April 30, 1963 E. A. THOMPSON 3,087,475

MECHANICAL LASH ADJUSTER

Filed Aug. 11, 1961 4 Sheets-Sheet 1

FIG. 1

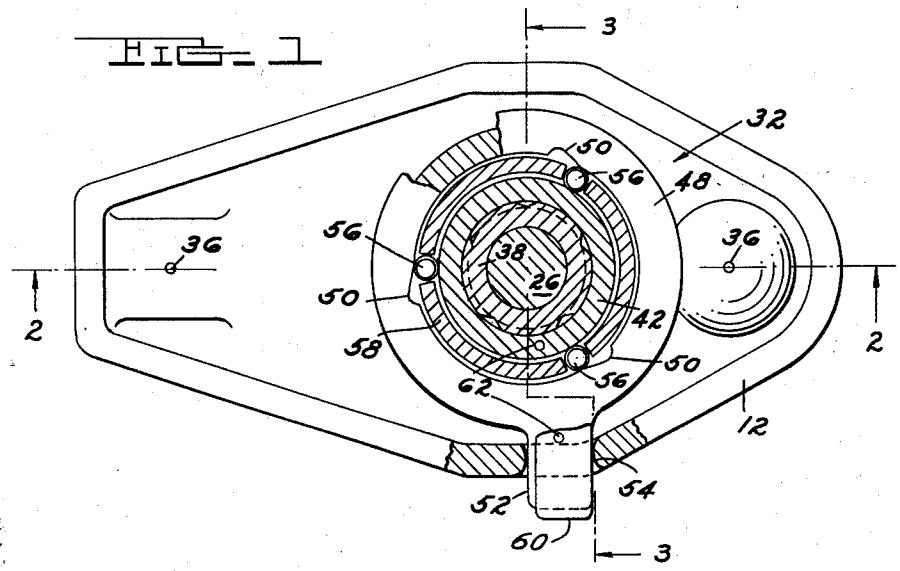
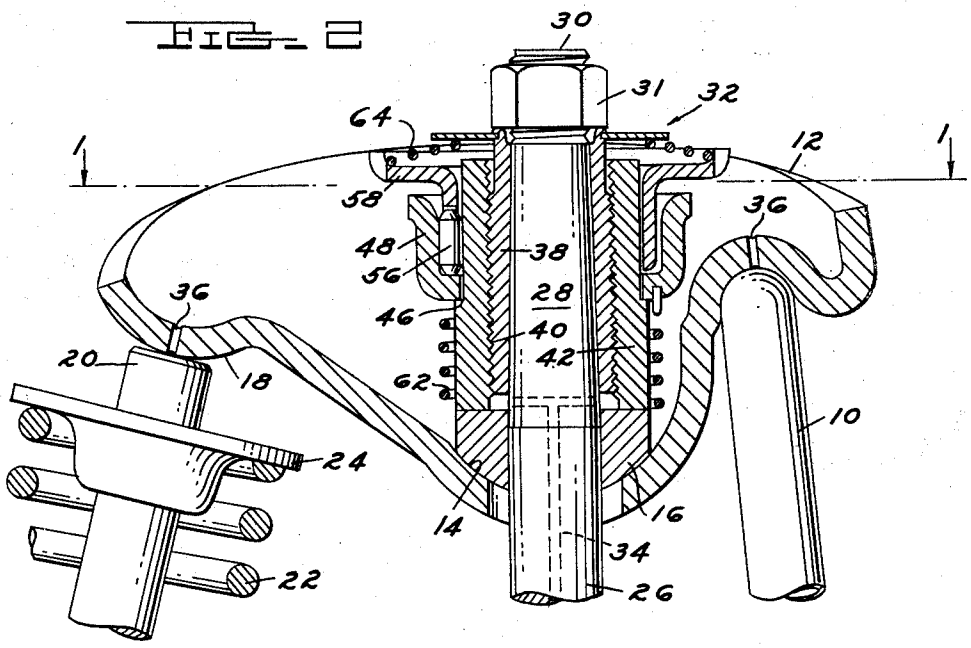


FIG. 2



INVENTOR.
EARL A. THOMPSON
BY
Ralph L. Tweedale
ATTORNEY

April 30, 1963 E. A. THOMPSON 3,087,475

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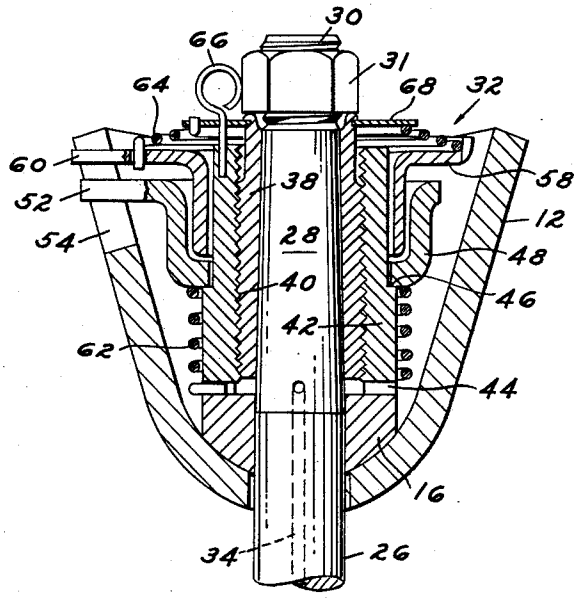


FIG. 3

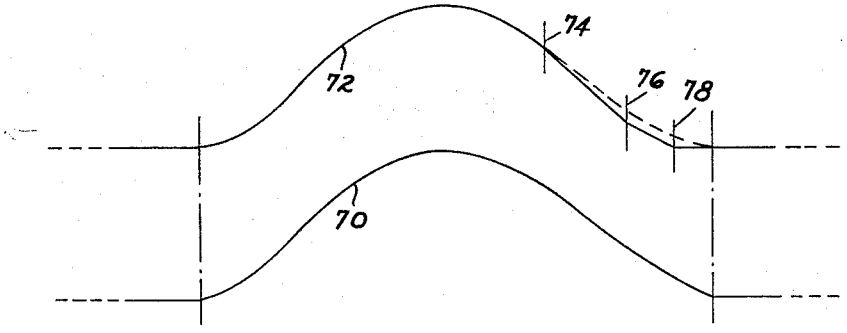


FIG. 4

INVENTOR.
EARL A. THOMPSON
BY
Ralph L. Tweedale
ATTORNEY

April 30, 1963 E. A. THOMPSON 3,087,475

MECHANICAL LASH ADJUSTER

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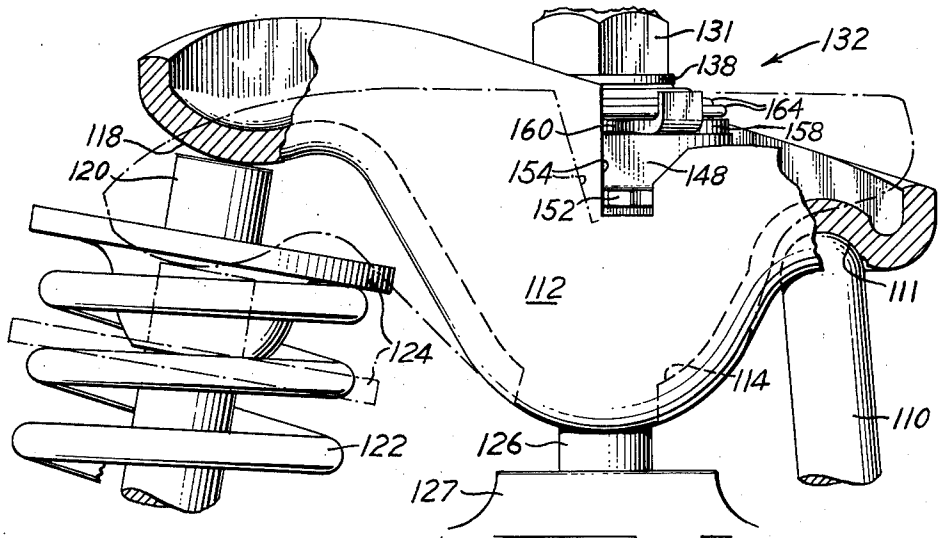
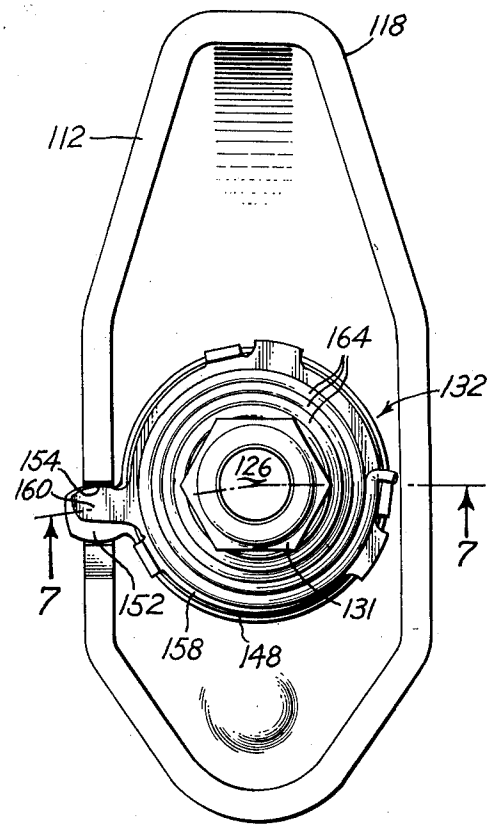


FIG. 5

FIG. 6



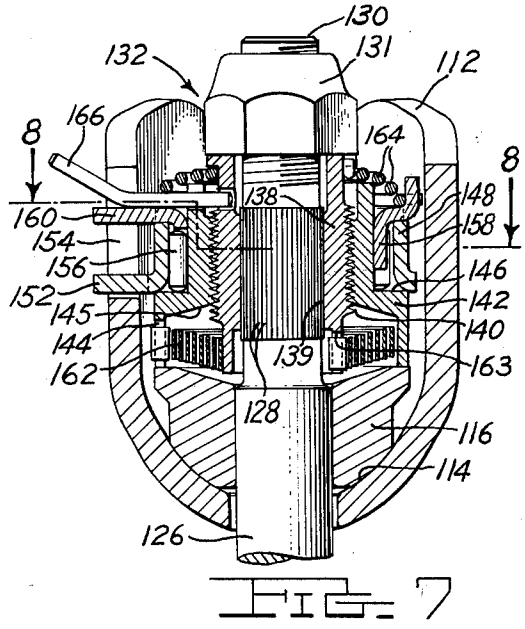


FIG. 7

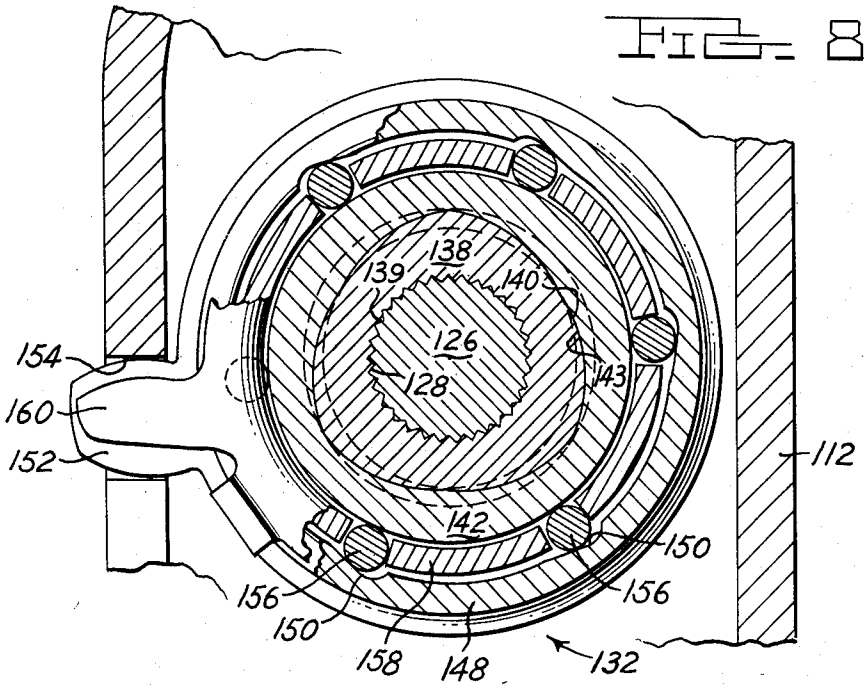
INVENTOR.
EARL A. THOMPSON
BY
Ralph L. Tweedale
ATTORNEY

April 30, 1963 E. A. THOMPSON 3,087,475

MECHANICAL LASH ADJUSTER

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FIG. 8



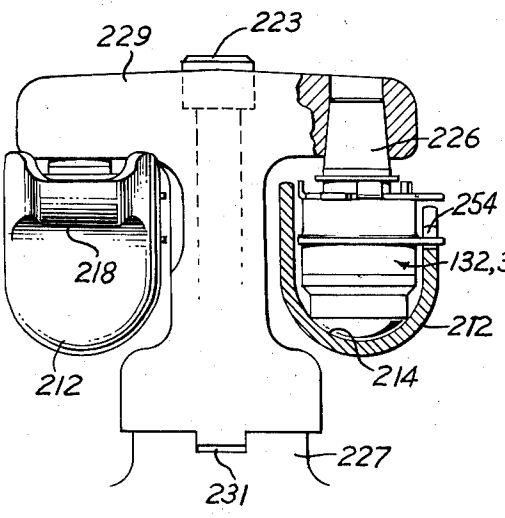


FIG. 9

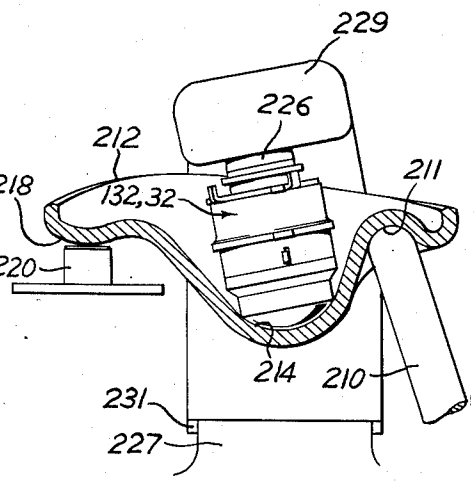


FIG. 10

INVENTOR.
EARL A. THOMPSON
BY
Ralph L. Tweedale
ATTORNEY

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3,087,475
MECHANICAL LASH ADJUSTER

Earl A. Thompson, 1300 Hilton Road, Ferndale, Mich.

Filed Aug. 11, 1961, Ser. No. 131,714
30 Claims. (Cl. 123—90)

This invention relates to lash adjusting mechanism such as is adapted for use with engine valve operating trains. This is a continuation-in-part of co-pending and now abandoned application S.N. 762,121, filed September 19, 1958.

The modern high compression overhead valve type of automotive engine customarily utilizes valve trains of the rocker arm type which valve trains, being fairly long, are frequently provided with automatic lash adjusting devices. Such devices, as heretofore utilized commercially, are almost entirely of the hydraulic type and utilize a chamber of trapped oil which is replenished from the lubricating system through an internal check valve. While these hydraulic valve lifters function quite well for their intended purpose, they do malfunction occasionally due to accumulations of varnish and other oxidation products and are subject to jamming with dirt particles which may be circulated through the lubrication system.

The sensitivity of hydraulic valve lifters to varnish and dirt have lead designers to seek improved reliability in automatic lash adjusters through the use of purely mechanical devices. Heretofore, mechanical lash adjusters have been based upon the use of a force-multiplying mechanism, such as a wedge, eccentric or a helix, all of which are inherently unreliable when utilized at or near their critical friction angle. In prior designs of mechanical lash adjusters it has been necessary to utilize the force-multiplying device at or near this angle and because of the unavoidable small changes in the friction coefficient which arise under various operating conditions they have not proven satisfactory.

It is an object of the present invention to provide a mechanical lash adjuster in which a force-multiplying mechanism of the class embracing wedges, cams and screws may be utilized with an angle of inclination which is inherently self-locking, that is, an angle which is substantially smaller than the critical friction angle.

A further object of the invention is to provide an improved lash adjusting mechanism of the mechanical type wherein a desired positive increment of potential lash is deliberately introduced into the valve train each time it is under load so that an automatic lash removal device may function as soon as the load is removed. The invention also seeks to accomplish this with positively driven mechanical actuating trains independent of frictional forces.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings wherein several forms of the present invention are illustrated.

FIGURE 1 is a top view of one form of rocker arm and lash adjuster assembly embodying the present invention, with parts broken away on line 1—1 of FIGURE 2.

FIGURE 2 is a cross sectional view on line 2—2 of FIGURE 1.

FIGURE 3 is a cross sectional view on line 3—3 of FIGURE 1.

FIGURE 4 is a developed diagram of valve stem travel as compared with push rod travel.

FIGURE 5 is an elevational view of another form of lash adjuster assembly embodying the present invention.

FIGURE 6 is a top view of the assembly shown in FIGURE 5.

FIGURE 7 is a cross sectional view on line 7—7 of FIGURE 6.

FIGURE 8 is fragmentary cross sectional view to a larger scale on line 8—8 of FIGURE 7 with the parts in the valve opened position.

FIGURE 9 is an end elevational view of a different engine mounting for the lash adjuster assembly of the present invention.

FIGURE 10 is a side elevational view of a different engine mounting for the lash adjuster assembly of the present invention.

The invention has been illustrated in embodiments suitable for use with valve trains which employ individually fulcrumed rocker arms. Regarding FIGURES 1–3, such valve trains comprise a push rod **10** which is actuated from the conventional cam shaft, not shown, and the upper end of which cooperates with a spherical socket formed in one end of a deep drawn or cast rocker arm **12**. The rocker arm **12** has an upwardly facing spherical socket **14** which rocks upon a spherical fulcrum member **16** and has a nose portion **18** in abutting engagement with the end of a valve stem **20**, having the usual spring **22** and retainer **24**. A stud **26** is fixed to the engine cylinder head and carries a tapered portion **28** and a threaded portion **30** for the purpose of mounting a self-contained lash adjuster assembly generally designated **32** which serves to variably position the fulcrum **16** with respect to the stud **26** in a manner later to be described. The stud **26** may be provided with a lubricant passage **34** through which lubricant may be supplied to the interior of the lash adjuster **32** and the rocker arm **12**. If desired, suitable lubricating passages **36** may be provided to lubricate the abutting contacts of the rocker arm with the push rod and stem respectively.

The lash adjuster comprises a tubular base **38** which has an internal taper mating with taper **28** and is retained by a nut **31** on thread **30** so as to be fixed in relation to the stud **26** but nevertheless removable therefrom for replacement of the entire lash adjuster **32** if required. The base **38** is provided with external threads **40** which have a helix angle significantly less than the friction angle of the particular materials being utilized which are normally hardened steel. In a typical lash adjuster this angle may be of the order of magnitude of 5 degrees and the thread **40** may be approximately ⅝" in diameter and comprises a five element thread, each element having a pitch of seven threads per inch. Thus, in the sectional view shown, the thread may appear to be one of 35 threads per inch.

Shiftable on the base **38** both rotationally and translatably is a member **42** having an internal thread matching the thread **40** and having its lower surface abutting the upper surface of the spherical fulcrum member **16**. A transverse groove **44** in the bottom of the member **42** provides for passage of oil as well as for an anchoring point for a helical spring, later to be described. The member **42** has a shoulder **46** against which a cup member **48** rests and is rotatably mounted with respect to member **42**.

The cup **48** forms the driving member of a one-way clutch and for this purpose is provided with three or more cam surfaces **50**. Cup **48** is provided with a radially projecting arm **52** which rides in a slot **54** formed in the side wall of the rocker arm **12** as shown in FIGURES 1 and 3. The point of engagement between slot **54** and arm **52** is considerably above the imaginary pivot point of the rocker arm about fulcrum **16** as is evident from FIGURE 3. Above the shoulder **46** the member **42** is provided with a cylindrical surface for cooperation with three clutch rollers **56**. The rollers **56** are spaced by a cage member **58** having a radially projecting arm **60** which also cooperates with the slot **54** but in somewhat different time phase than the arm **52**.

The member **42** is biased rotationally, in a direction tending to advance the fulcrum **16** downwardly, by means

of a helical spring **62** which is anchored at its lower end in the slot **44** and at its upper end in the cup **48** as shown in FIGURE 2. The spring **62** is chosen to have insufficient strength to turn the member **42** while the valve train is under load but with sufficient strength to turn the same when the load is relieved. A conical spring **64** biases the cup or cage **58** clockwise in FIGURE 1 with a light force in order to urge the rollers **56** into the narrow ends of the cam slots **50**.

The lash adjuster assembly **32** prior to installation is wound up to preload the springs **62** and **64** and is retained in the wound condition by means of a temporary lock pin **66** which is engaged in a suitable hole in a plate **68** and a hole in the end of the member **42**. Plate **68** may be staked to the upper end of base **38** and provide a suitable hole for anchoring one end of the spring **64**.

Regarding FIGURES 5–8, another form of the invention is illustrated, wherein the valve train similarly comprises a push rod **110** which is also actuated from the conventional cam shaft, not shown, and the upper end of which cooperates with an abutment such as a spherical socket **111** formed in one end of a deep drawn or cast rocker arm **112**. The elongated rocker arm **112** has an upwardly facing semi-spherical socket **114** which rocks upon a semi-spherical faced fulcrum member **116**, and a nose portion **118** in abutting engagement with the end of a valve stem **120** having a spring **122** acting to seat the valve by means of a retainer **124**. An engine member such as a stud **126** fixed to the cylinder head **127** carries a splined portion **128** and a threaded end portion **130** for the purpose of mounting a self-contained lash adjuster assembly generally designated **132** which serves to variably position the rocker arm fulcrum **116** with respect to the fixed stud **126** in a manner later to be described.

The lash adjuster **132** comprises a tubular base **138** which has internal splines **139** mating with splines **128** on the engine member and is retained by a self-locking nut **131** on threads **130** so as to be axially adjustable in relation to the stud **126**, but nevertheless removable therefrom for replacement of the entire lash adjuster **132** if required. The lash adjuster is urged upwardly against the nut **131** by the valve spring **122** when the train is loaded, and by the take-up action of the adjuster itself when the valve is seated. The base **138** is provided with external threads **140** which have a helix angle significantly less than the friction angle of the particular materials being utilized, which are normally hardened steel, and may comprise a three flight thread. This force multiplying thread is thus inherently self-locking against the load force of the valve train.

Shiftable on the base **138** both rotationally and translatably is a nut or adjusting member **142** having an internal thread **143** matching the thread **140**, and having its lower surface abutting and rotationally slidable on the upper surface of the spherical fulcrum member **116**. An annular chamber **145** is provided in the lower end of the member **142** to house a lash take-up spring, described below. A radial slot **144** in the bottom wall of the spring chamber of the member **142** provides an anchoring point for the take-up spring. The member **142** has an external shoulder **146** against which a one-way clutch rests in concentric relationship with respect to the rotary adjusting member **142**.

The one-way clutch may comprise a driving member **148** which is provided with six axially extending cam surfaces **150** on the axially unobstructed inner surface thereof. Cup **148** is also provided with a radially projecting actuating arm **152** which rides snugly in a slot **154** formed in the side wall of the rocker arm **112**, as shown in FIGURES 5–8. The point of engagement between the actuating shoulder of the slot **154** and arm **152** is considerably above the pivot point of the rocker arm about fulcrum **116**, as is evident from FIGURES 5 and 7. Above the shoulder **146** is also provided six clutch rollers **156**, each disposed axially, one adjacent each cam surface **150** for cooperation with a cylindrical surface on the nut **142**. The rollers **156** are also spaced by an unlocking member **158** also having a radially projecting actuating arm **160** which cooperates with the same slot **154**, but with a lost motion connection and at a greater distance from the rocker arm pivot so as to be in somewhat different time phase than the arm **152**. A spring **164** biases the unlocking cage **158** clockwise in FIGURE 8 with a light force in order to urge the rollers **156** into the narrow ends of the cam slots **150**, ready to perform their clutching function; the spring **164** also holds the one-way clutch assembly down against the shoulder **146**.

The member **142** is biased rotationally, in a direction tending to advance the fulcrum **116** downwardly in the direction of decreased lash, by means of a torsion motor **162** of the type wherein flat spring wire is coiled on itself. This spring is too weak to act when the valve train is loaded, and is anchored at its outer end in the slot **144**, and at its inner end is anchored relative to the engine **127** by means of a slot **163** in the lower end of the base **138**, as shown in FIGURE 7. The upper surface of the fulcrum member **116** and the opposed bottom surface of the spring chamber **145** are dished conically inwardly to make room for the spring **162** as the axial position of the fulcrum shifts relative to the stud and screw member **138** fixed thereon.

The lash adjuster assembly **132** prior to installation is wound up to preload the springs **162** and **164**, and may be retained in the wound condition by means of a temporary lock pin **166** which is engaged in a suitable opening in the member **142** and a hole in the member **138**, several of which may be provided in each member to facilitate installation locking of the unit with the correct preload.

In FIGURE 4 there is shown by the line **70** a horizontal plot of push rod motion, but showing only the portion of the action when the cam lobe is effective. The upper line **72** plots the corresponding movements of the valve stem **20** to show the differences which are introduced by the lash adjuster mechanism. It will be seen from FIGURE 4 that the push rod motion and the valve stem motion correspond exactly during the rising portion of the cam ramp and during the initial part of the falling portion of the cam ramp.

In operation, initial travel of the rocker arm in a clockwise direction on the valve closing stroke picks up the arm **52**, **152** (both embodiments function similarly) to rotate it counterclockwise in FIGURES 1, 8, tightening the rollers **56**, **156** into clutching engagement with their cam slots **50**, **150** and the surface of the nut **42**, **142**. After point **74**, the one-way clutch begins to drive the member **42**, **142** along with the cup **48**, **148**. This counterclockwise rotation of member **42**, **142** causes an upward translation of the member **42**, **142** and thus permits the fulcrum **16**, **116** to recede upwardly. This motion introduces an increment of potential lash into the valve train.

At a time when a point such as **76** is reached, the wall of slot **54**, **154** actuates the arm **60**, **160** on cage **58**, **158** to unlock the rollers **56**, **156** and thereafter no further lash is introduced into the train and the valve stem follows the motion of the push rod until a point such as **78** is reached where the valve seats. It will be noted that the arm **60**, **160** is at a higher point in the slot **54**, **154** than is the arm **52**, **152** and at this radius the slot walls partake of a greater travel. Thus the cage member **58**, **158** overtakes the cup **48**, **148** at the point **76**.

Thus the valve stem comes to rest on its seat earlier than the cam follower and push rod reach the end of their downward travel. This comes about by reason of the fulcrum having been raised a small increment. The spring **62**, **162**, however, now takes over control of the member **42**, **142** since that member is now entirely free of the one-way clutch and the thread locking force of the

valve spring. As the push rod recedes further, the member **42, 142,** is driven clockwise by spring **62, 162** and thus forces the fulcrum downwardly as fast as the recession of the push rod will permit, thus precluding any actual lash in the system. The increment of potential lash which was introduced by the one-way clutch becomes wiped out and the parts come to rest with no lash in the system.

If, due to temperature or other changes, there should be need to adjust the datum position of the fulcrum, such adjustment requirement adds itself algebraically to the increment of potential lash and the net sum is wiped out by the action of the last take-up spring.

It will thus be seen that the present invention provides an improved mechanical lash adjuster in which reliability is assured and which does not depend on wedges, cams or screws having angles close to the friction angle. At the same time all lash-adjusting motions are produced by positively acting drives independent of any coefficient of friction between two relatively slidable surfaces. That is to say, such drives operate through fully compulsive connections to the threaded adjusting members, both as to the actuating connections (e.g., in the first embodiment: **54—52—48—50—56**) to the nut and as to the reactive connection (e.g., in the first embodiment: **12—10**—cylinder head (not shown)—**26—28—31**) to the threaded stud.

In FIGURES 9 and 10, a different engine mounting and rocker arm are shown. A push rod **210** is actuated from the cam shaft, not shown, and cooperates with a spherical socket **211** formed in one end of a dished rocker arm **212**. The rocker arm **212** has an upwardly facing spherical socket **214** which rocks upon the spherical fulcrum of a lash adjuster according to this invention. The rocker arm has a nose portion **218** in abutting engagement with the end of a valve stem **220**, after the normal fashion.

Studs **226** are fixed to the engine cylinder head **227** by a T shaped bracket **229**, which may carry a stud from each arm thereof and may be secured against rotation by a key and way arrangement **231** and against upward movement by a fastener **233**. The downwardly extending studs may support a lash adjusting unit by either the wedge taper or spline connection described above. One advantage of such a mounting is the ability to use deep drawn or cast rocker arms including an actuating shoulder **254** similar to the ones described above yet without necessitating the extra step of providing a stud hole in the bottom.

While the embodiments of the invention herein disclosed constitute preferred forms, it is to be understood that other forms might be adapted, all coming within the scope of the claims which follow.

I claim:

1. In an engine valve operating train, a lash adjusting system of the mechanical type comprising force-multiplying means inherently non-slipping against the force of valve train load, independent means for compulsively engaging the force-multiplying means each time the train is under load to positively introduce potential lash into the train and then completely disengaging the force-multiplying means well before the load on the train is relieved, and yieldable biasing means for precluding actual lash from the train as the load on the train is relieved.

2. In an engine valve operating train, a lash adjusting system of the mechanical type comprising a threaded adjusting mechanism having a self-locking helix angle, mechanical means including a fully compulsive driving connection and a fully compulsive reaction connection to the adjusting mechanism for positively introducing an increment of potential lash into the train while the train is under load and a resilient biasing element for removing lash from the train only while the load on the train is relieved.

3. In an engine valve operating train, a lash adjusting system of the mechanical type comprising a force-multiplying adjusting mechanism of the self-locking type, means including a fully compulsive driving connection and a fully compulsive reactive connection with the adjusting mechanism for positively introducing an increment of potential lash into the train while the train is under load and a resilient biasing element for removing lash from the train only while the load on the train is relieved.

4. A mechanical lash adjuster for an intermittently loaded motion transfer train comprising a pair of relatively shiftable adjusting members having a force multiplying engagement with each other to vary the effective length of the train and inherently self-locking against the intermittent load force of the train, first means responsive to transfer train motion for positively shifting one of the adjusting members relative to the other adjusting member in the direction of increased lash each time the train is loaded to introduce an increment of potential lash, second means having insufficient force to operate the one adjusting member while the train is loaded for biasing the one adjusting member relative to the other adjusting member in the direction of decreased lash as in intermittent load on the train is relieved to wipe out the potential lash introduced by the first means plus or minus any required adjustment, and means securing the other adjusting member against shifting relative to the one member in a direction which would vary the effective length of the train.

5. A mechanical lash adjuster for an intermittently loaded motion transfer train comprising a pair of relatively shiftable adjusting members having a force multiplying engagement with each other to vary the effective length of the train and inherently self-locking against the intermittent load force of the train, first means including a one-way drive arrangement responsive to transfer train motion for positively shifting one of the adjusting members relative to the other adjusting member in the direction of increased lash each time the train is loaded to introduce an increment of potential lash, second means including a mechanical spring arrangement having insufficient force to operate the one adjusting member while the train is loaded for biasing the one adjusting member relative to the other adjusting member in the direction of decreased lash as the intermittent load on the train is relieved to wipe out the potential lash introduced by the first means plus or minus any required adjustment, and means securing the other adjusting member against shifting relative to the one member in a direction which would vary the effective length of the train.

6. A mechanical lash adjuster for an intermittently loaded, reciprocating, motion transfer train comprising a pair of relatively shiftable adjusting members having a force multiplying engagement with each other to vary the effective length of the train in response to such relative shifting and inherently self-locking against shifting in response to load force imposed in the line of motion transmitted by the train, an actuating means for shifting one of said members relative to the other to produce an increment of potential lash while the train is under load, said actuating means including a self-locking one-way gripping device for driving one of the adjusting members, means for positively constraining the other adjusting member against conjoint motion in the same direction, a releasing means for disengaging the one-way gripping device to terminate the relative shifting of the adjusting members while the train continues under load, and resilient means having insufficient force to operate said members while under load and acting in the opposite direction to the actuating means whereby the increment of potential lash is removed and any compensating adjustment in the effective length of the train is introduced as the load is relieved from the train.

7. An engine valve train comprising a threaded lash adjusting member having a helix angle inherently self-locking against the thrust of valve actuation, an actuator

responsive to valve train motion and including a self-locking one-way gripping device connected to turn the adjusting member while the train is under load in a direction to introduce an increment of potential lash into the train, a releasing device also responsive to valve train motion and arranged to disengage the gripping device at a subsequent time in the operating cycle, and resilient means for turning the adjusting member in the opposite direction to wipe out the lash in the train while the load is relieved.

8. An engine valve train comprising a threaded lash adjusting member having a helix angle inherently self-locking against the thrust of valve actuation, an actuator responsive to valve train motion and including a means for positively engaging and then positively disengaging the adjusting member to turn the adjusting member a predetermined distance in the lash increasing direction while the train is under load, and resilient means for turning the adjusting member in the opposite direction to wipe out the lash in the train while the load is relieved.

9. A valve operating train comprising a pair of threaded members relatively rotatable to vary the lash in the train, a biasing spring connected between the members to urge them in the direction of decreased lash and having insufficient force to overcome the operating load on the train, and means forming a compulsive connection between said members for producing relative threading motion in a lash increasing direction while the train is under load.

10. A valve operating train comprising a pair of threaded members relatively rotatable to vary the lash in the train, a biasing spring connected between the members to urge them in the direction of decreased lash and having insufficient force to overcome the operating load on the train, and means including a one-way gripping device actuated by motion of the valve train and forming a compulsive connection between said members for producing relative threading motion in a lash increasing direction while the train is under load.

11. A valve operating train comprising a pair of threaded members relatively rotatable to vary the lash in the train, a biasing spring connected between the members to urge them in the direction of decreased lash and having insufficient force to overcome the operating load on the train, a one-way gripping device associated with said members for producing relative threading motion in a lash increasing direction and means for releasing said device while the train is under load.

12. A mechanical lash adjuster for an intermittently loaded motion transfer train comprising a base, a member shiftable relative thereto to increase or decrease lash, means including a self-locking force-multiplying mechanism for shifting said member, resilient means for operating said mechanism in a direction to decrease lash and having insufficient force to operate the lash adjuster while the adjuster is under load, and positive mechanical drive means including a clutch engageable with said mechanism and means for disengaging the clutch while the adjuster is under load for operating said mechanism a predetermined distance in a direction to increase lash whereby an increment of potential lash is introduced during loaded operation of the train and that increment, plus or minus any required adjustment, is removed by the resilient means when the load is relieved.

13. A mechanical lash adjuster for an intermittently loaded motion transfer train comprising a base, a member shiftable relative thereto to increase or decrease lash, means including a self-locking screw mechanism for shifting said member, resilient means for operating said mechanism in a direction to decrease lash and having insufficient force to operate the lash adjuster while the adjuster is under load and positive mechanical drive means effective while the adjuster is under load including fully compulsive driving and reactive connections for operating said mechanism in a direction to increase lash whereby an increment of potential lash is introduced during loaded operation of the train and that increment, plus or minus any required adjustment, is removed when the load is relieved.

14. A mechanical lash adjuster for an intermittently loaded motion transfer train comprising a base, a member shiftable relative thereto to increase or decrease lash, means including a self-locking force-multiplying mechanism for shifting said member, a biasing spring for operating said mechanism in a direction to decrease lash and having insufficient force to operate the lash adjuster while the adjuster is under load and positive mechanical drive means engaged and positively disengaged while the adjuster is under load for operating said mechanism a predetermined distance in a direction to increase lash whereby an increment of potential lash is introduced during loaded operation of the train and that increment, plus or minus any required adjustment, is removed by the biasing spring when the load is relieved.

15. A mechanical lash adjuster for an intermittently loaded motion transfer train comprising a base, a member shiftable relative thereto to increase or decrease lash, means including a self-locking force-multiplying mechanism for shifting said member, resilient means for operating said mechanism in a direction to decrease lash and having insufficient force to operate the lash adjuster while the adjuster is under load, fully compulsive means connecting the motion transfer train to positively operate said mechanism in a direction to increase lash, and means for disconnecting said fully compulsive means before the load is relieved from the train whereby an increment of potential lash is introduced during loaded operation of the train and that increment, plus or minus any required adjustment, is removed by the resilient means when the load is relieved.

16. A mechanical lash adjuster for an intermittently loaded motion transfer train comprising a base, a member shiftable relative thereto to increase or decrease lash, means including a self-locking screw mechanism for shifting said member, resilient means for operating said mechanism in a direction to decrease lash and having insufficient force to operate the lash adjuster while the adjuster is under load and a one-way clutch and fully compulsive driving and reactive connections with the motion transfer train to operate said mechanism in a direction to increase lash whereby an increment of potential lash is introduced during loaded operation of the train and that increment, plus or minus any required adjustment, is removed by the resilient means when the load is relieved.

17. A mechanical lash adjuster for an engine valve train comprising a base, a member shiftable relative thereto to increase or decrease lash, a self-locking force-multiplying mechanism for shifting said member, resilient biasing means for operating said mechanism in a direction to decrease lash whenever the valve train is relieved of load and positive mechanical drive means having fully compulsive driving and reactive connections with said mechanism to introduce an increment of potential lash while the valve train is loaded whereby that increment, plus or minus any required adjustment, may be removed by the biasing means when the load is relieved.

18. A mechanical lash adjuster for an engine valve train comprising a base, a member shiftable relative thereto to increase or decrease lash, a self-locking screw mechanism for shifting said member, resilient biasing means for operating said mechanism in a direction to decrease lash whenever the valve train is relieved of load and positive mechanical drive means having fully compulsive driving and reactive connections with said mechanism to introduce an increment of potential lash while the valve train is loaded whereby that increment, plus or minus any required adjustment, may be removed by the biasing means when the load is relieved.

19. A rocker arm for the valve gear of an internal combustion engine comprising an elongated trough shaped

member having a fulcrum journal intermediate its ends, means forming a pair of abutments adjacent each its ends for engaging a push rod and a valve stem, respectively, and means including an actuating shoulder on the arm forming a third abutment for positively operating the one-way drive arrangement of a spring-loaded mechanical lash adjusting unit, the actuating shoulder lying away from the fulcrum center for oscillatory movement about the fulcrum center.

20. A rocker arm for the valve gear of an internal combustion engine comprising an elongated trough shaped member having a depression in its bottom wall containing a fulcrum journal intermediate its ends, means forming external abutment surfaces adjacent each end, said arm having a trough wall which extends radially outwardly from the fulcrum center a substantial distance, and means including a shoulder on the radially extending wall forming a third abutment surface for actuating a lash adjuster and lying away from the fulcrum center for oscillatory movement about the fulcrum center.

21. A unitary rocker arm for the valve gear of an internal combustion engine comprising an elongated trough shaped member having a downward depression in its bottom wall containing a fulcrum journal intermediate its ends, means forming external abutment surfaces on its bottom wall adjacent each end, said arm having trough side walls which extend upwardly from the fulcrum center a substantial distance, and means forming a third abutment surface for actuating a lash adjuster and facing approximately at right angles to the other abutment surfaces, said means including an opening in the side wall lying above and at one side of the fulcrum center for oscillatory movement about the fulcrum center.

22. In an engine valve operating train having a rocker arm mounted for rocking about a fulcrum, a lash adjusting system comprising a unitary assembly providing the fulcrum and comprising a base, a member shiftable relative thereto to advance and retract the fulcrum, means including a self-locking force-multiplying mechanism for shifting said member, resilient means for operating said mechanism in a direction to advance the fulcrum and having insufficient force to operate the mechanism while the valve train is under load, and means associated with the rocker arm to positively operate the mechanism in the direction to retract the fulcrum while under load whereby an increment of potential lash is introduced during loaded operation of the train and that increment, plus or minus any required adjustment, is removed by the resilient means when the load is relieved.

23. In an engine valve operating train having a rocker arm mounted for rocking about a fulcrum, a lash adjusting system comprising a unitary assembly providing the fulcrum and comprising a base, a member rotatable and translatable relative thereto to advance and retract the fulcrum, means including a self-locking screw mechanism for translating said member, resilient means for operating said mechanism in a direction to advance the fulcrum and having insufficient force to operate the mechanism while the valve train is under load, and means including one-way drive means associated with the rocker arm to positively operate the mechanism in the direction to retract the fulcrum while under load whereby an increment of potential lash is introduced during loaded operation of the train and that increment, plus or minus any required adjustment, is removed by the resilient means when the load is relieved.

24. In an eninge valve operating train having a rocker arm mounted for rocking about a fulcrum, a lash adjusting system comprising a unitary assembly providing the fulcrum and comprising a base, a member rotatable and translatable relative thereto to advance and retract the fulcrum, means including a self-locking screw mechanism for translating said member, resilient means for operating said mechanism in a direction to advance the fulcrum and having insufficient force to operate the mechanism while the valve train is under load, and means including a one-way clutch associated with the rocker arm to positively operate the mechanism in the direction to retract the fulcrum while under load whereby an increment of potential lash is introduced during loaded operation of the train and that increment, plus or minus any required adjustment, is removed by the resilient means when the load is relieved, said one-way clutch being arranged to drive the screw mechanism during valve closing movement of the train, and additional means associated with the rocker arm for releasing the one-way clutch prior to the end of such movement.

25. In an engine valve operating train having a rocker arm mounted for rocking about a fulcrum, a lash adjusting system comprising a unitary assembly providing the fulcrum and comprising a base, means for removably mounting the base in fixed relation to the engine, a member shiftable relative thereto to advance and retract the fulcrum, means including a self-locking force-multiplying mechanism for shifting said member, resilient means for operating said mechanism in a direction to advance the fulcrum and having insufficient force to operate the mechanism while the valve train is under load, and means including one-way drive means associated with the rocker arm to positively operate the mechanism in the direction to retract the fulcrum while under load whereby an increment of potential lash is introduced during loaded operation of the train and that increment, plus or minus any required adjustment, is removed by the resilient means when the load is relieved.

26. A mechanical lash adjuster comprising a self-locking force-multiplying member rotatable to adjust the amount of lash, biasing means connected with the member to urge it in the direction of decreased lash, and one-way clutch means connected with the member for producing motion in the direction of increased lash including a clutch driving member in juxtaposed concentric relationship to the force-multiplying member, the juxtaposed surface of one of the members having a plurality of one-way gripping cams formed thereon, a rollable clutching element wedgingly associated with each cam to transfer motion of the driving member to the force-multiplying member in only the rotational direction of increased lash, and element releasing means connected to move each clutching element out of operative association with its cam so that the biasing means may function.

27. A mechanical lash adjuster comprising a self-locking force-multiplying member rotatable to adjust the amount of lash, biasing means connected with the member to urge it in the direction of decreased lash, and one-way clutch means connected with the member for producing motion in the direction of increased lash including a clutch driving member in juxtaposed concentric relationship to the force-multiplying member, the juxtaposed surface of one of the members having a plurality of axially extending one-way gripping undulations formed thereon, the latter member being free from interfering ledges at both axial ends of the juxtaposed surface to facilitate formation of the undulations thereon, and means for releasing the one-way clutch means so that the biasing means may function.

28. A mechanical lash adjuster for an intermittently loaded motion transfer train shiftable relative to an engine member comprising a pair of cooperating adjusting members having mating self-locking helix angle surfaces, one-way drive means responsive to transfer train motion to positively rotate one of the adjusting members in the direction of increased lash when the train is under load, locking means securing the other of the adjusting members against rotation relative to the engine member, and a coiled spring connected at one end directly with one member and at the other end directly with the other member to bias the one member in the direction of decreased lash when the load on the train is relieved.

29. A mechanical lash adjuster for an intermittently

loaded motion transfer train shiftable relative to an engine member comprising a pair of cooperating adjusting members having mating self-locking helix angle surfaces, one-way drive means responsive to transfer train motion to positively rotate one of the adjusting members in the direction of increased lash when the train is under load, locking means securing the other of the adjusting members against rotation relative to the engine member, and torque biasing means connected to urge the one member in the direction of decreased lash when the load on the train is relieved including a spirally wound length of flat spring steel connected at one end with the one member and anchored at the other end to the engine member.

30. A mechanical lash adjuster for an intermittently loaded motion transfer train shiftable relative to an engine member comprising a pair of cooperating adjusting members having mating self-locking helix angle surfaces, first means responsive to transfer train motion to positively rotate one of the adjusting members in the direction of increased lash when the train is under load, second means connected with the one member to bias it in the direction

of decreased lash when the load on the train is relieved, and means securing the other of the adjusting members against rotation relative to the engine member including an axially extending aperture in one of the members having a non-circular cross sectional configuration, and a stud on the other of the members of similar shape designed to be slidably received within the aperture to a varying axial extent whereby the first or the second means may rotate the one adjusting member while the other adjusting member is held in non-rotative relationship to the engine member.

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