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(54) ADJUSTABLE SUPPORT FOR FIREARMS

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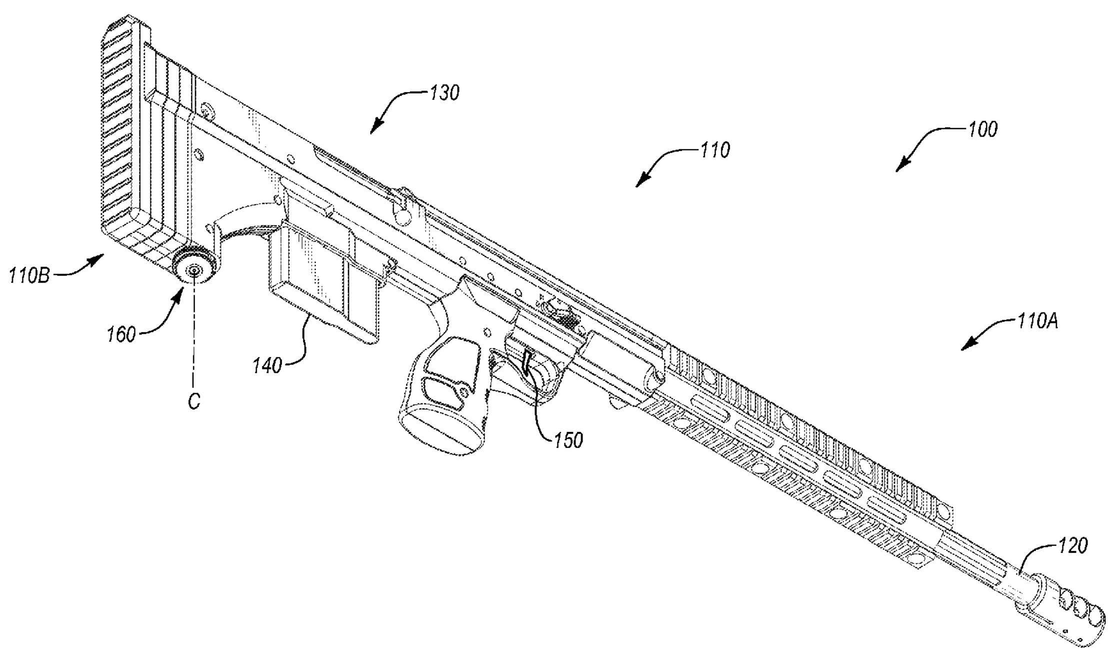
(57) ABSTRACT

An adjustable support for a firearm includes an extension shaft having a distal end, a proximal end, a central axis, and a plurality of engagement features formed at a plurality of axial locations between the distal end and the proximal end. A housing assembly is configured to house the extension shaft and defines a reference datum. At least one locking member is operatively associated with the housing assembly and is configured selectively engage the engagement features. An actuator is operatively associated with the housing assembly such that translation of the actuator relative to the central axis moves the locking members into and out of engagement with the engagement features on the extension shaft. Rotation of the actuator relative about the central axis moves the distal end of the extension shaft away from the housing assembly.



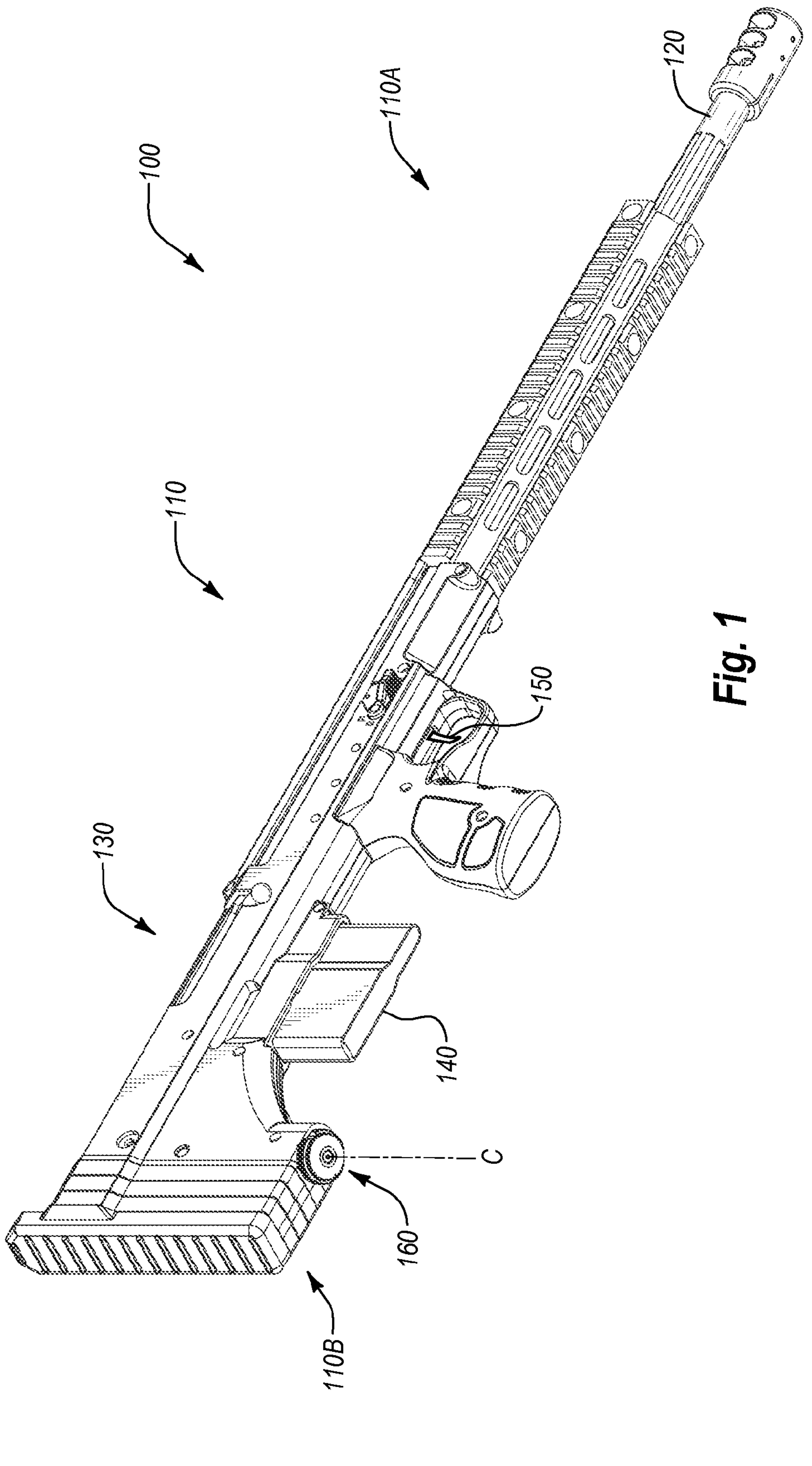


Fig. 1

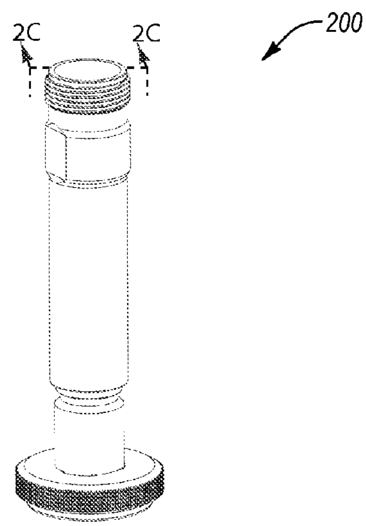

2C
2C
200

Fig. 2A

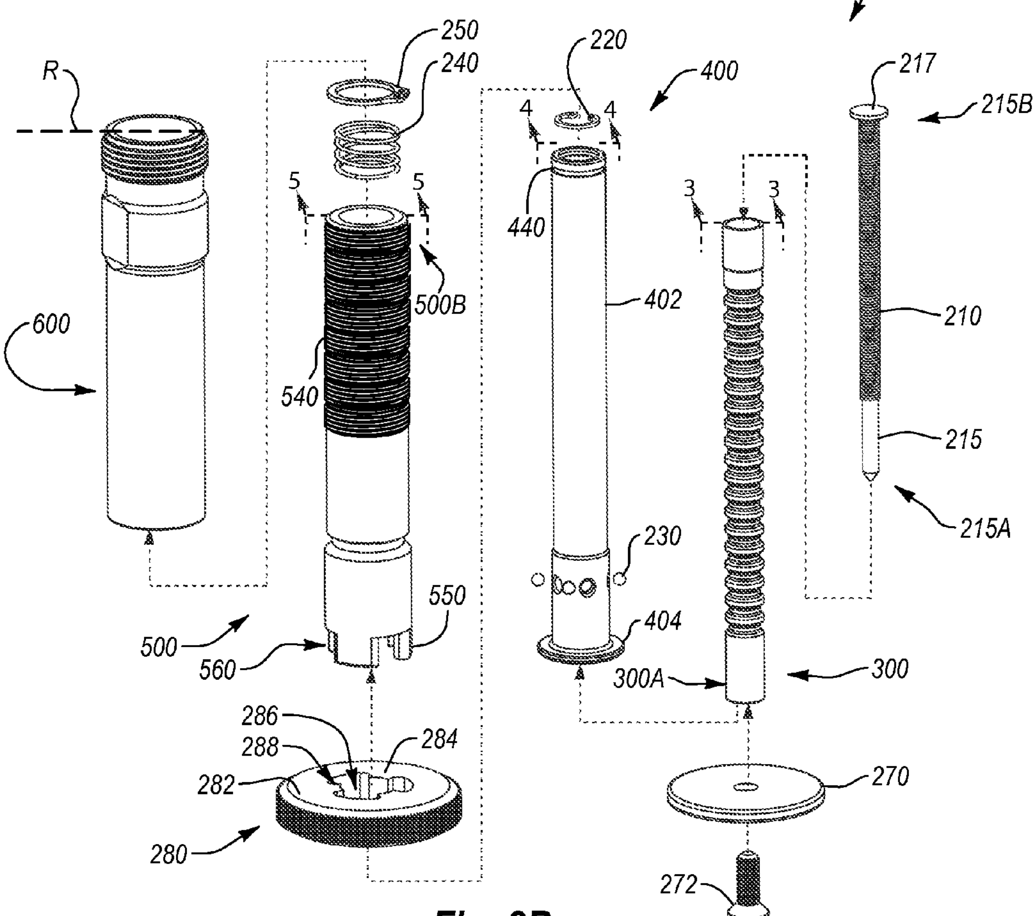

200
R
250
240
220
400
217
215B
4
4
5
5
440
3
3
500B
402
600
210
540
215
215A
230
550
404
500
560
300A
300
286
284
288
282
270
280
272

Fig. 2B

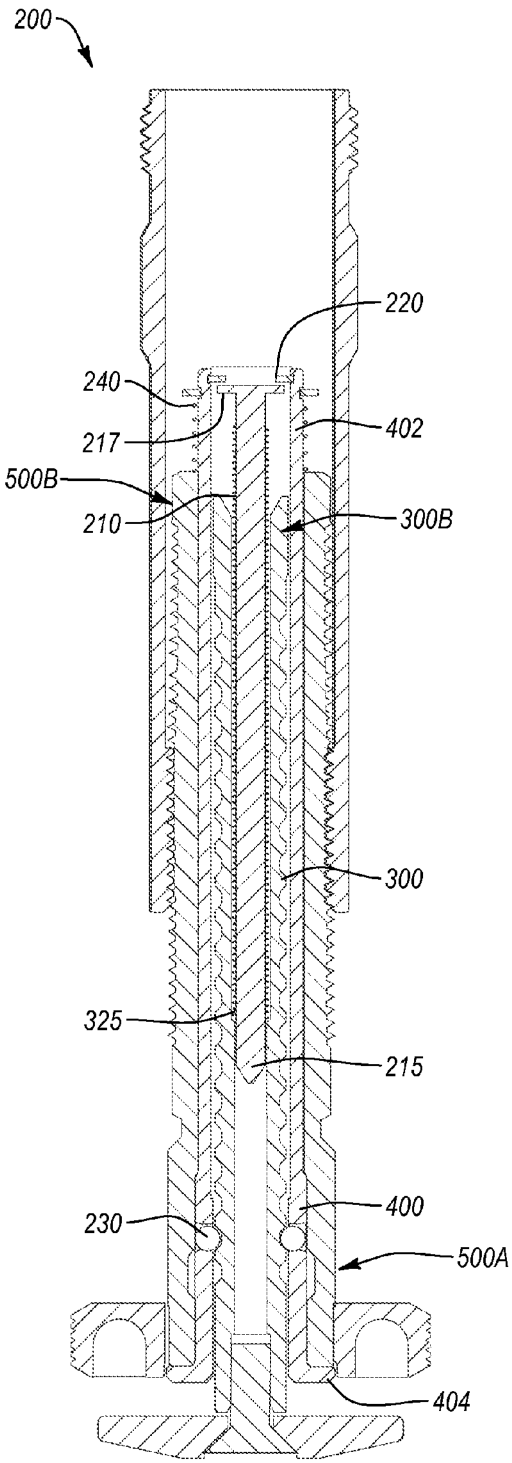

200
220
240
217
402
500B
210
300B
300
325
215
230
400
500A
404

Fig. 2C

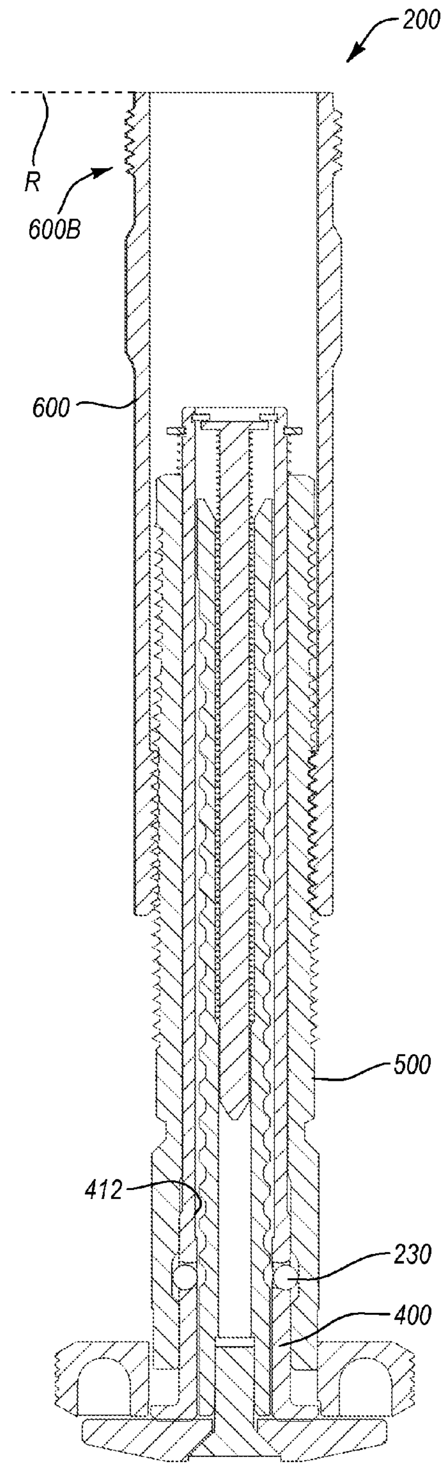

200
R
600B
600
500
412
230
400

Fig. 2D

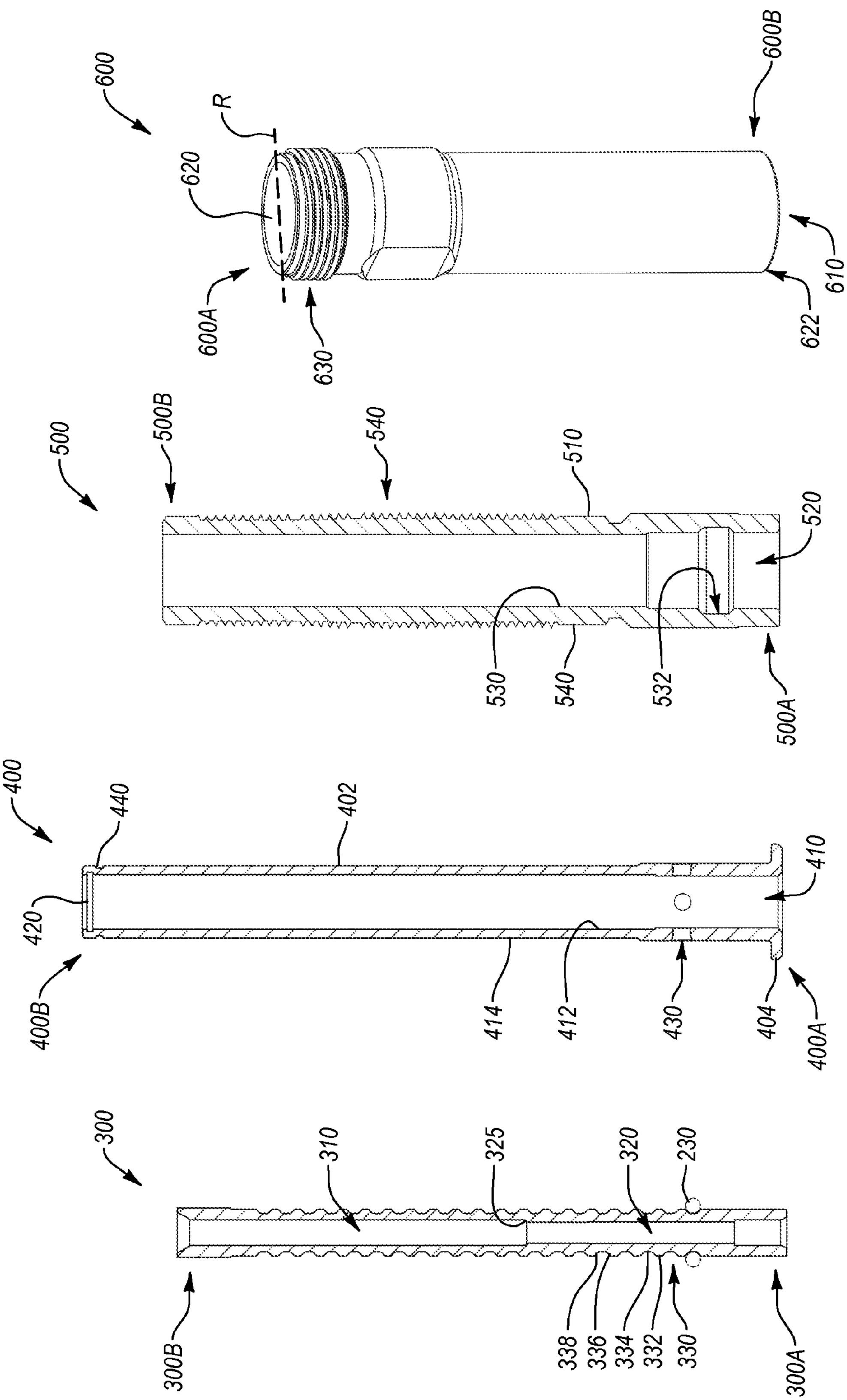


Fig. 6

Fig. 5

Fig. 4

Fig. 3

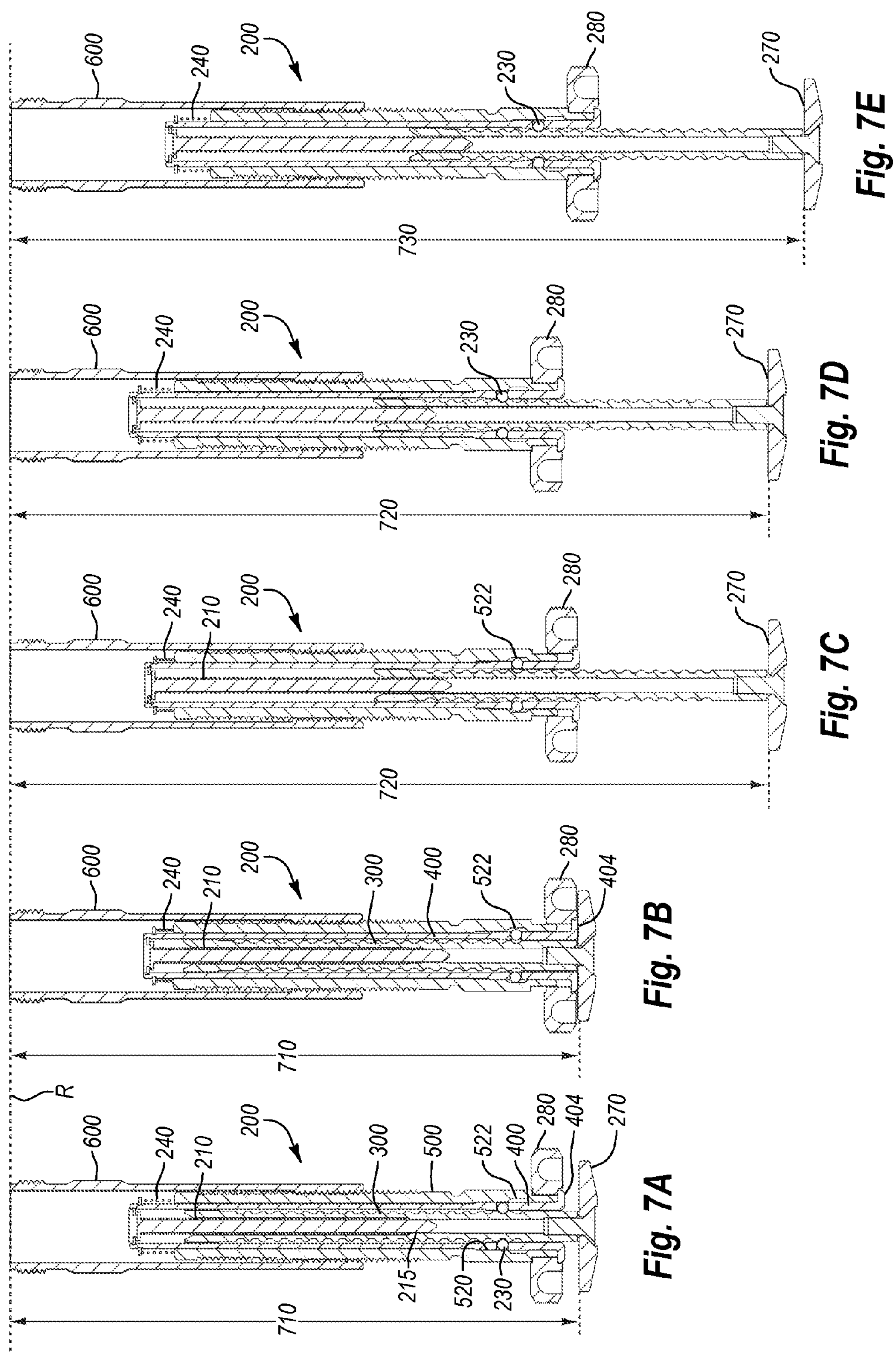


Fig. 7A

Fig. 7B

Fig. 7C

Fig. 7D

Fig. 7E

ADJUSTABLE SUPPORT FOR FIREARMS

BACKGROUND

[0001] 1. The Field of the Invention

[0002] The present application generally relates to adjustable supports for firearms, such as monopods and bipods.

[0003] 2. The Relevant Technology

[0004] Modern firearms make use of cartridges that include a projectile seated in a casing. The casing has an internal cavity defined therein that contains a charge of rapidly combusting powder. A primer is seated in a recess formed in a rear portion of the casing. A hole in the primer casing places the primer in communication with the internal cavity containing the power. A projectile is seated in the front portion of the casing such that the powder is more or less sealingly contained in the casing between the primer and the projectile.

[0005] An action, such as a bolt action, is used to advance the cartridge into a firing chamber ahead of firing. While in the firing chamber, a firing pin strikes the primer, causing the primer to ignite. The ignition is directed to the powder, which burns within the casing. The powder burning within the casing generates a rapidly expanding gas. The pressure generated by the rapidly expanding gas propels the projectile from the casing and through the barrel of the firearm toward an intended impact point. A sight is used to allow an operator to aim the projectile to the intended impact point.

[0006] For example, optical sights are often used that make use of an aiming point that is projected onto the intended target. Often, the optical sights provide magnification for the operator to view an intended impact point at long range more clearly and thus allow the operator to shoot more accurately. While magnification allows the operator to see intended targets at extended range more clearly, the field of view the operator is able to see at that range can be relatively small. Further, relatively small movements or variations in the orientation of the firearm can result in large variations in the actual impact point of the projectile.

[0007] Accordingly, operators often take several measures to steady the rifle at the desired orientation. Often, a bipod is used with the front stock and the operator then supports the butt end of the stock. While such a system supports the front end of the rifle, small variations in the orientation of the rear end of the rifle can also yield unsatisfactory results.

[0008] The subject matter claimed herein is not limited to embodiments that solve any disadvantages or that operate only in environments such as those described above. Rather, this background is only provided to illustrate one exemplary technology area where some examples described herein may be practiced.

BRIEF SUMMARY OF THE INVENTION

[0009] An adjustable support for a firearm includes an extension shaft having a distal end, a proximal end, a central axis, and a plurality of engagement features formed at a plurality of axial locations between the distal end and the proximal end. A housing assembly is configured to house the extension shaft and defines a reference datum. At least one locking member is operatively associated with the housing assembly and is configured selectively engage the engagement features. An actuator is operatively associated with the housing assembly such that translation of the actuator relative to the central axis moves the locking members into and out of engagement with the engagement features on the extension shaft. Rotation of the actuator relative about the central axis moves the distal end of the extension shaft away from the reference datum associated with the housing assembly.

[0010] This Summary is provided to introduce a selection of concepts in a simplified form that are further described below in the Detailed Description. This Summary is not intended to identify key features or essential characteristics of the claimed subject matter, nor is it intended to be used as an aid in determining the scope of the claimed subject matter.

[0011] Additional features and advantages of the invention will be set forth in the description which follows, and in part will be obvious from the description, or may be learned by the practice of the invention. The features and advantages of the invention may be realized and obtained by means of the instruments and combinations particularly pointed out in the appended claims. These and other features of the present invention will become more fully apparent from the following description and appended claims, or may be learned by the practice of the invention as set forth hereinafter.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] To further clarify the above and other advantages and features of the present invention, a more particular description of the invention will be rendered by reference to specific embodiments thereof which are illustrated in the appended drawings. It is appreciated that these drawings depict only typical embodiments of the invention and are therefore not to be considered limiting of its scope. The invention will be described and explained with additional specificity and detail through the use of the accompanying drawings in which:

[0013] FIG. **1** illustrates an firearm into which a monopod can be implemented according to one example;

[0014] FIG. **2**A illustrates an assembled perspective view of a monopod according to one example;

[0015] FIG. **2**B illustrates an exploded view of the monopod of FIG. **2**A;

[0016] FIG. **2**C illustrates a cross-sectional view of the monopod of FIGS. **2**A and **2**B in a first state taken along section **2**C-**2**C of FIG. **2**A;

[0017] FIG. **2**D illustrates a view of the monopod of FIGS. **2**A-**2**C taken along the same section as FIG. **2**A in which the monopod is in a second state;

[0018] FIG. **3** illustrates an isolated cross-sectional view of the extension shaft of FIG. **2**B;

[0019] FIG. **4** illustrates an isolated cross-sectional view of the first housing member of FIG. **2**B;

[0020] FIG. **5** illustrates an isolated cross-sectional view of the second housing member of FIG. **2**B;

[0021] FIG. **6** illustrates an isolated perspective view of the third housing member of FIG. **2**B;

[0022] FIG. **7**A illustrates a cross-sectional view of the monopod shown in FIGS. **2**A-**2**E in an locked, retracted state;

[0023] FIG. **7**B illustrates a cross-sectional view of the monopod of FIG. **7**A in an unlocked, retracted state;

[0024] FIG. **7**C illustrates a cross-sectional view of the monopod of FIGS. **7**A-**7**B in partially extended, unlocked position;

[0025] FIG. **7**D illustrates a cross-sectional view of the monopod of FIGS. **7**A-**7**C in partially extended, locked position; and

[0026] FIG. **7**E illustrates a cross-sectional view of the monopod of FIGS. **7**A-**7**D in partially extended, locked position in which the actuator is rotated while locked to adjust the extension of the distal end of the extension shaft.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0027] A monopod and rifle stocks including monopods are provided herein that provide both incremental adjustment as well as infinite adjustment for the extension of an extension shaft along an axis relative to a reference datum. The incremental adjustment as well as the infinite adjustment are controlled and manipulated by a single actuator. In at least one example, the actuator is a knob that is moved parallel to the axis to control the incremental adjustment while the knob can rotated relative to the central axis to provide infinite adjustment. Such a configuration can allow an operator to quickly extend the extension shaft to near a desired extension using the incremental adjustment and then to fine tune the position of the extension shaft with the infinite adjustment to the final desired position. Additional adjustments can be performed quickly using the same process.

[0028] In at least one example, rotation of the actuator is isolated from the extension shaft. Such a configuration can further increase the speed of moving the extension shaft to the desired extension by reducing the likelihood that fine adjustments of the shaft will result in an unintended change in the orientation of the associated firearm due to movement of the extension shaft relative to the ground due to rotation.

[0029] In other examples, the actuator can have a different configuration such that transverse or lateral movement of the actuator or some portion of the actuator relative to the shaft controls incremental adjustment. Such examples can include protrusions that are moved laterally to engage and disengage corresponding recesses in the extension shaft. For ease of reference, exemplary monopod configurations will be discussed that in which locking members are moved radially inward and outward by axial translation of an actuator, though it will be appreciated that other configurations can be provided without departing from the scope of the disclosure.

[0030] FIG. **1** illustrates a perspective view of a firearm system **100** according to one example that includes a stock **110**, a barrel **120**, an action **130**, and a magazine **140**. The action **130** is operatively associated with the barrel **110**. In the illustrated example, a bolt-type action is shown. It will be appreciated that in other examples, other types of actions, such as pump-type actions, recoil-operated actions, gas-operated actions, as well as any other type of actions can be operatively associated with any types of actions.

[0031] Regardless of the type, cycling of the action **130** moves a cartridge into position to be fired and removes the casing after the cartridge has been fired. For example, forward operation of the action **130** can move a cartridge through a breech and into position with the barrel **130**. Thereafter, a trigger **150** can be actuated to release a firing pin in the action **130**. The firing pin (not shown) strikes a primer, which ignites gun powder in a casing to propel a projectile through the barrel **120**.

[0032] In the illustrated example, the stock **110** generally includes a fore-end **110**A and a butt-end **110**B. A monopod **160** is coupled to or integrated with the butt-end **110**B of the stock **110**. As will be discussed in more detail below, the monopod **200** is configured to move between an extended state and a retracted state. For ease of reference, discussion will be made to proximal and distal portions of the monopod in which a proximal portion is nearer the butt-end **110**B than a corresponding distal portion.

[0033] The monopod **160** may be configured to allow an operator to quickly move the monopod **160** to any state between the fully retracted and fully extended states shown and discussed below through the use of incremental and infinite adjustments. In the example shown and discussed in more detail below, the monopod includes an actuator, shown as a knob (and hereinafter referred to as a knob for ease of reference) that controls both the incremental as well as infinite adjustments.

[0034] For example, actuator can be moved parallel to axis C to control incremental adjustments and can be rotated about axis C to control infinite adjustment. Such a configuration can allow for independent incremental and infinite adjustments using the same actuator. One exemplary monopod will be described in more detail below.

[0035] FIG. **2**A illustrates a perspective view of a monopod **200** according to one example, FIG. **2**B illustrates an exploded view of the monopod **200**, and FIGS. **2**C and **2**D illustrate cross-sectional views of the monopod **200** taken along section **2**C-**2**C of FIG. **2**A. As illustrated in FIG. **2**B, the monopod **200** generally includes an extension shaft **300**, a first housing member **400**, a second housing member **500**, a third housing member **600**, a foot pad **270** and an actuator **280**. By way of introduction, the extension shaft **300** is configured to be positioned at least partially within the first housing member **400**.

[0036] The monopod **200** includes an extension spring **210**, a spring guide **215**, and a retaining clip **220** that are configured to be positioned within the first housing member **400** to allow the extension spring **210** to exert a biasing force against the extension shaft **300** to urge the extension shaft **300** distally out of the first housing member **400**. The extension of the extension shaft **300** will be described with reference to a reference datum R associated with the third housing **600**, though it will be appreciated that the extension of the extension shaft **300** can be described with reference to any desired structure.

[0037] The first housing member **400** is configured to be positioned at least partially within the second housing member **500**. The monopod **200** includes locking members **230**, a retention spring **240**, and a retaining clip **250**. The locking members **230** are configured to be positioned between the first housing member **400** and the second housing member **500**. The first housing member **400** and the second housing member **500** include features that house the locking members **230** in such a manner that relative axial movement between the first housing member **400** and the second housing member **500** moves the locking members **230** in to and out of engagement with the extension shaft **300**. When the locking members are in engagement with the extension shaft **300**, the monopod **200** will be described as being in a locked state. Similarly, when the locking members **230** are out of engagement with the extension shaft **300** the monopod **200** will be described as being in an unlocked state.

[0038] The retention spring **240** and the retaining clip **250** couple the first housing member **400** and the second housing member **500** in such a manner as to allow the first housing member **400** and the second housing member **500** to move between the unlocked and locked state while exerting a biasing force therebetween to move them to a desired one of the unlocked and locked positions.

[0039] In the illustrated example, the retention spring **240** can be configured to bias the first housing member **400** and second housing member **500** toward a locked state. The relative positions described below are provided for ease of illustration only. It will be appreciated that the components can be configured differently, located in different positions and/or moved in different directions to achieve the same functionality described below without departing from the scope of the disclosure. The configurations of the extension shaft **300**, the first housing member **400**, the second housing member **500**, and the third housing member **600** will each be discussed in more detail with reference to FIGS. **3**, **4**, **5**, and **6** in conjunction with a discussion of the assembly of these elements with reference to FIG. **2**C.

[0040] FIG. **3** is a cross sectional view of the extension shaft **300** taken along section **3-3** of FIG. **2**B. As shown in FIG. **3**, the extension shaft **300** generally includes a distal end **300**A and a proximal end **300**B. As shown in FIG. **3**, at least a portion of the proximal end **300**B can be generally hollow. In particular, a spring lumen **310** extends distally from the proximal end **300**B.

[0041] In the illustrated example, the spring lumen **310** can be sized to receive at least a portion of the ejection spring **210** and the spring guide **215** (both seen in FIG. **2**B). The spring guide lumen **320** can be sized to constrain distal movement of at least a portion of the spring guide **215** (FIG. **2**A). Accordingly, the spring lumen **310** can have a larger diameter than the spring guide lumen **320** such that a shoulder **325** is formed at the transition between the spring lumen **310** and the spring guide lumen **320**. As a result, one or more lumens can extend distally from the proximal end **300**B of the extension shaft **300** to house and/or guide the ejection spring **210** and/or the spring guide **215**.

[0042] As shown in FIG. **2**B, the spring guide **215** generally includes a distal end **215**A and a proximal end **215**B. The proximal end **215**B can have a shoulder **217** formed thereon. The ejection spring **210** can be positioned on the spring guide **215** and in contact with the shoulder **217**.

[0043] As illustrated in FIG. **2**C, when the monopod **200** is assembled, the spring guide **215** extends proximally of the proximal end **300**B of the extension shaft **300**. Further, the ejection spring **210** is positioned between the shoulder **217** on the spring guide **215** and the shoulder **325** formed at the proximal end of the spring guide lumen **320** while the extension shaft **300** translates freely with respect to the spring guide **215**. As a result, proximal movement of the extension shaft **300** toward the shoulder **217** of the spring guide **215** compresses the ejection spring **210**. As the ejection spring **210** is compressed, the ejection spring **210** exerts a biasing force on the extension shaft **300** by way of the shoulder **325**. The extension shaft **300** is configured to engage one or more locking member, such as the locking member **230**, to lock the extension shaft **300** in a desired axial position within the monopod **200** despite the biasing force.

[0044] More specifically, as particularly shown in FIG. **3**, the extension shaft **300** can also include external features configured to engage a locking feature. The external features are positioned at a plurality of discrete axial locations between the distal end **300**A and the proximal end **300**B. The external features can have any desired configuration to engage any number of locking features in any desired manner to constrain the axial displacement of the extension shaft **300**. In the illustrated example, the external features are configured to receive at least a portion of the receiving members.

[0045] In particular, the external features can include a plurality of grooves **330** formed by alternating ridges **332** and recesses **334** configured to receive at least a portion of the locking members **230**. For example, the recesses **334** may be sized and shaped to have at least a portion of the locking member seated **230** therein. FIG. **2**C illustrates a situation in which the locking members **230** have been moved radially inward to engage the extension shaft **300**. As shown more clearly in FIG. **3**, as the locking members **230** are moved into engagement with the extension shaft **300**, the locking members **230** can be moved radially inward past the ridges **332** and into seating engagement with the recesses **334**.

[0046] While locking members **230** are seated in the recesses **334**, the ridges **332** can help prevent unintended axial movement of a locking member **230**. The grooves **330** can also be shaped to facilitate movement of the locking members **230** into and out of contact with the grooves **330**. In particular, each groove **330** can have angled sides **336**, **338** that guide the locking members **230** into the groove **330** if an edge of the locking member **230** is slightly out of alignment with the center of a particular recess **334**.

[0047] As shown in FIG. **2**C, engagement between the locking members **230** and the angled sides **336**, **338** (FIG. **3**) and between the locking members **230** and the first housing member **400** is sufficient to constrain the axial position of the extension shaft **300** with respect to the first housing **400** in opposition to the biasing force exerted by the ejection spring **210**. Accordingly, the extension shaft **300** can be configured to engage a locking member **230** to secure the extension shaft **300** at a desired axial position within the first housing member **400**. Structure associated with the first housing member **400** for constraining movement of the spring guide **215** will first be discussed, followed by a discussion of constraining axial movement of the extension shaft **300** in which the spring guide **215** provides a base from which a biasing force is exerted on the extension shaft **300**.

[0048] FIG. **4** illustrates a cross sectional view of the first housing member **400** taken along section **4-4** of FIG. **2**B. The general structure of the first housing member **400** will first be discussed, followed by a discussion of the configuration of the first housing member **400** for cooperating with the locking members **230**, and then a discussion of the configuration of the first housing member **400** for cooperating with the second housing member **500**.

[0049] As illustrated in FIG. **4**, the first housing member **400** can include a shaft **402** that extends distally from a proximal end **400**B. The first housing member **400** can further include a radially protruding portion, such as a flared skirt **404** that is positioned distally from or extends from the shaft **402**. In at least one example, an axial length of the shaft **402** can be greater than an axial length of the second housing member **500** (FIG. **2**C). In the illustrated example, the flared skirt **404** extends from the shaft **402** adjacent a distal end **400**A of the first housing member **400**.

[0050] Further, the first housing member **400** has an extension shaft lumen **410** defined therein that extends proximally from the distal end **400**A. In the illustrated example, the extension shaft lumen **410** extends from the distal end **400**A through the proximal end **400**B of the first housing member **400** to form an inner surface **412** and an outer surface **414**. In other examples, the extension shaft lumen **410** does not extend completely through the first housing member **400**.

[0051] As previously discussed, the first housing member **400** includes structure to constrain the axial movement of the spring guide **200** (FIGS. **2**B, **2**C) and to help constrain proximal movement of the spring guide **215** in particular. As illustrated in FIG. **4**, a retaining clip receiving groove **420** is defined in the inner surface **412** and is positioned proximally of the distal end **400**A. The retaining clip receiving groove **420** can be positioned proximally of the distal end **400**A of the first housing member **400**. For example, the retaining clip receiving groove **420** can be defined adjacent the proximal end **400**B of the first housing member **400**.

[0052] As illustrated in FIG. **2**C, the retaining clip **220** can be positioned within the retaining clip receiving groove **420** (FIG. **4**). When the spring guide **215** is positioned relative to the extension shaft **300** and the extension shaft **300** is positioned within the first housing member **400**, the shoulder **217** of the spring guide **215** abuts the retaining clip **220** to constrain proximal, axial movement of the spring guide **215** relative to the first housing member **400**. Such a configuration can provide a base from which the ejection spring **210** is able to exert a biasing force on the extension shaft **300**.

[0053] Engagement between the locking members **230** and the extension shaft **300** can act to control the ejection of the extension shaft **300**, as will now be discussed in more detail with reference to FIG. **2**C and FIG. **4**. As illustrated in FIGS. **2**C and **4**, the first housing member **400** includes a plurality of receiving recesses **430** in communication with the extension shaft lumen **410**. Each of the receiving recesses **430** is configured to allow a locking member **230** to pass at least partially therethrough and into engagement with the extension shaft **300** as introduced above. Any structure, device, or combinations thereof can be implemented to selectively move the locking member **230** or any other structure in and out of engagement with the extension shaft **300**. In the illustrated example, the locking member **230** is moved into engagement with the extension shaft **300** by axial translation of the second housing member **400** relative to the second housing member **500**.

[0054] The first housing member **400** also includes structure configured to help control the axial position and translation of the second housing member **500** relative to first housing member **400**. As shown in FIG. **4**, the first housing member **400** includes an external retaining clip groove **440** defined proximally of the distal end **400**A, such as adjacent the proximal end **400**B. The retaining clip groove **440** and the flared skirt **404** can cooperate to allow the first housing member **400** to translate axially relative to the second housing member **500** (FIG. **2**C) to selectively move the locking members **230** (FIG. **2**C) in and out of engagement with the extension shaft **300** (FIG. **2**C). These interactions will be discussed in more detail after a brief discussion of an exemplary structure of the second housing member **500**.

[0055] FIG. **5** illustrates a cross sectional view of the second housing member **500**. As illustrated in FIG. **5**, the second housing member **500** includes a shaft **510** that extends at least partially between a distal end **500**A and the proximal end **500**B. The shaft **510** can be sized to receive the first housing member **400** (FIG. **2**C).

[0056] As illustrated in FIG. **5**, the second housing member **500** includes a lumen **520** defined therein. The lumen **520** extends from a distal end **500**A toward a proximal end **500**B of the second housing member **500**. In the illustrated example, the lumen **520** extends substantially through the second housing member **500** such that the second housing member **500** has a generally tubular shape thereby causing the second housing member **500** to have an inner surface **530** and an outer surface **540**. The inner surface **530** includes features formed therein that cause axial movement of the second housing member **500** to result in radial movement of the locking members **230** (FIG. **2**C). These can include any combination of protrusions, recesses, or any other structure.

[0057] For example, an annular groove **532** can be defined in the inner surface **530** that is in communication with the lumen **510**. The annular groove **532** has a larger diameter than the lumen **510** adjacent the annular groove **532**. As will be described in more detail below, such a configuration allows the annular groove **532** to receive at least a portion of the locking members **230** (FIG. **2**C) therein when the annular groove **532** is moved into alignment with the locking members **230**.

[0058] The annular groove **532** can be moved into and out of proximity with the locking members **230** by axial translation of the first housing member **400** relative to the second housing member **500**. The coupling of the first housing member **400** to the second housing member **500** will now be discussed in more detail, followed by a more detailed discussion of the interaction between the locking members **230**, the extension shaft **300**, the first housing member **400**, and the second housing member **500**.

[0059] Referring now to FIGS. **2**B-**2**C, the first housing member **400** can be secured to the second housing member **500** in any suitable manner. In at least one example, the locking members **230** can be positioned in the receiving recess **430** (FIG. **4**). Thereafter, the shaft **402** of the first housing member **400** can be passed through the second housing member **500**. As the shaft **402** passes through the shaft second housing member **402**, engagement between the inner surface **520** and the annular groove **522** allows the locking members **230** to move radially inward and outward, respectively, through the receiving recesses **430**.

[0060] In the illustrated example, the shaft **402** of the first housing member **400** can be passed through the second housing member **500** until the external retaining clip groove **440** is positioned proximally of the proximal end **500**B of second housing member **500**. The retention spring **240** is then placed over the shaft **402**. Thereafter, the retaining clip **250** is then secured to the external retaining clip groove **440**. With the retaining clip **250** in place, distal movement of the first housing member **400** is resisted by compression of the retention spring **240** between the proximal end **500**B of the second housing member **500** and the retaining clip **250**.

[0061] As previously introduced, the first housing member **400** also includes a flared skirt **404**. As shown in FIG. **2**C, engagement between the flared skirt **404** and a distal end **500**A of the second housing member **500** can constrain proximal movement of the first housing member **400** relative to the second housing member **500**. Further, as previously introduced, the shaft **402** can be longer than the second housing member **500**. As a result, when positioned between the retaining clip **250** and the proximal end **500**A of the second member **500** as described above, the retention spring **240** can be positioned to move the flared skirt **404** toward engagement with the distal end **500**A of the second housing member **500** as a default position. Accordingly, the first housing member **400** can be moved distally relative to the second housing member **500** by compressing the retention spring **240**, such as by drawing the flared skirt **404** away from the distal end **500**A of the second housing member **500**.

[0062] FIG. **2**D illustrates a view of the monopod **200** in which the first housing member **400** has been displaced distally relative to the second housing member **500** to thereby move the receiving recesses **430** (FIG. **4**) into alignment with the annular groove **532** (FIG. **5**). The first housing member **400** and second housing member **500** can be thus aligned to allow the locking members **230** to be displaced radially outward into the annular groove **532**.

[0063] In particular, the locking members **230** can be displaced radially outward in response to engagement between the locking member **230** and some structure in contact with the inner surface **412** of the first housing member **400**. In other examples, biasing members can bias the locking members **230** radially inward or radially outward as desired. In the illustrated example, one such structure can include the ridges **332** of the grooves **330** (both seen in FIG. **3**). As a result, while the first housing member **400** is aligned relative to the second housing member **500** as shown in FIG. **2**D, the locking members **230** can be displaced radially outward to allow the extension shaft **300** to translate within the first housing member **400**.

[0064] Initially, the first housing member **400** can be thus aligned to allows the extension shaft **300**, the extension spring **210**, and the spring guide **215** to be positioned within the extension lumen shaft **410** as shown in FIG. **2**D. After the extension shaft **300**, the extension spring **210**, and the spring guide **215** are positioned in the second housing member **400**, returning the components of the monopod **200** to the relative positions shown can act to release the extension shaft **300** from the first housing member **400**.

[0065] The first housing member **400** can be returned to a position relative to the second housing member **500** as shown in FIG. **2**C to secure the extension shaft **300** within the first housing member **400**. As the first housing member **400** is returned to the position shown in FIG. **2**C, engagement between the inner surface **412** adjacent the receiving recesses **430** drives the locking member **230** radially inward and into engagement with the extension shaft **300**.

[0066] Accordingly, movement of the first housing member **400** axially relative to the second housing member **500** between the positions shown in FIG. **2**C and FIG. **2**D, allows the locking members **230** to selectively engage the extension shaft **300** at various axial locations along its length. Selectively engaging the extension shaft **300** in such a manner can thus allow for rapid, incremental adjustments of the position of the distal end **300**A extension shaft **300** relative to a stationary reference datum R, such as a proximal end **600**B of the third housing member **600**.

[0067] As previously introduced, the monopod **200** is also configured to provide infinite adjustment which may be manipulated with the same actuator that controls incremental adjustment. Exemplary structure associated with infinite adjustments will first be discussed, followed by a discussion of the manipulation of the actuator associated with both the incremental as well as the infinite adjustments.

[0068] As shown in FIG. **5**, the second housing member **500** also includes features configured to interact with other features of the monopod to provide infinite adjustment of the extension of the extension shaft **300**. As shown in FIG. **5**, the second housing member **500** can include a threaded portion **540** formed on the outer surface **530** of the proximal end **500**B. Referring now to FIG. **2**B, the threaded portion **540** can be configured to engage corresponding features in the third housing member **600** such that rotation of second housing member **500** moves the second housing member **500** axially relative to the reference datum R. The extension shaft **300** and associated components can be coupled to the second housing member **500** in such a manner that the extension shaft **300** and associated components move with the second housing member **500** as it moves axially relative to the third housing member **600**. Accordingly, rotation of the second housing member **500** relative to the third housing member **600** moves the extension shaft **300**, and thus the distal end **300**A thereof, axially relative to the reference datum R.

[0069] FIG. **6** illustrates the third housing member **600** in more detail. As illustrated in FIG. **6**, the third housing member **600** can include a distal end **600**A and a proximal end **600**B. A lumen **610** is defined in the distal end **600**A that extends proximally to define an inner surface **620**. A threaded portion **622** can be formed on the inner surface **620** that is configured to have the threaded portion **540** of the second housing member **500** (both shown in FIG. **5**) coupled thereto.

[0070] The proximal end **600**B of the third housing member **600** can include a stock interface **630**. The stock interface **630** can have any configuration that allows the third housing member **600** to be secured to the stock **110** (FIG. **1**) in any desired fashion, such as to allow the second housing member **500** to rotate relative to the third housing member **600**. As previously discussed, rotation of the second housing member **500** (FIG. **5**) relative to the third housing member **600** can control the infinite adjustment of the position of the distal end **300**A of the extension shaft **300** relative to the reference datum R.

[0071] As shown in FIG. **2**B, the footpad **270** can be secured to the distal end **300**A of the extension shaft **300** by way of a fastener **272**. In other examples, the footpad **270** can be integrally formed with the extension shaft **300**. The footpad **270** can be configured to interface with the ground or another stationary surface.

[0072] As previously introduced, the incremental adjustment and infinite adjustments can be made by manipulating a single actuator, such as the knob **280** shown in FIG. **2**B. As shown in FIG. **2**B, the knob **280** includes an annular portion **282** and knob tabs **284** extending inward from the annular portion **282**. The knob tabs **284** form a recess **286** having a diameter that is less than the diameter of the flared skirt **404** and greater than the shaft **402**. Such a configuration allows the knob **280** to pass over the shaft **402** and into engagement with the flared skirt **404**. Further, such a configuration allows the knob **280** to rotate about the shaft **402**.

[0073] As also shown in FIG. **2**B, knob slots **288** are defined between the knob tabs **284**. The knob slots **288** and knob tabs **284** can be configured to cooperate with corresponding housing tabs **550** and housing slots **560** formed in the distal end **500**A of the second housing member **500**. In particular, the knob slots **284** can extend through the housing slots **560** and the housing tabs **550** can extend into the knob slots **288**. Such a configuration can allow engagement between the knob tabs **284** and the knob slots **288** such that rotation of the knob **280** can result in rotation of the second housing member **500**.

[0074] In at least one example, the length of the housing slots **560** can be greater than the thickness of the knob **280**. The relative length of the housing slots **560** can allow the knob **280** to move axially independently from the second housing member **500**. Accordingly, axial movement of the knob **280** causes the knob tabs **284** to engage and move the first housing member **400** axially while causing minimal or no axial movement of the second housing member **500** axially while rotation of the knob member **280** can result in rotation of the second housing member **500** while causing minimal or no rotation of the first housing member **400**.

[0075] The axial movement can be sufficient to cause the locking members **230** to move in and out of engagement with the extension shaft **300** to allow for incremental adjustments of the extension of the distal end **300**A of the extension shaft **300** relative to the reference datum R. The rotation of the second housing member **500** causes the second housing member **500**, and thus the distal end **300**A of the extension shaft **300**, to move axially relative to the reference datum R to thereby provide infinite adjustments. As a result, incremental and infinite adjustments can be made using a single actuator. One exemplary process will now be described in more detail below with reference to FIGS. **7**A-**7**E.

[0076] FIG. **7**A illustrates the monopod **200** in a locked and fully retracted state. The detailed interaction of the various components has been described in more detail above. For ease of reference, engagement between various components will be described generally, though it will be appreciated that the interactions and engagement may be similar to those described above. The locked aspect of the state shown in FIG. **7**A will first be discussed, followed by a discussion of the fully retracted aspect.

[0077] As shown in FIG. **7**A, the retention spring **240** can exert a biasing force to move the first housing member **400** proximally relative to the second housing member **500**. Drawing the first housing member **400** proximally places the locking members **230** in engagement with the inner surface **520** adjacent the annular groove **522**. Engagement between the locking members **230** and the inner surface **520** moves the locking members **230** radially inward through the first housing member **400** and into locking engagement with the extension shaft **300**. As shown in FIG. **7**A, engagement between the flared skirt **404** and the knob **280** and/or between the knob **280** and the second housing member **500** limits further proximal movement of the first housing member **400** relative to the second housing member **500**. Accordingly, the retention spring **240** can act to move the monopod **200** toward a locked state.

[0078] In the fully retracted position, the foot pad **270** is spaced a first distance **710** from the reference datum R. With the foot pad **270** spaced the first distance **710** from the reference datum R, the extension spring **210** can be compressed between the spring guide **215** and the extension shaft **300** to cause the extension spring **210** to exert an ejection force on the extension shaft **300** that acts to move the extension shaft **300** and thus the foot pad **270** distally away from the reference datum R. Engagement between the locking members **230** and the extension shaft **300** resists the ejection force provided by the extension spring **210**.

[0079] In order to move the monopod **200** from a locked state to an unlocked state, the knob **280** is moved distally as shown in FIG. **7**B. As the knob **280** moves distally it does so in opposition to the basing force exerted by the retentions spring **240** described above. Further, as the knob **280** moves distally, it acts on the flared skirt **404** to also move the first housing member **400** distally relative to the second housing member **500**. As the second housing member **400** moves from the position shown in FIG. **7**A to the position shown in FIG. **7**B, the locking members **230** are able to move radially outward into the annular grooves **522** and thus out of engagement with the extension shaft **300**.

[0080] While the locking member **230** are out of engagement with the extension shaft **300**, the ejection force exerted by the extension spring **210** moves the extension shaft **300** distally relative to the first housing member **400**, as shown in FIG. **7**C. An approximate separation **720** between the foot pad **270** and the reference datum R due to the ejection force can be determined by a proximally acting force acting on the footpad **270**. For example, the approximate separation **720** can be established by contact between the foot pad **270** and the ground or anything else to provide sufficient force. Once the approximate separation **720** has been established, the locking members **230** can be moved into engagement by allowing the knob **280** to move proximally, such as in response to the proximally acting biasing force exerted by the retention spring **240** as shown in FIG. **7**D.

[0081] Thereafter, as shown in FIG. **7**E, the knob **280** can be rotated to control infinite adjustment resulting in an adjusted separation **730**. In the illustrated example, rotation of the second housing member **500** can be isolated from the extension shaft **300** by the locking members **230**. As previously discussed, the locking members **230** can be spherical members. As a result, the locking members **230** may spin with the rotation of the second housing member **500**, thereby isolating the extension shaft **300** from that rotation, which can help reduce unintended movement of the extension shaft **300** due to rotation.

[0082] Accordingly, a monopod has been discussed herein that provides both incremental adjustment as well as infinite adjustment for the position of an extension shaft. The incremental adjustment as well as the infinite adjustment are controlled and manipulated by a single actuator. In at least one example, the actuator is a knob that is moved parallel to the central axis provide the incremental adjustment. In such an example, the knob can rotated relative to the central axis to provide infinite adjustment. In other examples, the actuator can have a different configuration such that transverse or lateral movement of the actuator or some portion of the actuator relative to the shaft allows for infinite adjustment. Such a configuration can allow an operator to quickly extend the extension shaft to near a desired extension using the incremental adjustment and then to fine tune the position of the extension shaft with the infinite adjustment to the desired position. Additional adjustments can be performed quickly using the same process.

[0083] The present invention may be embodied in other specific forms without departing from its spirit or essential characteristics. The described embodiments are to be considered in all respects only as illustrative and not restrictive. The scope of the invention is, therefore, indicated by the appended claims rather than by the foregoing description. All changes which come within the meaning and range of equivalency of the claims are to be embraced within their scope.

What is claimed is:

1. An adjustable support for a firearm, comprising:

an extension shaft having a distal end, a proximal end, a central axis, and a plurality of engagement features formed at a plurality of axial locations between the distal end and the proximal end;

a housing assembly configured to house the extension shaft and defining a reference datum;

at least one locking member operatively associated with the housing assembly and configured selectively engage the engagement features; and

an actuator operatively associated with the housing assembly, wherein translation of the actuator relative to the central axis moves the locking members into and out of engagement with the engagement features on the extension shaft and wherein rotation of the actuator about the central axis moves the distal end of the extension shaft away from the reference datum associated with the housing assembly.

2. The adjustable support of claim **1**, wherein translation of the actuator relative to the central axis is translation parallel to the central axis.

3. The adjustable support of claim **1**, wherein translation parallel to the central axis moves the locking member radially inward and outward relative to the extension shaft.

4. The adjustable support of claim **3**, wherein the locking member includes a spherical locking member.

5. The adjustable support of claim **1**, wherein the engagement features include alternative grooves and ridges.

6. An adjustable support for a firearm, comprising:

an extension shaft having a distal end, a proximal end, a central axis, and a plurality of engagement features formed at a plurality of axial locations between the distal end and the proximal end;

a housing assembly having a reference datum, a first housing member configured to receive at least a portion of the extension shaft, and a second housing member configured to receive at least a portion of the first housing member;

at least one locking member operatively associated with the housing assembly and configured selectively engage the engagement features; and

an actuator operatively associated with the housing assembly, wherein translation of the actuator parallel to the central axis moves the first housing assembly relative to the second housing assembly to move the locking members into and out of engagement with the engagement features on the extension shaft and wherein rotation of the actuator relative about the central axis moves the distal end of the extension shaft away from the reference datum, the actuator being configured to move parallel to the central axis independently of rotation about the central axis.

7. The adjustable support of claim **6**, wherein the first housing member includes receiving recesses defined therein configured to receive at least a portion of each of the locking members.

8. The adjustable support of claim **7**, wherein the second housing member includes an interior lumen defined therein forming an interior surface, wherein the interior surface has an annular groove formed therein such that alignment of the annular groove and the receiving recesses allows the locking features to move out of engagement with the engagement features on the extension shaft and wherein alignment of the receiving recesses with the inner surface adjacent the annular groove moves the locking features into engagement with the engagement features on the extension shaft.

9. The adjustable support of claim **8**, wherein a proximal end of the second housing member includes a threaded portion.

10. The adjustable support of claim **9**, wherein the housing assembly further includes a threaded third housing member configured to be threadingly coupled to the threaded portion of the proximal end of the second housing member and wherein rotation of the actuator about the central axis threads and unthreads the second housing member to and from the third housing member.

11. An adjustable support for a firearm, comprising:

an extension shaft having a distal end, a proximal end, a central axis, and a plurality of engagement features formed at a plurality of axial locations between the distal end and the proximal end;

a housing assembly having:

a first housing member having a shaft portion extending distally from a proximal end toward a distal end, a flared portion positioned distally from the shaft portion, a first lumen extending proximally from the distal end and being configured to receive at least a portion of the extension shaft, and wherein a plurality of receiving recesses are defined in the first housing member and are in communication with the first lumen,

a second housing member having a second lumen defined therein extending proximally from a distal end of the second housing member toward a proximal end, the second lumen being configured to receive at least a portion of the first housing member, an annular groove defined in an inner surface of the second housing member, and alternating tabs and slots formed adjacent the distal end of the second housing member;

a plurality of locking members positioned between the inner housing of the second housing member and the first housing member in the receiving recesses; and

an actuator operatively associated with the housing assembly, the actuator being configured to move the first housing member parallel to the central axis relative to the second housing member to move the receiving recesses into and out of alignment with the annular groove in the second housing member to move the locking member into and out of engagement with the engagement features on the extension shaft, the actuator being further configured to rotate the second housing member relative to the central axis independently of movement of the first housing member parallel to the central axis.

12. The adjustable support of claim **11**, wherein further comprising a biasing member between the distal end of the first housing member and the extension shaft.

13. The adjustable support of claim **11**, wherein the shaft of the first housing member extends proximally of a proximal end of the second housing member.

14. The adjustable support of claim **13**, further comprising a biasing member positioned between the proximal end of the first housing member and the proximal end of the second housing member.

15. The adjustable support of claim **11**, wherein a proximal end of the second housing member includes a threaded portion.

16. The adjustable support of claim **15**, further comprising a third housing member having a threaded distal portion configured to have the threaded portion of the proximal end of the second housing member coupled thereto, wherein the rotation of the actuator about the central axis threads and unthreads the second housing member from the third housing member to move the distal end of the extension shaft independently from extension of the extension shaft relative to the first housing member.

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