Nov. 9, 1954 E. K. RALSTON 2,693,790

AUTOMATIC TAPPET

Filed Sept. 27, 1950. 2 Sheets-Sheet 1

Fig. 1

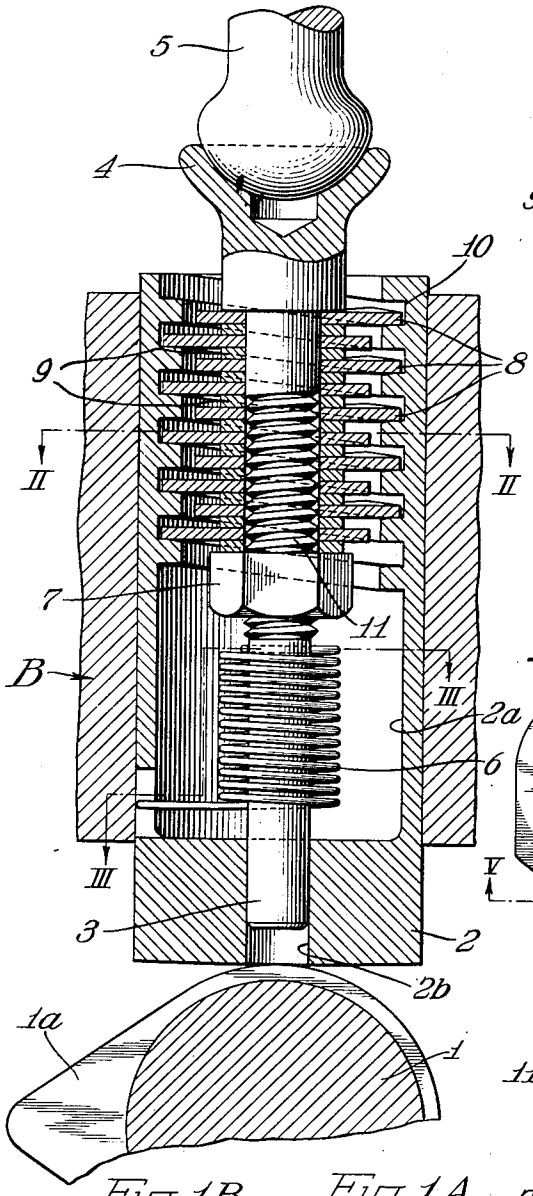


Fig. 2

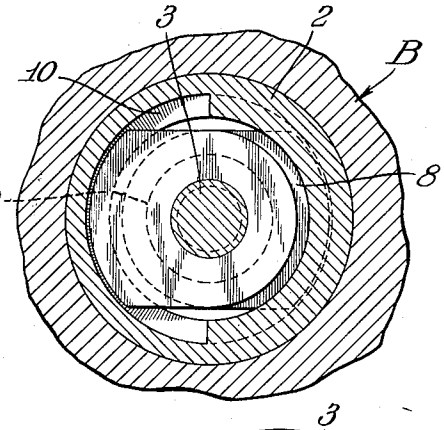


Fig. 3

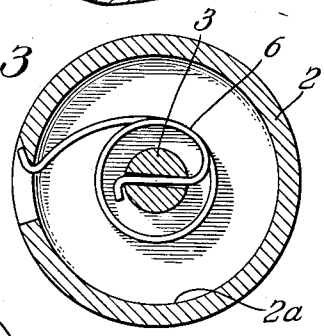


Fig. 4

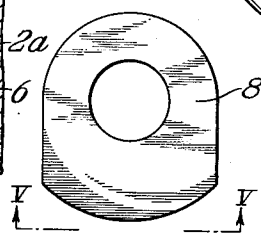


Fig. 5



Fig. 6

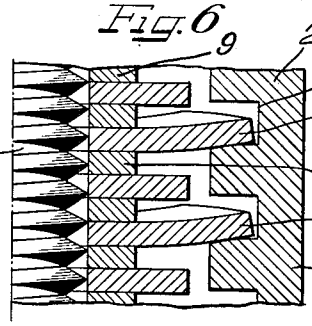


Fig. 1B

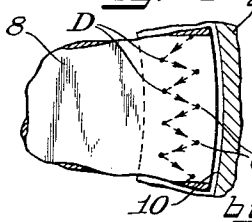
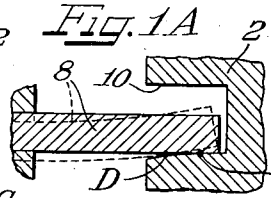


Fig. 1A



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Nov. 9, 1954 E. K. RALSTON 2,693,790

AUTOMATIC TAPPET

Filed Sept. 27, 1950 2 Sheets-Sheet 2

Fig. 7

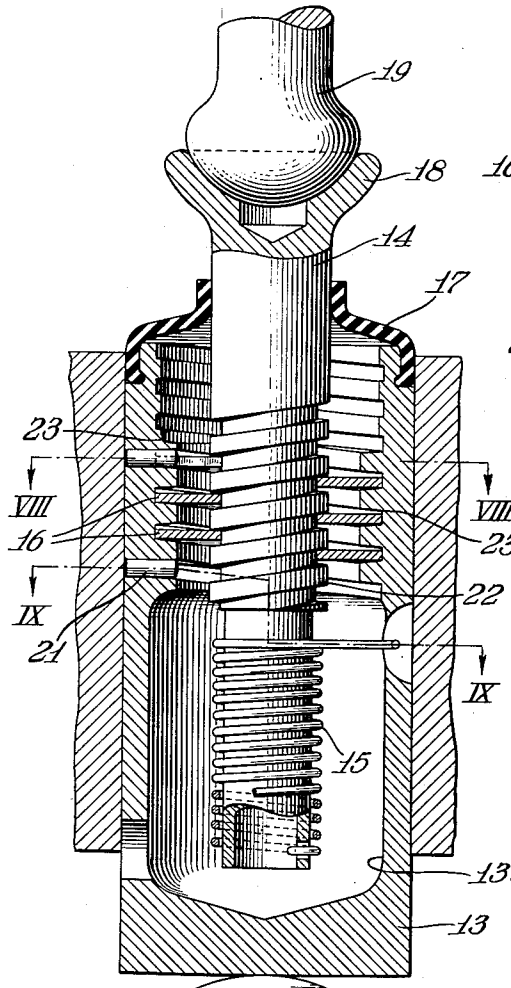


Fig. 8

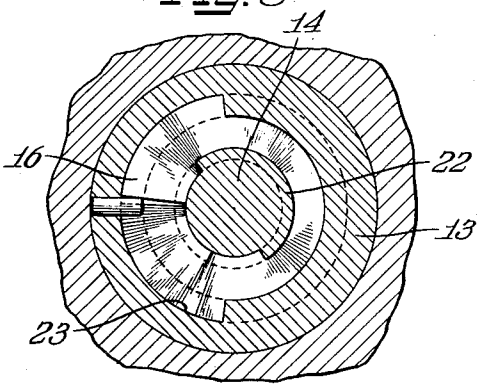


Fig. 9

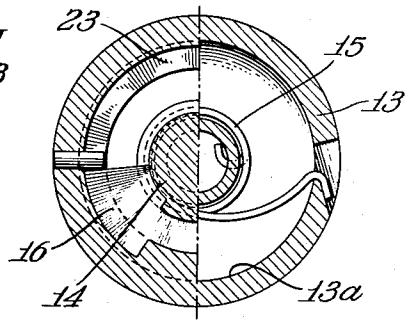


Fig. 10

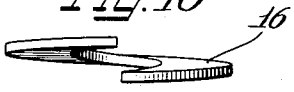
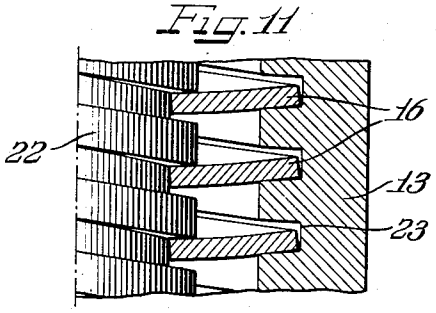
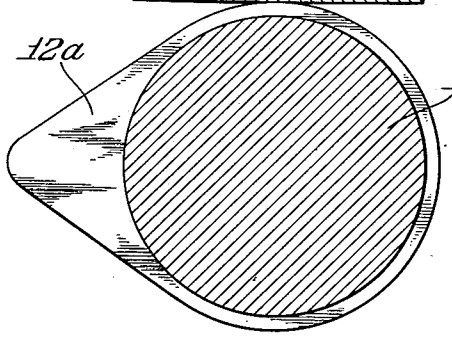


Fig. 11





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AUTOMATIC TAPPET

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Application September 27, 1950, Serial No. 187,074

13 Claims. (Cl. 123—90)

This invention relates to automatic lash adjusters or clearance regulators particularly useful as tappets in valve linkages for internal combustion engines.

According to this invention, there is provided an automatic valve tappet composed of screwed-together parts acted upon by a loaded torsion spring which tends to unscrew the parts to increase their over-all length wherein the screw threads of one part are resiliently deflectable. The deflectable threads, when subjected to valve opening loads, will bend to slide radially inward relative to the mating threads. Since these mating threads are pitched for sliding action, the resilient threads slide inward and downward at the same time relative to the mating threads, and thereby the parts will automatically screw together to foreshorten their overall length. When the load is released, the deflected threads will reclaim their normal full seating position in the mating threads, and if too much clearance has developed, the torsion spring will unscrew the parts to take up this clearance.

The resilient threads are conveniently provided by a stack of helically twisted spring leaves or washers secured on or screwed on a male bolt-like member forming the one part of the tappet. The other tappet part is conveniently in the form of a female nut-like member having internal threads which loosely receive the spring leaves and accommodate their deflection between full seating unstressed condition and sliding bent stressed condition. However, it should be understood that the resilient threads can be in the form of a single helical member and that they can be carried on either the male or female part or merely loosely threaded relative to both parts.

In one preferred embodiment the spring leaves are in the form of flat washers having helically twisted extensions or tabs on one side thereof. These washers are positioned in spaced stacked relation on the male part with the tabs of adjacent washers extending in diametrically opposed directions so that their twisted contours will cooperate to form a helical thread.

In another preferred embodiment, the spring leaves are in the form of split helical washers threaded on the male bolt part and into the female nut part. A feature of the invention resides in the provision of a resilient cap or cover for the male and female parts which functions as a seal and as a guide for the male member.

It is then an object of the present invention to provide an automatic clearance regulator having extensible parts joined by resilient threads which deflect under load to thread the parts into foreshortened condition and having a spring effective to extend the parts when the load is released.

A further object is to provide an automatic valve tappet which will take up clearance under spring action and will compensate against the spring action by deflection of resilient threads that cause a foreshortening of extensible parts.

Another object of the present invention is to provide an improved automatic tappet having the parts thereon connected by spring leaves forming helical threads.

Another object of the invention is to provide a tappet having threaded-together male and female parts guided and sealed by a resilient cap.

Other and further objects of the invention will be apparent to those skilled in the art from the following detailed description of the annexted sheets of drawings which, by way of a preferred example only, illustrate several embodiments of the invention.

On the drawings:

Figure 1 is a longitudinal sectional view, with parts in elevation, of a clearance adjusting device embodying this invention, showing the elements thereof in their unloaded positions;

Figure 1A is a view diagrammatically illustrating the movement of the deflectable leaves under load;

Figure 1B is a view diagrammatically illustrating the movement of the deflectable leaves during several cycles;

Figure 2 is a transverse cross-sectional view taken along the section line II—II of Figure 1, showing the relative positions of the flexible leaves and threads;

Figure 3 is a transverse cross-sectional view taken along the section line III—III of Figure 1, showing the manner in which the torsion spring is secured;

Figure 4 is a plan view of a spring leaf or washer used to form the threads in the embodiment of Figure 1;

Figure 5 is an end elevational view taken along the line V—V of Figure 4 showing the helical shape of the spring leaf;

Figure 6 is an enlarged view similar to Figure 1 showing the deflection of the spring leaves or washers under load;

Figure 7 is a longitudinal sectional view with parts in elevation of a clearance adjusting device embodying this invention, showing the elements thereof in their unloaded positions;

Figure 8 is a transverse sectional view taken along the section line VIII—VIII of Figure 7, showing the relative position of the split washers and threads;

Figure 9 is a sectional view taken along the section line IX—IX of Figure 7, showing the manner in which the torsion spring is secured;

Figure 10 is a plan view of the split washer herein used in connection with the embodiment shown in Figure 7; and

Figure 11 is an enlarged view similar to Figure 7 showing the deflection of the split washers under load.

As shown on the drawings:

In the valve tappet assembly of Figures 1 to 6 a conventional cam shaft **1** of an internal combustion engine acts on the flat bottom of a hollow cylindrical tappet body **2** which is slidably mounted in the engine block B. A lobe **1***a* of the camshaft will raise the body **2** to effect opening of the engine valve. Through the axial center of the tappet body member **2** is a generally cylindrical interior bore **2***a* which extends to the lower extremity of the tappet body member **2**. Another interior bore **2***b*, also through the lower extremity, forms an aperture in the flat bottom surface of the tappet body member **2**. The diameter of the last-mentioned bore **2***b* is such as to just allow a bolt-like member **3** to pass therethrough. The upper portion of the tappet body member **2** is provided with internal threads **10**.

The bolt-like member or adjusting member **3** is cylindrically shaped and extends through the interior of the upper bore **2***a* and partially through the interior of the lower bore **2***b*. The bolt-like member **3** is provided with a socket upper end **4**. The socket has a substantially ball-shaped recess therein for lifting a push rod **5**. The push rod **5** is of the conventional type and has a substantially ball-shaped lower extremity thereby fitting into the recess of the socket **4**.

The upper portion of the bolt-like member **3** has a threaded portion **11**, and mounted thereto are a plurality of resilient threads such as deflectable spring leaves **8** and spacers **9**. The spring leaves **8** may be integrally formed with the stem **3**, if desired. The spring leaves **8** and spacers **9** are of such thickness and so located on the bolt-like member that the projecting ends of the spring leaves **8** have substantially the same pitch as the interior threads **10** of the tappet body member **2**. The spacers **9** threadably cooperate with the internal threads **10** of the tappet body member **2**. A nut **7** is screwed on the threads **11** of the bolt-like member **3** to maintain the proper spacing for the spring leaves **8** and the spacers **9**. It is to be noted that the ends of the spring leaves **8** are twisted (as shown in Figure 5) to match the helix angle of the interior threads **10** of the tappet body member **2** so that the whole stem assembly acts the same as a bolt and will screw up and down in the threads **10** of the tappet body

member 2. The shape of the spring leaves 8 is shown in Figure 4. In Figure 6 it is shown how the spring leaves deflect to enable cooperation with the threads 10 of the tappet body member 2.

A torsion spring 6 encompasses the lower extremity of the bolt-like member 3 so as to provide a continual torque tending to rotate the bolt-like member 3 in a direction as to unscrew the bolt-like member 3 or elongate the tappet assembly. The torsion spring 6 is provided with one long end which hooks through a hole in the side of the tappet body member 2, as shown in Figures 1 and 3, and the other end of the torsion spring 6 hooks through a hole in the bolt-like member 3, as shown in Figures 1 and 3.

Referring now to Figure 7, which is another embodiment of the present invention, the automatic tappet herein shown is somewhat similar to the one shown in Figure 1. However, in Figure 7, resilient threads such as split washers 16 are on the tappet body member 13 at the portions having the internal threads 23. The split washers 16 are secured to the tappet body member 13 and are helical in shape, as shown in Figure 10. The split washers 16 or flexible members are screwed into the internal threads 23 in the tappet body member 13, and then locked in place by pin 21 or other suitable means. It should be noted that the washers 16 are prevented from screwing up or down in the threads 23 of the tappet body member 13. The threads 23 of the tappet body member 13 are somewhat wider than the thickness of the washers 16 and perferably tapered as shown so the washers 16 can deflect in an axial direction. It will also be apparent that a helical spring of the same cross-section as the washers can be substituted for the several washers 16. In this instance, the split washers 16 threadedly cooperate with the threads 22 of the bolt-like member 14.

A resilient cap 17, which may be made of rubber or any other suitable material, is secured to the upper portions of the tappet body member 13 and has an aperture wherein passes the bolt-like member 14. The primary purpose of the resilient cap 17 is to prevent the bolt-like member 14 from having excessive lateral deflection and also serves as a partial seal.

Considering now the operation of the automatic tappet which maintains a constant clearance in the valve mechanism linkage of an engine, it must both elongate and contract automatically, as the various parts of the engine expand or contract, tending to change the normal clearance.

Referring now to Figure 1 and assuming that the clearance in the valve mechanism is greater than that required for the oil films between the parts. In this instance, the load or force acting against the bolt-like member 3 is small. When this occurs, the loaded torsion spring 6 provides a rotating torque to the bolt-like member 3. As a result thereof, the bolt-like member 3 unscrews out of the tappet body member 2 until the excessive clearance is eliminated or until the bolt-like member meets enough resistance from the push rod 5 to overcome the torque load from the spring 6. Thereupon the automatic tappet has taken up looseness or slack in the valve linkage to effect a normal desired clearance. The just-described operation is similar for the embodiment shown in Figure 7.

Assuming now that the expansion and contraction of the engine parts are such as to decrease the normal clearance. When this occurs, a shortening or contraction of the automatic tappet is required. Under this condition, when the tappet is lifted by the cam section 1*a* and the valve opens, an appreciable load is applied to the bolt-like member 3. The load is caused by the compression of the valve spring and inertia load. The load applied to the bolt-like member 3 is transferred through the spring leaves 8 to the threads 10 of the tappet body member 2. As a result thereof, the spring leaves 8 deflect radially so that their contacts with the female threads will ride radially inward toward the inner edges of the female threads. Since the female threads 10 are helical, the movement of the leaves 8 will be radially inward and downward at the same time.

More specifically, when the stem 3 is loaded during the lifting of the valve, the flexible threads 8 will bend as shown in dotted lines in Figure 1A. In so bending, any point C on the deflectable leaves 8 will move in radially to a position D. Thus, the spring leaves 8 slide radially inward relative to the threads 10. However, since the threads 10 are helical and thus have a circumferential incline or pitch, the point C in moving inwardly will also slide down the incline to a circumferentially displaced lower point D. Therefore the outer ends of the spring leaves 8 will slide both inward and downward over the threads 10 when the leaves are deflected under load. A repeated cycle of flexing and release of the springs 8 would cause the tappet to be foreshortened during each load application a step at a time as shown in Figure 1B until a clearance exists in the linkage whereupon the torsion spring 6 will elongate the tappet to take up the clearance. When the valve is seated and the corresponding load on the bolt-like member 3 is reduced, the leaves 3 return to their normal seating position in the threads 10. This downwardly slipping of the leaves 8 on the internal threads 10 results in the bolt-like member assembly 3 screwing down into the tappet body member 2 each time a spring leaf deflecting load is applied. Thereupon the automatic tappet contracts to provide the proper clearance.

Referring now to the embodiment shown in Figure 7, the operation is similar to that just described for Figure 1. In this instance, however, the deflection of the split washers 16 moves their inner diameters or ends outwardly and instead of sliding downwardly the deflected washers which are held against rotation will cause the bolt to rotate for shifting the inner ends of the washer to downhill positions. This rotation of the bolt foreshortens the tappet and is successively induced each time the washers are deflected until the desired clearance is developed whereupon the torsion spring will prevent undesired looseness by reversely rotating the bolt.

It will, of course, be understood that modifications and variations may be effected without departing from the scope of the novel concepts of the present invention.

I claim as my invention:

1. In an automatic clearance mechanism for valve linkage, a pair of nested inner and outer threadably cooperating members whose relative positions determine the effective length of the mechanism, a torsion spring encompassing one of said threadable members and secured to both of said threadable members for threadedly adjusting the length of said mechanism in one direction, the threads on one of said members comprising a circumferentially continuous flexible member deflectable axially in response to increased load to slidably engage the other threadable member, thereby to slidably adjust the length of said mechanism in an opposite direction.

2. A clearance regulator comprising first and second parts in telescoping relation and adapted to be extended and contracted to change their over-all length, said first part having a helical thread thereon facing the second part, resiliently deflectable thread-forming means carried by said second part and riding freely in the threads of the first part, and spring means acting to unscrew said first and second parts to extend the effective over-all length thereof, said thread forming means deflecting under load in said threads of the first part to slide radially inward and downwardly thereof to cause the first and second parts to telescope together for contracting the effective over-all length of the parts.

3. A slack adjusting apparatus comprising a tube member and a stem member having one end telescoped in said tube member and arranged to be relatively translated with respect to one another to selectively vary the axial spacing dimension between separated points on the members, and flexible thread forming means between said members to transfer axial loads from one of said members to the other of said members and being resiliently flexible in response to an increased axial load, said thread forming means together with at least one of said members providing mating abutting surfaces lying in a plane intersecting the common axis of said members at an acute angle, any two coincident contact points on said surfaces generating a resultant path of relative displacement with respect to one another which includes an axial component of substantial quantitative amount, thereby to automatically adjust the axial spacing dimension in one direction in response to increased load.

4. A slack adjusting apparatus comprising a tube member and a stem member having one end telescoped in said tube member and arranged to be relatively translated with respect to one another to selectively vary the axial spacing dimension between separated points on the members, flexible thread forming means between said members to

transfer axial loads from one of said members to the other of said members and being resiliently flexible in response to an increased axial load, said thread forming means together with at least one of said members providing mating abutting surfaces lying in a plane intersecting the common axis of said members at an acute angle, any two coincident contact points on said surfaces generating a resultant path of relative displacement with respect to one another which includes an axial component of substantial quantitative amount, thereby to automatically adjust the axial spacing dimension in one direction in response to increased load, and a torsion loading means between said members to automatically adjust the axial spacing dimension in an opposite direction whenever said members are unloaded.

5. In an automatic clearance mechanism, two movable parts adapted to be translated along a common axis to vary the spacing dimension between two separated points on said parts, thread means bridging and connecting said parts including flexible spring leaf male threads, at least one of said parts being in firm assembly with said male threads, the other of said parts having rigid threads mating with said male threads and together therewith providing inclined confronting abutment surfaces wherein any two coincident contact points generate a resultant displacement path which includes an appreciable component in the direction of said axis in response to deflection of said male threads upon increased axial loading of said two movable parts.

6. In an automatic clearance mechanism, two movable parts adapted to be translated along a common axis to vary the spacing dimension between two separated points on said parts, thread means connecting said parts including flexible male threads deflectable in axial direction in response to increased axial loads on said parts, at least one of said parts being in firm assembly with said male threads, the other of said parts having rigid threads mating with said male threads and together providing inclined confronting abutmet surfaces wherein any two coincident contact points generate a resultant displacement path which includes an appreciable component in the direction of said axis, and continuous biasing means between said two parts loading said parts for relative movement in an opposite direction.

7. A slack adjusting apparatus, comprising, a pair of relatively translatable telescoping members controlling the axial spacing dimension between separated points on said members, circumferentially continuous axially flexible thread forming means interconnecting said members and flexing in response to increased axial load to automatically adjust the axial spacing dimension in one direction.

8. In a clearance regulator, a body member having a recess with helical threads, a stem member received in said recess and having a plurality of longitudinally spaced radially outwardly extending spring members of substantially the pitch of said threads, said spring members being twisted to match the helix angle of said threads, thereby to advance said stem relative to said body, and said spring members being resilient to deflect under increased load for sliding movement relative to said threads, thereby to adjust the effective length of said body and stem members.

9. In a clearance regulator, a body member having a recess, helically shaped spring means in said recess and firmly assembled in said body member, a stem member received in said recess having threads on the peripheral surface thereof of mating pitch and helix angle with said spring means to effect axial adjustment of said members, said spring means being resilient to deflect under increased load for sliding movement relative to said threads, thereby to adjust the effective length of said body and stem members.

10. In a valve operating mechanism, a stem member having a socket at one end adapted to engage a push rod, a body member adapted to engage a cam and embracing a portion of said stem, and helical thread means between said stem member and said body member including resilient male threads flexing in response to increased axial load and providing an inclined abutment surface wherein a contact point will generate a resultant path of displacement with respect to the contact point and an adjoining thread surface initially coincident therewith which will include an appreciable axial component, thereby to automatically adjust the effective axial length of said body and stem members.

11. In a valve operating mechanism, a body member having a recess, a plurality of helically shaped split washers in said recess, internal threads in said recess supporting said washers, locking means between said washers and said body member locking said washers in said threads, a stem member received in said recess having threads on the peripheral surface thereof mating in pitch and helix angle with said washers to effect axial adjustment of said members, said washers being resilient to deflect under increased load for sliding movement relative to said threads, thereby to adjust the effective length of said body and stem members.

12. In a valve operating mechanism, a body member having a recess, a plurality of helically shaped split washers in said recess, internal threads in said recess supporting said washers, locking means between said washers and said body member locking said washers in said threads, a stem member received in said recess having threads on the peripheral surface thereof mating in pitch and helix angle with said washers to effect axial adjustment of said members, said washers being resilient to deflect under increased load for sliding movement relative to said threads, thereby to adjust the effective length of said body and stem members, said threads being wider than the thickness of said washers for accommodating axial deflection of said washers.

13. In a clearance regulator, a body member having a recess, a helical coil spring in said recess, internal threads in said recess supporting said spring, a stem member received in said recess having threads on the peripheral surface thereof mating in pitch and helix angle with said helical spring to effect axial adjustment of said members, said helical spring being resilient to deflect under increased load for sliding movement relative to said threads, thereby to adjust the effective length of said body and stem members.

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