary abutment or camming wall 64 of the aperture 62. As the push rod continues its upward motion, the arm abutment 36 in contact with the cam abutment 64 will thread the screw member into the nut member in the direction of increased lash (that is, shorten the push rod) to introduce an increment of potential lash into the valve actuating train. During this (and, in fact, the entire) cycle the nut member is positively restrained from rotating by the arm 54 in the slot 60. As the cam passes its peak and the valve closing stroke begins, the self-locking character of the threads holds the adjusting members 32, 34 against relative rotation, which retains the increment of potential lash in the train to insure proper seating of the valve. This self-locking action also causes the operating abutment 36 to move downwardly parallel with the wall 66 without any relative rotary motion. As the valve comes to its seat, and the actuating train is relieved of the load force of the valve seating spring, a little more return travel of the operating train remains due to the lash introduced on the valve opening stroke. At this point, the lash take-up spring 70 operates to drive the screw adjusting member 32 with an unthreading motion to lengthen the push rod and wipe out any increment of potential lash in the train as fast as the receding cam contour permits. This swings the operating arm 36 generally horizontally back away from the wall 66 and part way toward the wall 64. On the next valve opening stroke, the arm moves upwardly in a straight line for the first portion of the cycle until it engages the wall 64 at a mid-point thereof, whereupon the driving relation so established again rotates the screw member 32 to introduce an increment of potential lash to insure proper valve seating.

Thus, a lash adjusting device has been disclosed which serves, by means of a single pair of positive acting abutments forming a fully compulsive driving connection and the rectilinear slot and pin forming a fully compulsive reaction connection, to shift an inherently self-locking rotary wedge through a variable distance to introduce a corresponding amount of potential lash into the train. This is done during the last portion of each valve opening stroke, such lash being retained on the valve closing stroke by a self-locking character of the wedge or force-multiplying mechanism until the valve seats, at which point the lash take-up spring operates to increase the effective length of the train as fast as the receding cam contour permits. The amount of potential lash removed by this spring during normal "warmed-up" operation will shift the force-multiplying mechanism through only part of the available lash eliminating distance, thus only a corresponding increment of potential lash will be introduced by the one-way drive abutments on the next opening stroke. Thus, the increment or amount of potential lash will vary with the lengths of the parts relative to each other and to the engine. Enough extra travel of the force-multiplying mechanism may be provided to compensate for wear of the parts.

Furthermore, the extreme simplicity of the device renders it available for mass production purposes, and the placement of the parts, particularly of the force-multiplying mechanism including its operating abutment, minimizes adverse influences caused by momentum and inertia forces during high speed engine operation.

While the above described embodiment constitutes a preferred mode of carrying out this invention, many other forms might be adopted within the scope of the actual invention, which is variously claimed as:

1. A lash adjusting system of the mechanical type for a valve operating train of an engine comprising in combination therewith

a pair of co-axially positioned and relatively rotatable adjusting members having a screw thread connection with one another,

one of the adjusting members being secured against rotation relative to the other in a direction which would vary the effective length of the train and the other adjusting member being rotatable in one direction and return through a limited stroke to decrease and increase, respectively, the effective length of the train by a predetermined amount,

a single pair of one-way drive abutments movable toward and away from one another between spaced and engaged relationships in response to valve opening and valve closing motion of the train, respectively, one of the abutments being associated with the other adjusting member and the other abutment being located to engage the one abutment part way through the valve opening motion of the train and thereafter compulsively rotate the other adjusting member in the one direction from a mid-stroke position through the distance required to reach the limit of its stroke to create a corresponding amount of potential lash in the train,

the screw thread helix angle being inherently self-locking against the force of valve train load to retain such amount of potential lash in the train during valve closing motion of the train as the abutments disengage and move away from one another,

and a lash take-up spring having insufficient force to rotate the other adjusting member while the train is loaded and connected to rotate the other adjusting member in the return direction away from its stroke limit to a mid-stroke position through the distance required to remove actual lash from the train as the load on the train is relieved by seating of the valve.

2. A lash adjusting system of the mechanical type for a valve operating train of an engine comprising in combination therewith

an adjustable push rod including

a screw member and a nut member threaded together to form a pair of adjusting members,

one of the adjusting members being secured against rotation relative to the other in a direction which would vary the effective length of the train and the other adjusting member being rotatable in one direction and return through a limited stroke to decrease and increase, respectively, the effective length of the train by a predetermined amount,

a single pair of one-way drive abutments movable toward and away from one another between spaced and engaged relationships in response to valve opening and valve closing motion of the train, respectively, one of the abutments being associated with the other adjusting member and the other abutment being located on the engine to engage the one abutment part way through the valve opening motion of the train and thereafter compulsively rotate the

other adjusting member in the one direction from a mid-stroke position through the distance required to reach the limit of its stroke to create a corresponding amount of potential lash in the train,

the screw thread helix angle being inherently self-locking against the force of valve train load to retain such amount of potential lash in the train during valve closing motion of the train as the abutments disengage and move away from one another,

and a lash take-up spring having insufficient force to rotate the other adjusting member while the train is loaded and connected to rotate the other adjusting member in the return direction away from its stroke limit to a mid-stroke position through the distance required to remove actual lash from the train as the load on the train is relieved by seating of the valve.

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