United States Patent [19]

Winklhofer et al.

[11] **3,802,286**

[45] **Apr. 9, 1974**

[54] **CHAIN TENSIONING DEVICE**

[75] Inventors: **Gerhard Winklhofer,** Krailling; **Hermann Zollner,** Munich; **Adam Biedermann,** Puchheim, all of Germany

[73] Assignee: **Joh. Winflhofer & Sohn,** Munich, Germany

[22] Filed: **Feb. 26, 1973**

[21] Appl. No.: **335,458**

[30] **Foreign Application Priority Data**

Mar. 16, 1972 Germany 2212818

[52] **U.S. Cl.** ..... **74/242.11 S**

[51] **Int. Cl.** **F16h 7/08**

[58] **Field of Search** ..... 74/242.11 S, 242.13 A

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3,626,776 12/1971 Staudinger et al. ..... 74/242.11 S

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Primary Examiner—Leonard H. Gerin

[57] **ABSTRACT**

A chain tensioning device in which a plunger axially movable in a cylinder carries a chain engaging head and is biased outward of the cylinder cavity by a compression spring. One of two guide elements engaging each other for threaded movement substantially about the cylinder axis is secured to the plunger while the other guide element is fixedly fastened to one part of a unidirectional ratchet coupling, the other coupling part being fastened to the cylinder. The engaged coupling permits the plunger and chain engaging head to move outward of the cylinder cavity while preventing movement of the plunger toward a retracted position. An operating shaft is accessible outside the cavity for manual disengagement of the ratchet coupling and rotation of the second guide element to move the plunger into its retracted position against the compression spring. A manually releasable locking device locks the plunger in the retracted position.

12 Claims, 14 Drawing Figures

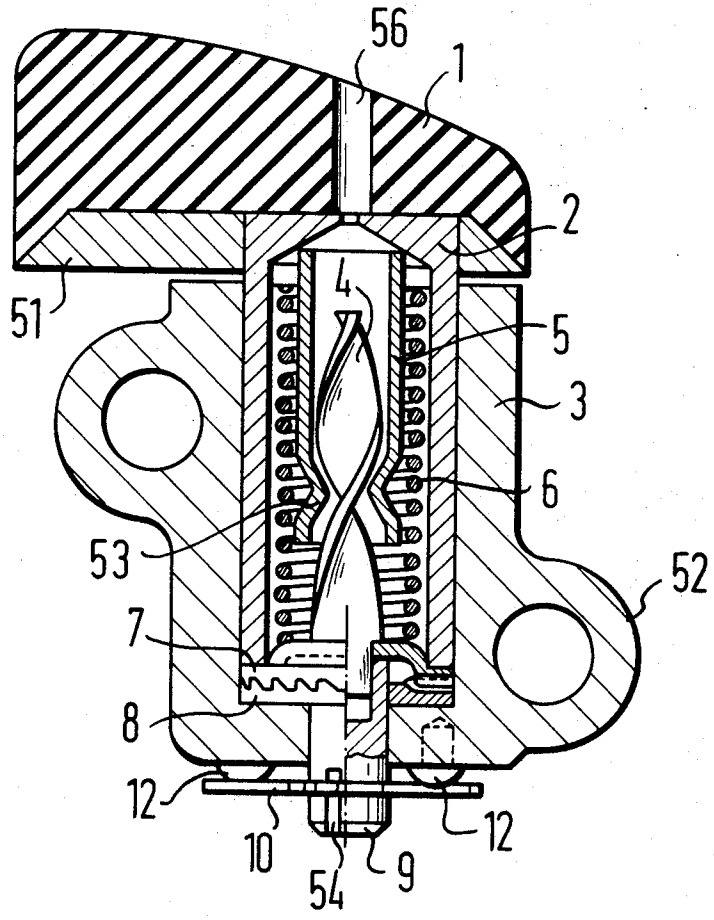


Fig.1

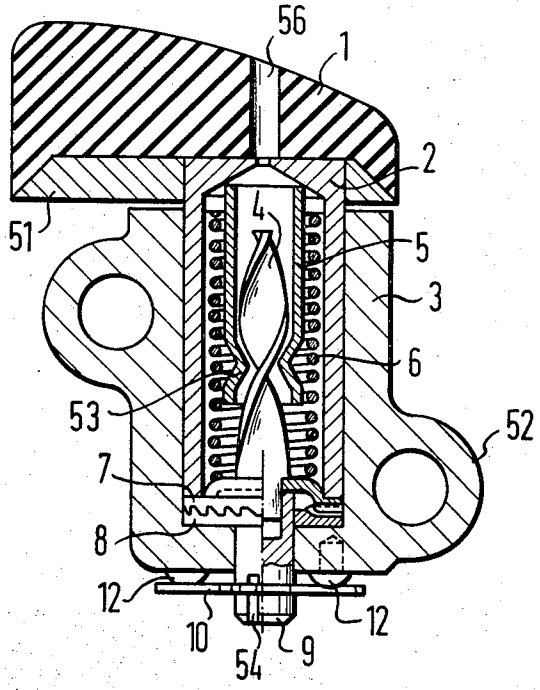


Fig.2

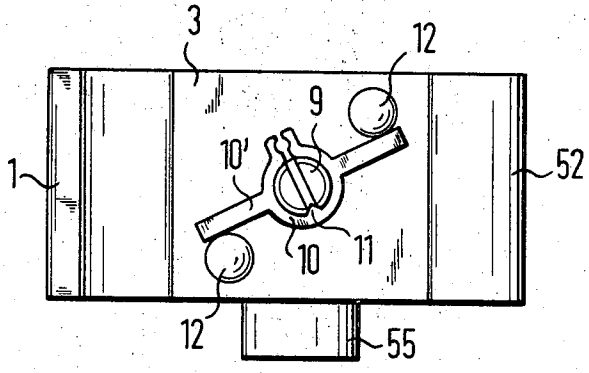


Fig.3

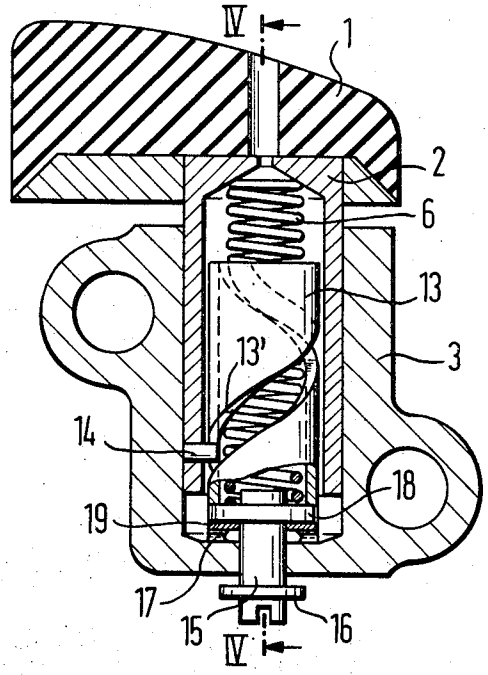


Fig.4

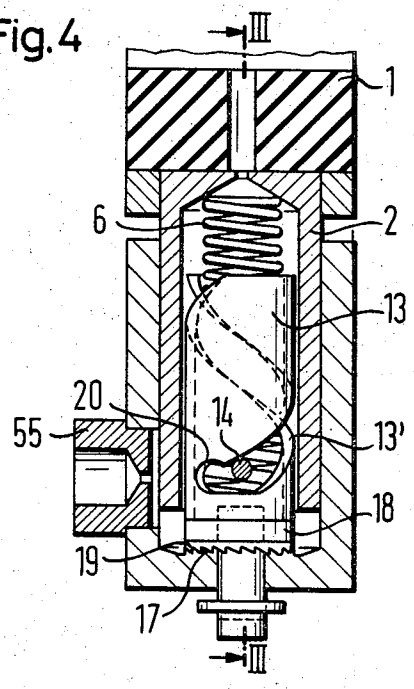


Fig.5

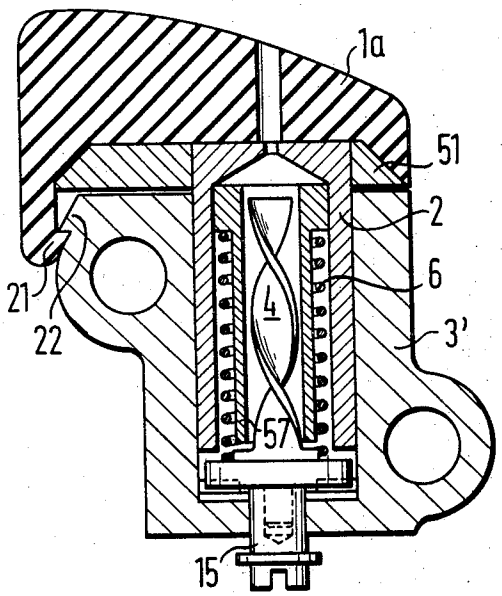


Fig.6

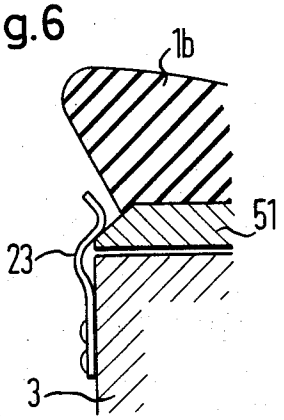


Fig.9

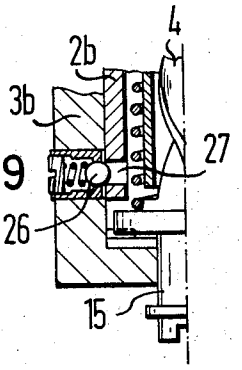


Fig.8

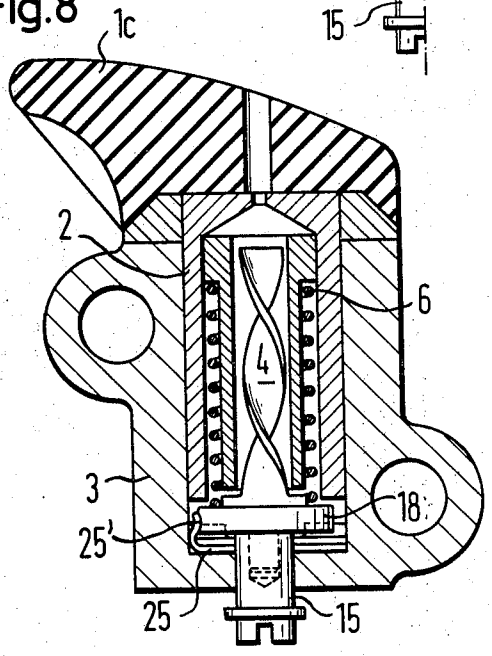


Fig.7

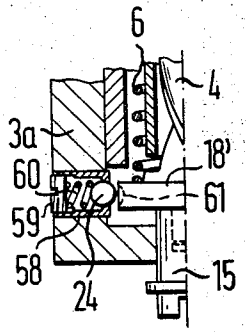


Fig.10

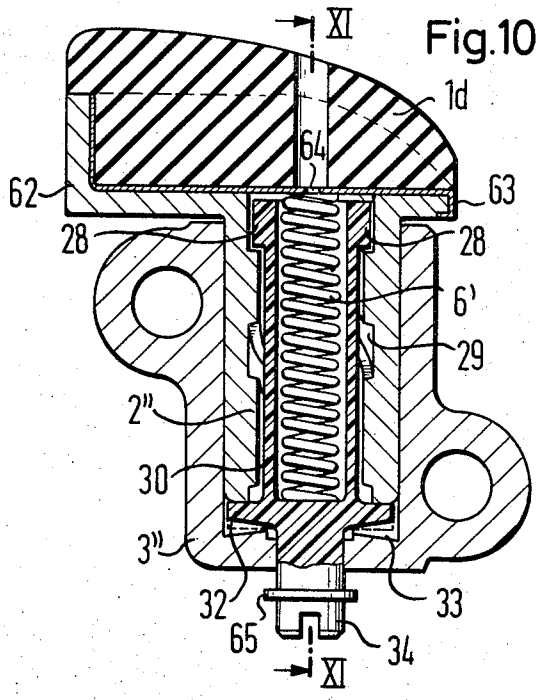
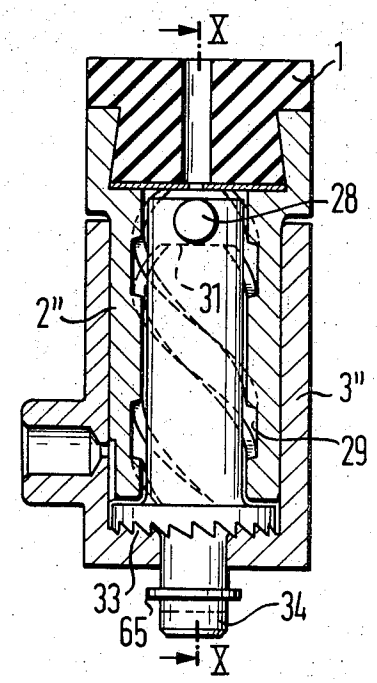


Fig.11



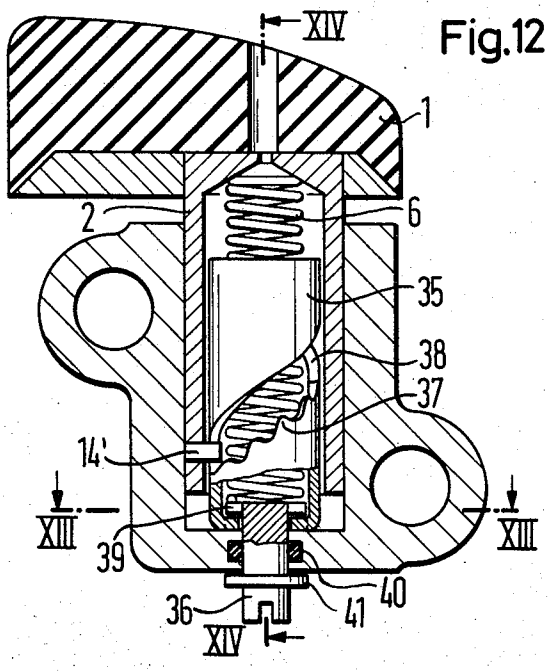


Fig.12

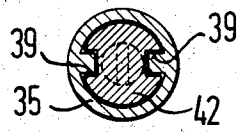


Fig.13

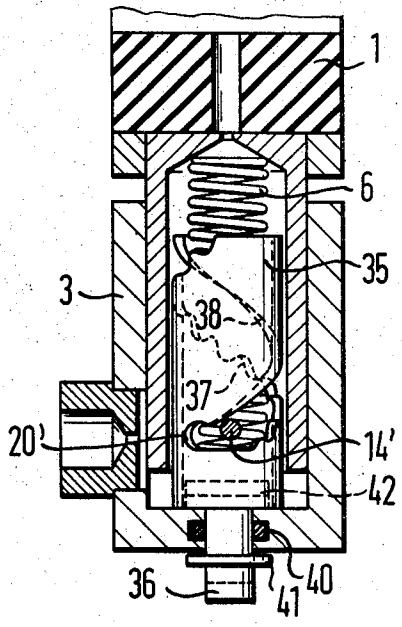


Fig.14

CHAIN TENSIONING DEVICE

This invention relates to tensioning devices for transmission belts, chains, and like elongated, flexible, power transmitting elements, and particularly to an improvement in the tensioning device for the timing chain of an internal combustion engine disclosed in the German Pat. application No. 1,775,273, published on May 27, 1971.

The known device includes two telescopically engaged members, hereinafter referred to as a cylinder and a plunger, which are movable relative to each other in the direction of their common axis, the plunger being biased outward of the cylinder cavity by a compression spring. Two guide elements engaged for relative threaded movement about the common axis of the cylinder and the plunger are fixedly fastened to the plunger and to one of two ratchet elements respectively, the other ratchet element being fixedly fastened to the cylinder to prevent relative threaded movement of the guide elements in a direction that would permit movement of the plunger inward of the cylinder cavity.

When the device is arranged on a suitable fixed support with the axis transverse to the direction of movement of the chain to be tensioned, the tensioning head is held in resilient engagement with the chain by the compression spring, and is moved outward of the cylinder in steps corresponding to the spacing of the ratchet teeth as the chain stretches to keep the chain in tensioned conditions.

Ultimately, the chain becomes too long to permit proper operation even with the aid of the tensioning device, and must be replaced. The tensioning device, for cooperation with the new chain, must be restored to the original condition, that is, the plunger and the head must be retracted inward of the cylinder. This cannot be done in the known device without partly disassembling the same. The compartment, normally oil-filled, which houses the timing chain of most internal combustion engines, and in which the tensioning device is mounted, is downwardly open to the oil sump of the engine in the crankcase, and a small part removed from the chain tensioning devie during partial disassembly may accidentally drop into the sump and be very difficult to recover. Yet, it may cause serious damage to the engine unless removed.

The object of the invention is an improvement in the known device which permits the engaging head of the device to be retracted for cooperation with a newly installed chain without removing anything from the device.

It is another object to provide a locking device, manually releasable, which holds the engaging head in the retracted condition and out of the way of the old chain being removed and the new chain being installed until tensioning engagement of the head with the chain is again required.

With these objects in view, the invention provides a tensioning device for a chain or other elongated, flexible, power transmitting element which includes a cylinder arranged for mounting on a stationary support and a plunger received in the cylinder for axial movement inward of the cylinder cavity into a retracted position, and outward of the cavity away from the retracted position. A chain engaging head is mounted on the plunger outside the cavity for joint axial movement. The

plunger is resiliently biases away from the retracted position and is secured to a first guide element. A second guide element is rotatable in the cylinder cavity and engages the first element for relative helical movement of the guide elements substantially about the cylinder axis, whereby the second guide element is rotated about the axis in one direction during the outward movement of the plunger. A ratchet device on the second guide element limits inward movement of the plunger under axial pressure applied to the chain engaging head to a substantially constant maximum distance in all axial positions of the plunger spaced from the retracted position. Operating means are accessible outside the cylinder cavity for manually turning the second guide element in a direction to move the plunger into its retracted position. A manually releasable locking device permits the plunger to be locked in the retracted position.

Other features, additional objects, and may of the attendant advantages of this invention will readily be appreciated as the same becomes better understood by reference to the following detailed description of preferred embodiments when considered in connection with the appended drawing in which:

FIG. **1** shows a chain tensioning device of the invention in side-elevational section on its axis;

FIG. **2** illustrates the device of FIG. **1** in bottom plan view;

FIG. **3** shows another tensioning device of the invention in section on the line III—III in FIG. **4**;

FIG. **4** is a sectional view of the device of FIG. **3** taken on the line IV—IV;

FIG. **5** illustrates yet another tensioning device of the invention in a view corresponding to that of FIG. **1**;

FIGS. **6, 7,** and **9** show modified details for use in the device of FIG. **5**;

FIG. **8** is a side-elevational, sectional view of yet another modification of the device of FIG. **5**;

FIG. **10** illustrates a further tensioning device of the invention in section on the line X—X in FIG. **11**;

FIG. **11** shows the device of FIG. **10** in section on the line XI—XI;

FIG. **12** is a view of an additional tensioning device of the invention in front-elevational section on its axis;

FIG. **13** illustrates the device of FIG. **12** in fragmentary section on the line XIII—XIII; and

FIG. **14** shows the device of FIG. **12** in section on the line XIV—XIV.

Referring initally to FIGS. **1** and **2,** there is shown a chain tensioning device for tensioning the timing chain of an internal combustion engine. It includes a cushion **1** of oil-resistant, synthetic rubber which engages the moving chain to be tensioned when the device is installed in its normal operating condition. The cushion **1** is backed by a metal frame **51,** and the chain engaging head formed by the cushion **1** and frame **51** is fixedly fastened to a plunger **2** having the approximate shape of an inverted, tall, cylindrical cup. The plunger **2** is coaxially received in a cylinder **3** integrally cast with two mounting lugs **52** which permit the device to be installed on a stationary engine part, such as the cylinder block or the timing chain cover.

A guide spindle **4** having approximately one turn each of steeply pitched, dual threads is a strip of glass-fiber reinforced plastic twisted about the common axis of the plunger **2** and cylinder **3.** It engages a matingly

threaded guide nut 53 which is a suitably shaped axial portion of an otherwise cylindrical tube 5 fixedly and coaxially fastened to the transverse top wall of the plunger 2 and depending therefrom. The tube 5 partly envelops the spindle 4, and the tube 5 together with the inner, axial wall of the plunger 2 bounds an annular space in which an axial portion of a helical compression spring 6 is received.

The spring is axially confined between the aforementioned transverse wall of the plunger 2 and a crown wheel 7 fixedly and coaxially fastened to the end of the spindle 4 remote from the cushion 1. The spring 6 normally holds the wheel 7 in conforming, locking engagement with a complementary, annular crown wheel 8 fixedly fastened to the bottom wall of the cylinder 3. The wheels 7, 8 have each a crown of radial ribs or ratchet teeth closely similar in cross section to saw teeth so that the two wheels constitute a uni-directional ratchet coupling which permits relative angular displacement of the spindle 4 and the cylinder 3 in one direction under an applied torque sufficient to overcome the locking force of the spring 6.

An operating shaft 9 coaxially and fixedly attached to the spindle 4 and the wheel 7 rotatably extends through central bores of the wheel 8 and of the cylinder bottom outward of the cylinder 3. The portion of the shaft 9 accessible outside the cylinder 3 has a slot 54 in an axial plane which permits the shaft 9 to be turned manually by means of an inserted tool or ket. A split, spring-metal washer 10 carrying two integral, diametrically opposite,radial locking arms 10′ is secured on the exposed part of the shaft 9 against rotation by an integral projection 11 of the washer 10 which engages the slot 54. In the illustrated position of the apparatus, the washer 10 is axially spaced from the outer, radial end wall of the cylinder 3 a distance slightly greater than the engaged axial height of the teeth on the wheels 7, 8. The rounded heads 12 of two rivets inserted in the bottom wall of the cylinder 3 abuttingly engage the resilient arms 10′ and prevent counterclockwise rotation of the spindle 4 and the shaft 9 from the position shown in FIG. 2 under the pressure exerted by the spring 6 which tends to drive the plunger 2 out of the cylinder 3.

A nipple 55, better seen in FIG. 4, normally is supplied with lubricating oil during operation of the tensioning device, and the oil is discharged through a duct 56 leading from the cavity of the plunger 2 to an orifice in the cushion 1. Restricted throttling passages in the nippe 55 and the duct 56 prevent sudden relative motion of the plunger 2 and the cylinder 3 when the device is filled with non-compressible oil, this dash-pot effect being analogous to that of a liquid-filled automotive shock absorber.

The apparatus of FIGS. 1 and 2 is operated as follows:

The cylinder 3 is mounted by means of the lugs 52 on an internal combustion engine (not shown) in the normally oil-filled compartment which houses the valve timing chain and the cooperating sprockets on the crankshaft and the camshaft of the engine. A new timing chain, properly installed, is spacedly adjacent the face of the cushion 1 which is directed obliquely upward in the view of FIG. 1.

Oil under pressure is fed to the timing chain compartment through the nipple 55, the interior cavity of the cylinder 3 and the plunger 2, and the duct 56, so that a film of fresh lubricant is maintained between the timing chain and the cushion 1, and oscillations of the plunger assembly are damped. The oil is returned to a pump from the compartment in a conventional manner, not relevant to this invention. Flutter of the chain may move the cushion 1 inward of the cylinder 3 over a maximum axial distance corresponding to one tooth spacing of the wheels 7, 8 against the return pressure of the spring 6 in all positions of the plunger 2 except the illustrated fully retracted position.

As the chain stretches, the cushion 1 moves axially away from the cylinder 3, and the resulting relative axial motion of the tube 5 and the spindle 4 causes the latter to turn counterclockwise, as viewed in FIG. 2. The slope of the saw teeth on the crown wheels 7, 8 is sufficiently shallow to permit stepwise rotation. Flutter in the chain cannot compress the spring 6 because of the ratchet effect of the crown wheels 7, 8 by an amount greater than that determined by the circumferential length of one tooth on the wheels 7, 8.

When stretching of the chain can no longer be compensated for by the advancing cushion 1, the chain needs to be replaced, and the chain tensioning device must be restored to its original, illustrated condition to permit removal of the old chain and installation of a new one. For this purpose, a key, such as a flat steel bar, a screwdriver, or the like, is inserted into the slot 54, and the shaft 9 is pushed inward of the cylinder 3 until the teeth of the wheel 7 clear those of the wheel 8, and the washer 10 abuts against the outer bottom face of the cylinder 3. The plunger 2 may now be retracted by manually turning the shaft 9 in a direction which is clockwise, as viewed in FIG. 2, the manually applied force being sufficient to deflect the arms 10′ as they move over the rivet heads 12 into the illustrated position in which the plunger 2 is axially locked against the force of the spring 6 until the arms 10′ are again moved counterclockwise over the heads 12 to release the spring 6 after installation of the new timing chain.

During replacement of the timing chain, the tensioning device of the invention remains in the fully assembled condition, and no loose parts can be dropped into the non-illustrated sump at the bottom of the timing chain compartment.

Except as specifically set forth, the embodiments of the invention described hereinbelow with reference to FIGS. 3 to 14 are closely similar in structure and operation to the chain tensioning device illustrated in FIGS. 1 and 2, and identical elements are provided with the same numerals, and may not again be described.

The two guide elements which connect the plunger 2 with a ratchet coupling in the apparatus illustrated in FIGS. 3 and 4 are a cylindrical sleeve 13 and a pin 14 respectively, the pin projecting from the plunger 2 into a groove or slot 13′ in the sleeve 13. The groove extends in one helix turn about the common axis of the sleeve 13, the plunger 2, and the cylinder 3. The compression spring 6 is radially confined in the sleeve 13.

The operating shaft 15 which rotatably and axially slidably passes through the transverse end wall at the bottom end of the cylinder carries a radial flange 16 which limits axial movement of the shaft 15 inward of the cylinder cavity as described above with reference to the spring washer 10. The ratchet coupling which may be disengaged by axial movement of the shaft 15

is constituted by an integral rim of teeth **17** on the aforementioned end wall of the cylinder **3** and a second, conforming rim **19** on another flange **18** attached to the shaft **15**. The set screws which fixedly attached the flanges **16, 18** to the shaft **15** in a conventional manner have been omitted from the drawing. The flange **18** is fixedly fastened, as by soldering (not shown), to the lower, annular edge of the sleeve **13**.

As is better seen in FIG. **4**, wall portions of the sleeve **13** bound a lateral or axial pocket **20** at the lower end of the slot **13'**. When the plunger **2** is moved to its fully retracted position by means of the shaft **15** and a suitable key inserted in a tool-receiving transverse slot of the shaft, as described above, the pin **14** is axially aligned with the pocket **20**. When the shaft **15** is released, the spring **6** causes the pin **14** to be retained in the pocket **20**, thereby locking the plunger **2** in the retracted position until it is released manually by again moving the shaft **15** axially and turning the shaft until the pin **14** is out of alignment with the pocket **20**.

In the several modified tensioning devices illustrated in FIGS. **5** to **9**, a flanged shaft **15** substantially identical with that described with reference to FIGS. **3** and **4** is fixedly fastened to a guide spindle **4** identical with that shown in FIG. **1** and cooperating with a guide nut on a tube **57** fixedly fastened to the plunger **2**, the nut having been omitted from FIGS. **5** to **9** since its structure and operation will be adquately understood from FIG. **1** and the nut **54** shown therein. FIGS. **5** to **9** particularly illustrate the locking devices which hold the plunger assembly including the plunger **2**, the tube **57** and the chain-engaging head on the plunger in the retracted position of the plunger during installation of a new timing chain as described above.

The rubber cushion la on the frame **51** of the chain-engaging head illustrated in FIG. **5** has a hook-shaped, resilient lip portion **21** which conformingly engages a hook-shaped projection **22** of the cylinder **3'** in the fully retracted position of the plunger assembly shown in FIG. **5**. The lip portion **21** is readily disengaged manually after installation of the chain to be tensioned so that the spring b can **6** can the cushion l*a* axially into the chain-engaging position.

The cushion **1***b* illustrated in FIG. **6** is dimensioned so as to expose a face of the frame **51** which is obliquely inclined toward the axis of the device in a direction away from the cylinder **3**. A spring clip **23** attached to the cylinder **3** engages the oblique face of the frame **51** in the fully retracted condition of the plunger assembly and may be disengaged either by direct manipulation of the clip **23**, or by merely turning the shaft **15** with a force sufficient to slip the frame **51** out from under the clip **23**.

Since the plunger assembly cannot move axially when the two guide elements are prevented from relative threaded movement, it is sufficient angularly to secure the shaft **15** and associated elements to lock the plunger assembly in the retracted position. The embodiment illustrated in FIGS. **1** and **2** employs a locking device based on this mode of operation. Others are shown in FIGS. **7** and **8**.

A radial bore in the cylinder **3***a* shown in FIG. **7** is provided with a fixedly fastened, internally threaded sleeve **58** having a restricted radially inner orifice, and outwardly closed by a threadedly adjustable plug **59**. A helical compression spring **60** in the sleeve **58** biases a steel ball **24** outward of the restricted orifice of the sleeve **58** and into a conforming recess **61** of the flange **18'** on the shaft **15**. The click stop arrangement constituted by the spring-loaded ball **24** can lock the plunger assembly of the apparatus of FIG. **7** in the retracted position, yet can readily be released by merely turning the shaft **15**.

The apparatus of FIG. **8** has a rubber cushion **1***c* in its chain-engaging head which is merely illustrative of the wide variety of modifications that may be applied to the individual elements of the chain tensioning apparatus of the invention. The plunger assembly of the device shown in FIG. **8** is held in the retracted position by means of a leaf spring **25** fixedly fastened in the cavity of the cylinder **3** to the transverse bottom wall of the latter. One end portion **25'** of the spring **25** is offset angularly from the remainder of the spring for frictional, braking engagement with the cylindrical outer circumference of the flange **18** on the shaft **15**.

In the modified apparatus shown in FIG. **9**, the locking device releasably locking the plunger assembly in the retracted position is interposed between the plunger **2***b* and cylinder **3***b*. A bore in the cylinder **3***b* is provided with a click stop not significantly different from that described with reference to FIG. **7** and including a steel bearing ball **26** which is spring biased inward of a radial bore **27** of the plunger **2***b*.

The synthetic rubber cushion **1***d* of the tensioning apparatus illustrated in FIGS. **10** and **11** is a portion of a chain-engaging head otherwise constituted by an integral, trough-shaped part **62** of a tubular plunger **2''**. The cushion is vulcanized to a brass liner **63** in the trough **62** which upwardly closes an axial bore of the plunger **2''0** and is formed with a throttling passage **64** communicating with the bore. Two helical grooves **29** in the wall of the bore extend each in about one turn about the common axis of the plunger **2'** and the cylinder **3''** in which the plunger is axially movable.

The grooves **29** are slidably engaged by respective short, cylindrical pins **28** projecting in opposite diametrical directions from a plastic sleeve **30** coaxial with the plunger **2''**. A helical compression spring **6'** is axially interposed in the central bore of the sleeve **30** between the liner **63** and a bottom wall **32** of the sleeve **30** which projects radially and carries a rim of ratchet ribs engaging a corresponding rim **33** of ratchet ribs integral with the lower, transverse end wall of the cylinder **3''**. An operating shaft **34** integrally injection-molded with the sleeve **30** and its bottom wall **32** is accessible outside the cylinder cavity as described with reference to the other tensioning devices of the invention, and carries a separately attached flange **65**.

Wall portions of the plunger **2''**, in addition to the helical grooves **29**, also bound a circumferential groove **31** which extends in a radial plane relative to the plunger axis immediately adjacent the liner **63**. When the plunger **2''** is in the illustrated, retracted, axial position, it may be turned by means of the shaft **34** to locate the pins **28** in the groove **31**, and thereby to lock the plunger **2''** in the retracted position.

FIGS. **12** to **14** show a chain-tensioning device of the invention which is somewhat similar to that described above with reference to FIGS. **3** and **4**. A guide pin **14'** projects radially inward from the plunger **2** into a generally helical groove or slot **38** in a guide sleeve **35** coaxially received in the plunger **2** and enveloping the compression spring **6**. A lateral pocket **20'** at the lower longitudinal end of the slot **38** permits the plunger **2** to

be locked in its retracted position as described above with reference to FIGS. 3 and 4. The edge of the sleeve 35 upwardly bounding the slot 38 is smoothly helical, and the lower edge carries projecting ratchet teeth 37.

An operating shaft 36 projects axially from the bottom wall of the cylinder 3 in which the plunger 2 is movably received. The shaft 36 is axially secured by a radial flange 41 outside the cylinder cavity and an integral flange 42 in the cavity. Notches 39 in the flange 42 are engaged by lugs of the sleeve 35 which secure the sleeve against axial and angular movement relative to the shaft 36. A sealing ring 40 in the bottom wall of the cylinder 3 extends about the shaft 36.

During movement of the plunger 2 outward of the cylinder 3, as the associated timing chain stretches, the guide pin 14' normally is held in contact with the smooth edge of the slot 38 by the spring 6, and the sleeve 35 is gradually turned as the plunger 2 follows the stretching timing chain. During flutter of the chain, the axial pressure exerted by the chain on the cushion 1 can push the plunger 2 inward of the cylinder 3 only until the pin 14' is received between two ratchet teeth 37, the shape of the teeth being such that no significant circumferential force is exerted by the pin 14' on the sleeve 35. The slot 38 and the pin 14' thus combine the guide function of the elements 4, 53 in FIG. 1 with the uni-directional coupling function of the ratchet-toothed crown wheels 7, 8.

When it becomes necessary to replace the timing chain, a screwdriver or other key inserted into the slotted, accessible end of the shaft 36 permits the sleeve 35 to be turned, and the plunger 2 to be retracted thereby until the pin 14' is received in the pocket 20'. The wall of the pocket merges so gradually with that of the slot 38 that axial movement of the shaft 36 is not needed for disengaging the pin 14' from the pocket 20' after installation of a new timing chain. Manual turning force also is sufficient to dislodge the pin 14' from between two teeth 37 without axial movement of the shaft 36.

Frictional engagements between the plunger and the cylinder has been found sufficient in the several embodiments of the invention to prevent rotation of the plunger about the common axis when the plunger is retracted by means of the operating shaft. During normal operation, the angular position on the plunger assembly relative to the cylinder is secured by the chain engaging the rubber cushion 1 of the head. If necessary and desired, an axial rib on the cylinder may engage a corresponding groove in the plunger or vice versa to prevent rotation of the plunger in the cylinder. The problem, if any, is non-existent in a cylinder cavity and plunger of non-circular cross section, and such a device is specifically contemplated as a variation of the several cylindrical plungers illustrated.

The term "plunger," as employed in this specification and the attached claims does not exclude a suitably shaped piston combined with a piston rod projecting axially from the cylinder cavity and carrying the chain-engaging head.

It should be understood, therefore, that the foregoing disclosure relates only to preferred embodiments of the invention, and that it is intended to cover all changes and modifications of the examples of the invention herein chosen for the purpose of the disclosure which do not constitute departures from the spirit and scope of the invention set forth in the appended claims.

What is claimed is:

1. A tensioning device for an elongated, flexible, power transmitting element comprising, in combination:
   a. a cylinder member having an axis and defining a cavity therein;
   b. mounting means for mounting said member on a stationary support;
   c. a plunger member received in said cylinder member for axial movement inward of said cavity into a retracted position, and outward of said cavity away from said retracted position;
   d. an engaging head mounted on said plunger member outside said cavity for joint axial movement with said plunger member;
   e. yieldably resilient means interposed between said members and biasing said plunger member away from said retracted position thereof;
   f. a first guide element secured to said plunger member;
   g. a second guide element rotatable in said cavity about said axis and engaging said first guide element for relative helical movement of said guide elements, whereby said second guide element is rotated about said axis in one direction during said outward movement of said plunger member;
   h. ratchet means on said second guide element for limiting inward movement of said plunger member under axial pressure applied to said head to a substantially constant maximum distance in all axial positions of said plunger member spaced from said retracted position;
   i. operating means outside said cavity for manually turning said second guide element in a direction opposite to said one direction and for thereby moving said plunger member into said retracted position thereof; and
   j. manually releasable locking means for locking said plunger member in said retracted position axially outward movement.

2. A device as set forth in claim 1, wherein said ratchet means include a uni-directional coupling engageable to secure said second guide element to said cylinder member against relative angular movement in said opposite direction while permitting said angular movement in said one direction.

3. A device as set forth in claim 2, wherein said operating means include a shaft member extending axially outward of said cavity in a direction away from said head, said shaft member being fixedly fastened to said second guide element.

4. A device as set forth in claim 3, wherein said cylinder member has an end wall transverse to said axis, said shaft member passing axially and rotatably through said end wall, and abutment means limiting axial movement of said shaft member relative to said cylinder member to a distance sufficient for disengaging said coupling.

5. A device as set forth in claim 4, wherein the portion of said shaft member outside said cylinder is formed with a key-receiving recess.

6. A device as set forth in claim 3, wherein said locking means include a resilient arm projecting from said shaft member radially relative to said axis, and abutment means on said cylinder member engaging said arm and thereby limiting angular movement of said second guide element under the force of said yieldably resilient means, said arm being sufficiently resilient to

permit deflection of the same when said shaft member is being turned manually.

7. A device as set forth in claim **3,** wherein said second guide element is formed with a helical, elongated groove, and said first guide element engages said groove for longitudinal movement therein, a portion of said second guide element bounding a laterally enlarged pocket communicating with one longitudinally terminal portion of said groove, said portion of said second guide element jointly with said first guide element constituting said locking means, said first guide element being received in said pocket when said plunger member is locked in said retracted position, and being released from said pocket by movement of said shaft member axially inward of said cavity.

8. A device as set forth in claim **2,** wherein said locking means include a locking member, said cylinder member and said head constituting a pair of cooperating elements, said locking member being mounted on one of said cooperating elements, essentially consisting of reslient material, and lockingly engaging the other cooperating element under the resilient force thereof in said retracted position of said plunger member.

9. A device as set forth in claim **2,** wherein said head, said plunger member, and said one guide element jointly constitute a plunger assembly, and said locking means are operatively interposed between said assembly and said cylinder member for releasably locking said plunger member in said retracted position.

10. A device as set forth in claim **2,** wherein said locking means include a locking member mounted on said cylinder member and resiliently engaging said second guide element for impeding movement thereof relative to said cylinder member.

11. A device as set forth in claim **2,** wherein said plunger member has a central bore and is formed with an elongated, helical, first groove about said axis radially open toward said bore, wall portions of said plunger member bounding said groove and constituting said first guide element, said second guide element being tubular about said axis and carrying at least one radial projection received in said groove, additional wall portions of said plunger member bounding an elongated second groove extending in a radial plane relative to said axis, respective longitudinally terminal portions of said first and second grooves communicating with each other for sequential longitudinal movement of said projection in said first and second grooves, said additional wall portions in cooperation with said projection constituting said locking means.

12. A device as set forth in claim **1,** wherein said second guide element is formed with a helical, elongated groove, and said first guide element engages said groove for longitudinal movement therein, respective edge portions of said second guide element laterally bounding said groove, said ratchet means including a plurality of ratchet teeth on the edge portion bounding said groove in an axial direction away from said head, said ratchet teeth projecting into said groove and being spaced in the direction of groove elongation for receiving said first guide element therebetween during said inward movement of said plunger member under said axial pressure.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,802,286 Dated April 9, 1974

Inventor(s) GERHARD WINKLHOFER ET AL

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

In the heading, line [73], change "Joh. Winflhofer & Sohn" to

-- Joh. Winklhofer & Söhne --

Signed and sealed this 6th day of August 1974.

(SEAL)
Attest:

McCOY M. GIBSON, JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents

FORM PO-1050 (10-69)

USCOMM-DC 60376-P69
* U.S. GOVERNMENT PRINTING OFFICE : 1969 O—366-334.