Sept. 1, 1964 J. D. FAIRCHILD 3,146,766

RELEASING CLUTCH FOR LASH ADJUSTER

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Fig. 1

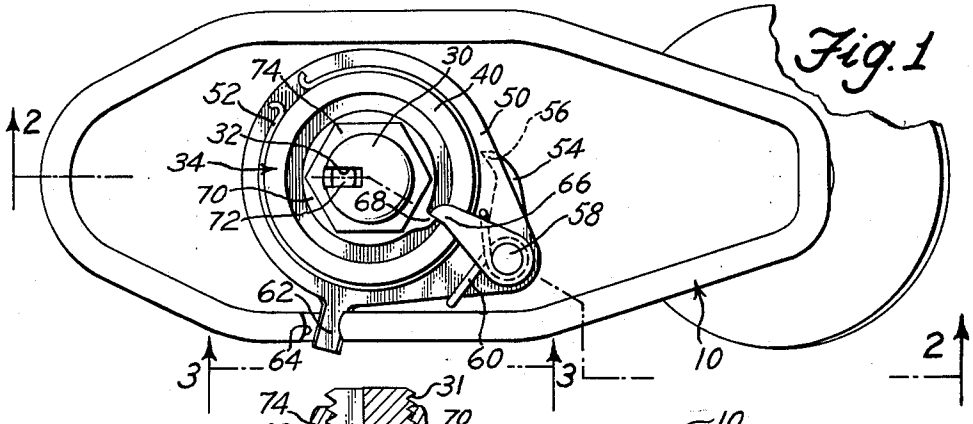


Fig. 2

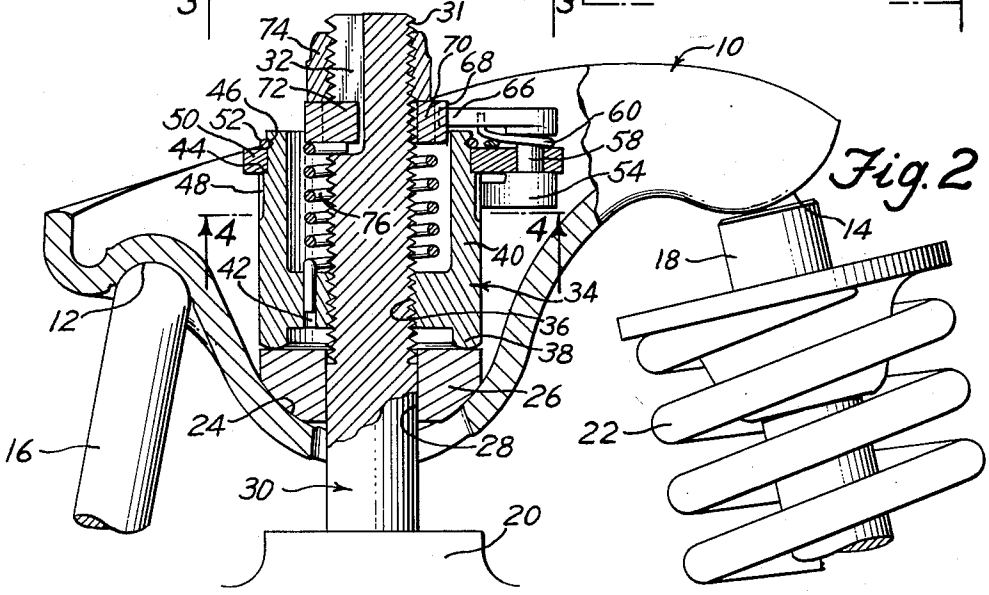


Fig. 3

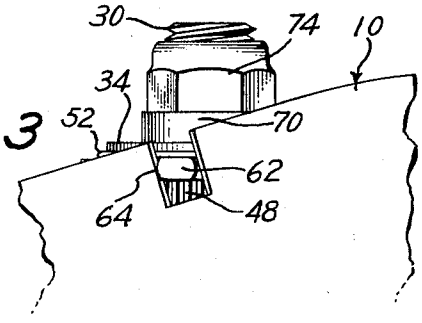
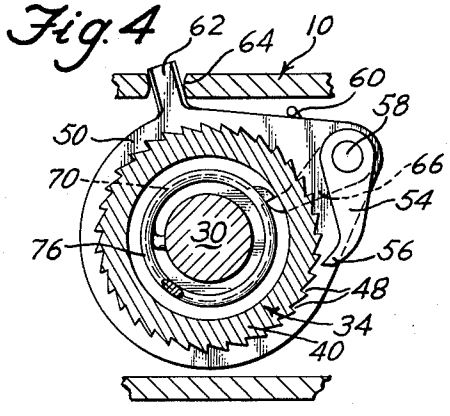


Fig. 4



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RELEASING CLUTCH FOR LASH ADJUSTER

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This invention relates to lash adjusting systems, and more particularly to mechanically actuated lash adjusters for the valve operating trains of internal combustion engines.

Prior successful lash adjusters, such as disclosed in Patent 3,087,475 issued April 30, 1963, have utilized a shiftable force-multiplying mechanism of the class embracing wedges, screws, eccentrics and the like with a self-locking angle; that is, an angle considerably below the critical friction angle which will be inherently non-slipping under the force of valve train load. This force-multiplying mechanism is shifted in a direction to decrease lash in the train by a spring or the like which has insufficient force to operate the mechanism while the train is loaded but will function after the valve is properly seated on each cycle to remove all actual lash from the train thus insuring full lift and silent operation on the following unseating stroke. To insure proper seating of the valve, however, additional means are provided to shift the force-multiplying mechanism in a direction opposite to the spring bias while the valve is unseated to introduce an increment of potential lash into the train. Moreover, the means for shifting the force-multiplying mechanism must act positively through both a fully compulsive driving connection as well as a fully compulsive reaction connection devoid of critical frictional requirements to insure successful operation under the diverse operating conditions imposed by modern high-speed automotive engines. Additionally, it will be obvious that the one-way drive means for shifting the mechanism to introduce lash must completely disengage the mechanism prior to valve seating to permit the lash take-up spring to act.

The ideal means for shifting the force-multiplying mechanism to introduce lash during valve operation is extremely simple of structure, yet is of such a design as to algebraically add the same increment of potential lash each cycle. This is desirable to assure uniform lift of the valve on each cycle as well as to compensate for large temperature, wear and other tolerances in the actual length of the valve train. By adjusting the datum point each time the valve seats with the lash take-up spring acting to the extent allowed by the actual length of the parts, the one-way drive may then decrease the effective length of the train by the same amount each cycle to quickly compensate for large dimensional changes.

A successful method of accomplishing the desired results may be performed by a one-way clutch shiftable to-and-fro by the motion of the valve train itself, a separate clutch releasing mechanism becoming operative prior to valve seating to permit the lash take-up spring to function through an established reaction connection as the load on the train is relieved, all as taught by the above mentioned patent. This, however, until the present invention, required fairly complex structure which for economic and maintenance reasons was not ideally suited to mass production use.

Accordingly, it is an object of the present invention to provide a simplified and improved one-way clutch for shifting a spring loaded, self-locking force-multiplying mechanism in the direction of increased lash during valve operation, which clutch operates through fully compulsive driving and reaction connections and includes means for completely disengaging the mechanism prior to valve seating so that the lash take-up spring may function.

Another object of the present invention is to provide a one-way releasing clutch for a mechanical lash adjusting system which utilizes the positive abutment features of a toothed ratchet mechanism instead of the friction wedging devices often employed in one-way clutches.

Other 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 a plan view of a valve train rocker arm and its fulcrum embodying the lash adjuster of this invention;

FIGURE 2 is a sectional elevational view on line 2—2 of FIGURE 1 showing details of the adjustable fulcrum;

FIGURE 3 is a fragmentary view on line 3—3 of FIGURE 1 showing the means for driving the clutch operating member in response to the valve train motion; and

FIGURE 4 is a sectional view on line 4—4 of FIGURE 2 showing the one-way pawl and ratchet clutch of the lash adjuster of this invention.

Referring in more particularly to the drawings, this invention is illustrated in association with valve trains of the type which involve an individually fulcrumed rocker arm. A trough-shaped or dished arm **10** includes means forming a push rod abutment **12** at one end thereof and a valve stem abutment **14** at the other end thereof which cooperate with a push rod **16** and a valve stem **18**, respectively. The push rod **16** is reciprocated up and down by means of a rotary cam, not shown, journalled in the engine **20**. The stem **18** of the valve is biased upwardly to seat the head of the valve, not shown, in the engine **20** by means of a heavy valve seating spring **22**. The rocker arm **10** further includes means forming an apertured, upwardly facing, semi-spherical fulcrum surface **24** intermediate its ends about which motion is transferred between the push rod **16** and the valve stem **18**.

The rocker arm may oscillate about a downwardly facing, semi-spherical fulcrum surface on a fulcrum member **26** having a central aperture **28** which forms a working fit with a stud **30** also extending through the apertured rocker arm fulcrum surface and fixably mounted in the engine **20**. By upward or downward translation of the fulcrum member **26** on the stud **30**, the effective length of the valve actuating train may thus be varied to increase or decrease the amount of lash therein.

For controlling the position of the fulcrum **26** on the stud **30**, an automatic mechanical lash adjusting mechanism is provided. The stud **30** itself may comprise an adjusting member having right-hand threads **31** thereon which may be of the multiple flight variety to obtain maximum lateral translation for a given amount of angular shifting; however, the slope of the thread helix angle is significantly below the critical friction angle to render such threads inherently self-locking against the upward thrust or force of the valve train when loaded by the valve seating spring **22**. A radial slot or keyway **32** may be provided in the upper portion of the rotationally oriented stud **30** to receive one end of a lash take-up spring, described below, as well as the register key of a fixed abutment member, also described below.

A second adjusting member **34** may take the form of a nut having internal threads **36** engaged with the threads **31** on the stud **30**. The nut adjusting member **34** may conveniently take the shape of a cup having a depending rim **38** around its bottom in rotationally abutting contact with the upper surface of the fulcrum member **26**. The upstanding wall **40** of the cup may be spaced from the stud **30** to form an annular cavity for housing a coiled lash take-up spring, described below; the bottom or web portion of the nut may include a hole **42** to receive the

other end of a lash take-up spring, described below. An external shoulder 44 around the upper portion of the wall 40 may cooperate with a snap ring groove 46 therearound to position a clutch operating member, described below. A ring of one-way ratchet teeth 48 may be formed around the outside of the wall 40 immediately below the shoulder 44.

An operating member 50 for automatically controlling the rotational position of the nut 34 may be fitted for free rotation about the upper portion of the wall thereof and may be held in guiding proximity to the shoulder 44 by means of a snap ring 52 in the snap ring groove 46. The operating member 50 may carry a pawl 54, having a point 56 engageable with the teeth of the ratchet 48, which may be pivoted at 58 and biased by a spring 60 into engagement with the ratchet. It will be understood that as the operating member 50 is rotated in one direction (counterclockwise in FIGURE 1, clockwise in FIGURE 4) the point 56 of the pawl will engage the ratchet 48 and rotate the nut 34 to produce upward translation of the rocker arm fulcrum 26 in the direction of increased lash; and, as the operating member 50 oscillates back in the opposite direction the point 56 of the pawl rides over the inclined face of the ratchet teeth against the bias of the spring 60 and delivers no appreciable torque force to the nut 34.

To control oscillation of the operating member 50, means including a laterally extending ear 62 thereon may be provided to engage with a generally vertical slot 64 in one side wall of the rocker arm 10. The usual points of contact between the arm 62 and the wall slot or shoulder 64 are significantly above the fulcrum center for the rocker arm, thus rocking motion of the arm 10 about its fulcrum in a vertical plane serves to control oscillation of the operating member 50 to and fro in a horizontal plane.

Means are also provided by this invention for completely disengaging the one-way ratchet clutch on each valve actuating cycle after it has rotated the adjusting member 34 in the direction of increased lash. Such a means may comprise a camming abutment arrangement including an abutment arm 66 connected to the pivot 58 in fixed relation to the pawl 54, and an abutment 68 fixed on the engine 20. During the final portion of return oscillation of the operating member 50, these abutments engage to swing the pawl 54 against the spring 60 until the point 56 thereof is disengaged from the ratchet 48. The abutment 68 may be formed on a cylindrical member 70 received on the stud 30 and having a radially inwardly extending register ear 72 keyed in the slot 32 of the stud. A self-locking nut 74 may be provided to secure the abutment member 70 on the stud.

For rotating the adjusting member 34 in the direction of decreased lash, a lash take-up spring 76 may be provided. This may be a coiled spring having axial dimensionally flexibility housed within the wall 40 of the cup and having its lower end anchored in the hole 42 in the cup bottom, and its upper end positioned in the slot 32 of the stud and held against the bottom end thereof by the nut 74 acting through the abutment member 70. This spring is of insufficient force to rotate the member 34 in relation to the threaded stud 30 while the valve train is under valve spring load; however, it is strong enough to operate the nut 34 when the valve is seated in a direction to drive the fulcrum member 26 downwardly.

In operation, the lash adjuster of this invention operates once on each cycle of the valve to introduce an increment of potential lash into the operating train while the train is loaded to insure proper seating of the valve; and, after the valve is seated, it operates to wipe out any lash in the train to insure full lift and quiet operation on the following cycle. With the parts at rest and the valve in the closed position, as shown in the drawings, the operating member 50 will be oscillated by the slot 64 in the rocker arm wall around to its rest position where the abutment 68 swings the radius arm 66 to disengage the pawl and the ratchet. With the pawl and ratchet thus disengaged, and the load of the valve seating spring 22 relieved by seating of the valve, the lash take-up spring 76 is operative to bias the adjusting member 34 in the direction to thread it downwardly in relation to the adjusting member 30 fixed in the engine to wipe out any lash in the train.

As a valve actuating cycle begins, the push rod 16 moves upwardly to rock the arm 10 about its fulcrum and overcome the force of the valve spring 22 to unseat the valve. Such rocking motion of the arm 10 oscillates the shoulder 64 of the rocker arm which, by means of the operating ear 62, oscillates the operating member 50. The initial oscillatory motion of the member 50 produces angular motion between the pawl pivot 58 and the fixed abutment 68 which permits the point 56 of the pawl to swing inwardly and operatively engage the ratchet 48.

Continued oscillatory motion of the operating member 50 in this direction then drives the adjusting member 34 in an unthreading direction in relation to the adjusting member 30 which allows the fulcrum member 26 to translate upwardly on the stud 30 in the direction of increased lash until the push rod is at the top of its stroke. This introduces an increment of potential lash into the train of similar magnitude on every valve opening cycle of the engine.

During the valve closing cycle, arm 10 rocks back in the opposite direction about its fulcrum thus causing the slot 64, by means of the operating ear 62, to oscillate the operating member 50 back in the other direction. In this direction, the pawl 54 is ineffective to rotate the adjusting member 34, the point thereof riding over the inclined faces of the ratchet teeth against the pawl spring 60. The increment of potential lash introduced on the valve opening stroke is thus retained in the operating train during the valve closing stroke by means of the self-locking character of the threaded connection between the nut adjusting member 34 and the fixed screw adjusting member 30.

Just prior to valve seating on the valve closing stroke, the oscillating member 50 will swing the pawl pivot 58 to the angular position where the arm 66 engages the abutment 68. Further oscillatory motion of the operating member in this direction swings the point 56 of the pawl out of operative engagement with the ratchet 48, thus freeing the adjusting member 34 for later operation by the lash take-up spring.

As the valve seats, a little more return motion of the actuating train remains because of the increment of potential lash introduced on the valve opening stroke. At this point, the lash take-up spring 76 becomes effective since the pawl and ratchet have been disengaged and the load of the valve spring on the train has been relieved. The spring 76 serves to bias the adjusting member 34 in relation to the fixed adjusting member 30 in a threading direction which translates the fulcrum 26 downwardly in the direction of decreased lash to remove lash from the train as fast as the receding cam contour will permit.

As the cam presents its base circle to the actuating train, all lash will have been removed by the take-up spring 76, and the system will come to rest with the valve fully and properly seated yet without any lash in the actuating mechanism.

It is desirable to provide a sufficiently large arc of travel of the operating member 50 and a large enough number of teeth on the ratchet 48 so that the pawl 54 will, on its return stroke, ride idly over several teeth thus minimizing the extent of any initial idle stroke of the pawl before engaging a tooth to drive.

Thus, an extremely simplified releasing clutch for lash adjusters has been disclosed which introduces the same predetermined increment of potential lash into the train on each valve opening stroke and is completely released prior to valve seating so that a lash take-up spring may operate when the load on the train is relieved. Further-

more, the ratchet and pawl engagement is of a positive nature suitable for use in the rugged environmental conditions encountered in modern high speed automotive engines.

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. In a mechanical lash adjusting system for an engine valve operating train of the type including a pair of relatively shiftable adjusting members having an inherently self-locking force-multiplying engagement with one another wherein one member is fixed against shifting relative to the other in a direction which would vary the effective length of the train and the other member is biased in the direction of decreased lash only when the load on the train is relieved, the combination comprising a positive one-way drive including a shiftable operating member, a movable pawl and a one-way ratchet, one on the operating member and the other on the other adjusting member, means urging the pawl and ratchet into operative engagement, means connected to shift the operating member to-and-fro in response to motion of the valve train to introduce an increment of potential lash into the train while the valve is unseated, and means connected to move the pawl and ratchet out of operative engagement after the increment of potential lash has been introduced and before the valve seats so that the other adjusting member may be biased in the direction of decreased lash when the valve is seated.

2. In a mechanical lash adjusting system for an engine valve operating train the combination comprising a pair of adjusting members having a screw thread connection with one another embodying a self-locking helix angle, yieldable biasing means connected to rotate one member relative to the other in the direction of decreased lash when the load on the train is relieved, means securing the other member against relative rotation, and one-way drive means connected to rotate the one member in the direction of increased lash while the train is under load including an operating member oscillatable co-axially with the one adjusting member, a pivoted pawl and a one-way ratchet, one on the operating member and the other on the one adjusting member, a spring connected to urge the pawl and ratchet into operative engagement, means connected to oscillate the operating member to-and-fro in response to motion of the valve train to thread the one adjusting member in the direction of increased lash, and camming means positioned to swing the pawl and ratchet out of operative engagement immediately prior to valve seating so that the yieldable biasing means may become operative when the load on the train is relieved.

3. In a mechanical lash adjusting system for an engine valve operating train the combination comprising a fulcrum, a rocker arm oscillatable about the fulcrum for transferring motion between a push rod and a valve stem, and adjusting mechanism for the fulcrum including a pair of adjusting members shiftable relative to one another to vary the effective length of the train and having a self-locking force-multiplying engagement with one another, yieldable biasing means connected to produce relative shifting motion between the members in the direction of decreased lash when the load on the train is relieved, and one-way drive means connected to produce relative shifting motion between the members in the direction of increased lash while the train is under load including a shiftable operating member, a pivoted pawl and one-way ratchet, one on the operating member and the other associated with the adjusting members, a spring connected to urge the pawl and ratchet into operative engagement, shoulder means on the rocker arm connected to shift the operating member to-and-fro in response to motion of the valve train, and camming means positioned to swing the pawl and ratchet out of operative engagement immediately prior to valve seating so that the yieldable biasing means may become operative when the load on the train is relieved.

4. In a mechanical lash adjusting system for an engine valve operating train the combination of a fulcrum, a rocker arm oscillatable about the fulcrum for transferring motion between a push rod and a valve stem, a pair of adjusting members, one fixed on the engine and the other rotatably associated with the fulcrum, a screw thread connection between the adjusting members embodying a self-locking helix angle, an operating member oscillatable co-axially with the other adjusting member, a pivoted pawl and a one-way ratchet, one on the operating member and the other on the other adjusting member, a spring connected to urge the pawl and ratchet into operative engagement, shoulder means on the rocker arm connected to oscillate the operating member to-and-fro in response to motion of the valve train to thread the other adjusting member in the direction of increased lash, camming means positioned to swing the pawl and ratchet out of operative engagement when the valve is seated, and yieldable biasing means connected to thread the other adjusting member in the direction of decreased lash when the load on the train is relieved.

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