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(54) **ADJUSTABLE BIPOD**

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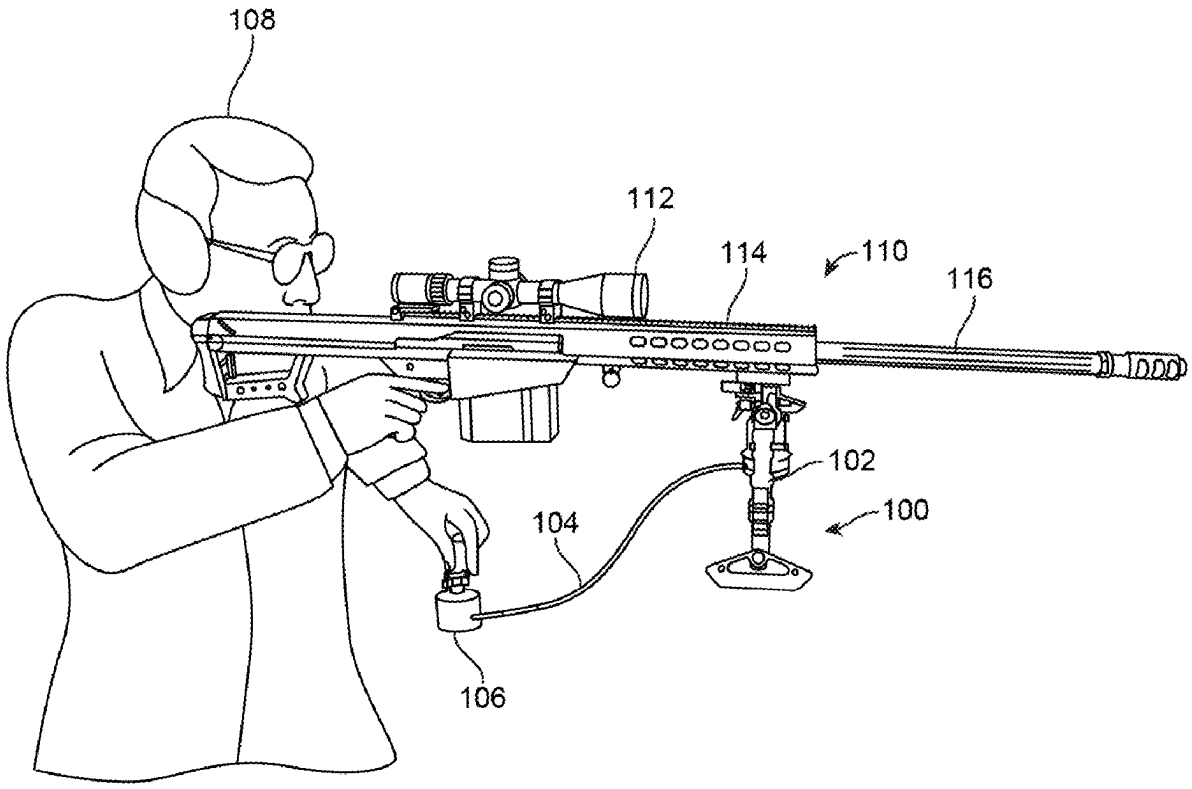
(57) **ABSTRACT**

A firearm support includes a housing, two or more legs, a column, a firearm mount, and a remote actuator. The housing including a first hydraulic cylinder. The two or more legs are pivotally coupled to and extending from the housing. The column resides at least partially within the first hydraulic cylinder. The firearm mount supports a firearm and is attached to a distal end of the column opposite the first hydraulic cylinder. The remote actuator is fluidly coupled to the first hydraulic cylinder through a hydraulic hose. The remote actuator adjusts a height of the column by moving hydraulic fluid through the hydraulic hose in response to rotation of a height adjustment knob on the remote actuator.



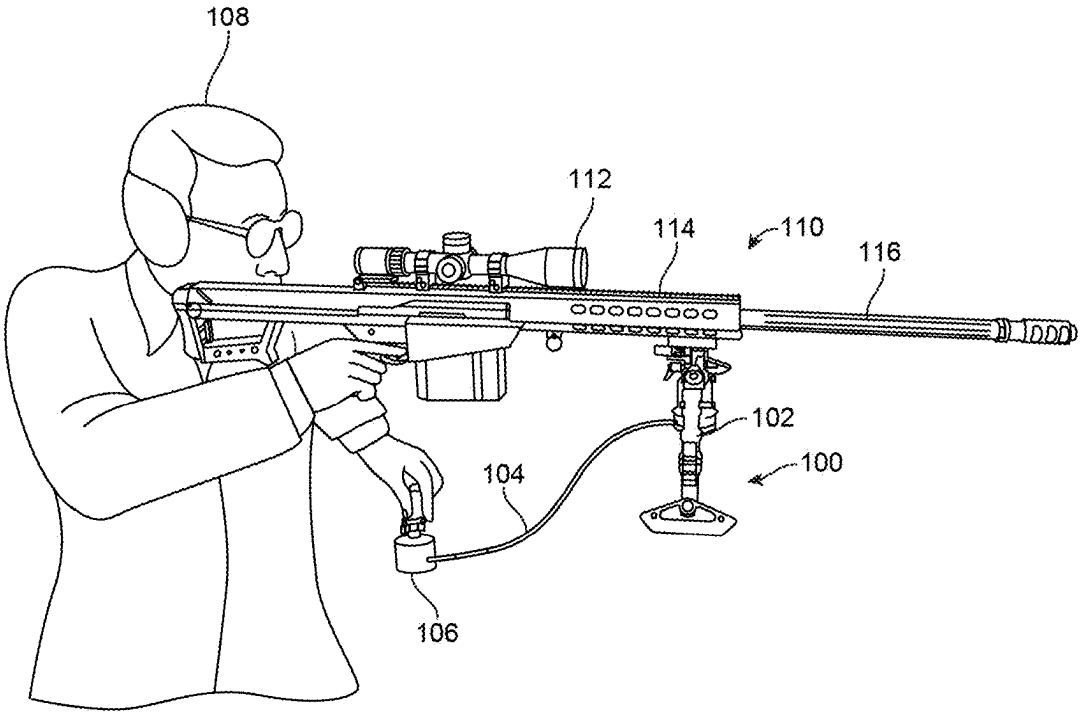
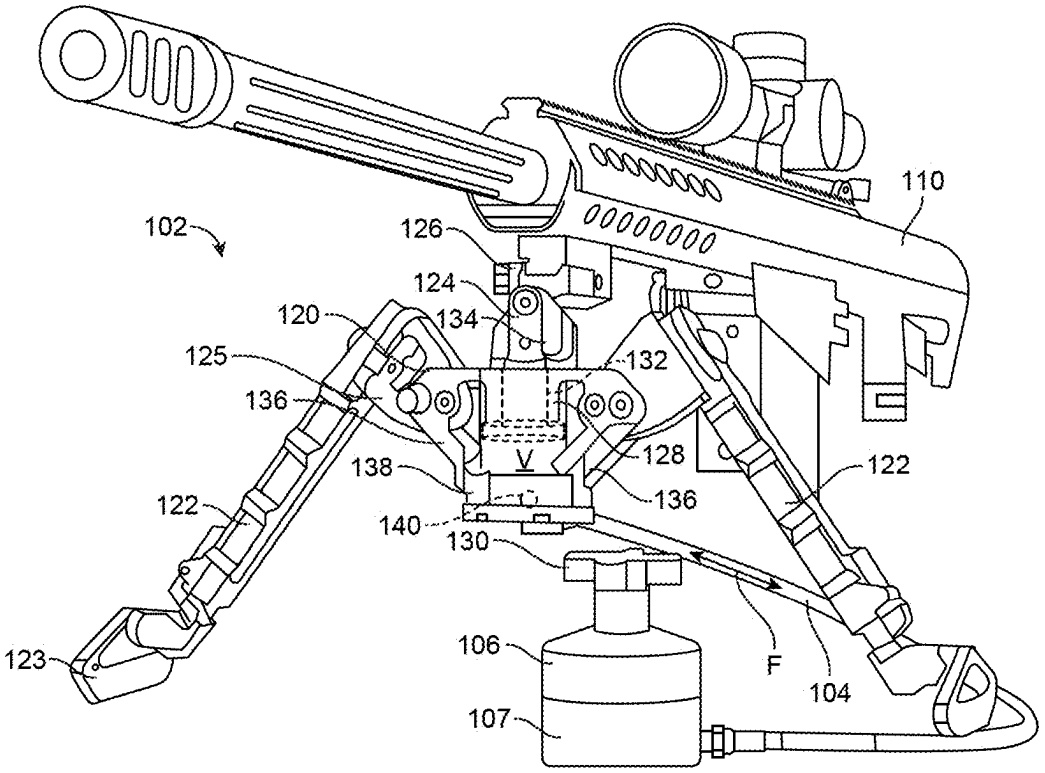


FIG. 1


102
110
126
124
134
120
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F
104
107

FIG. 2

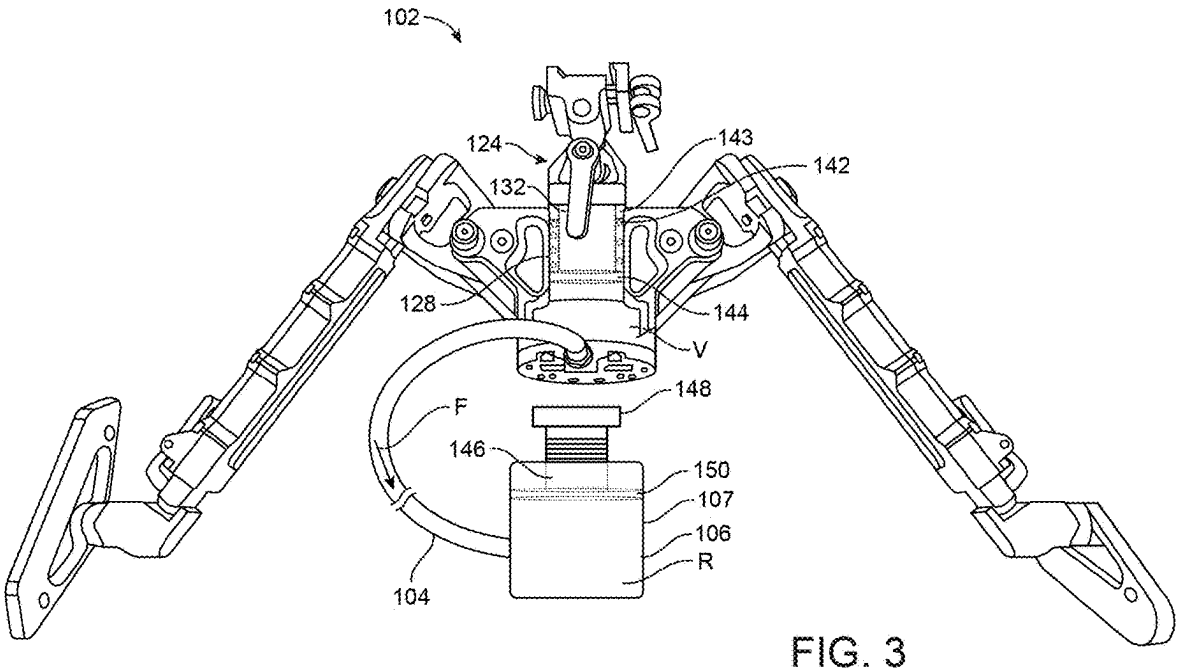

FIG. 3

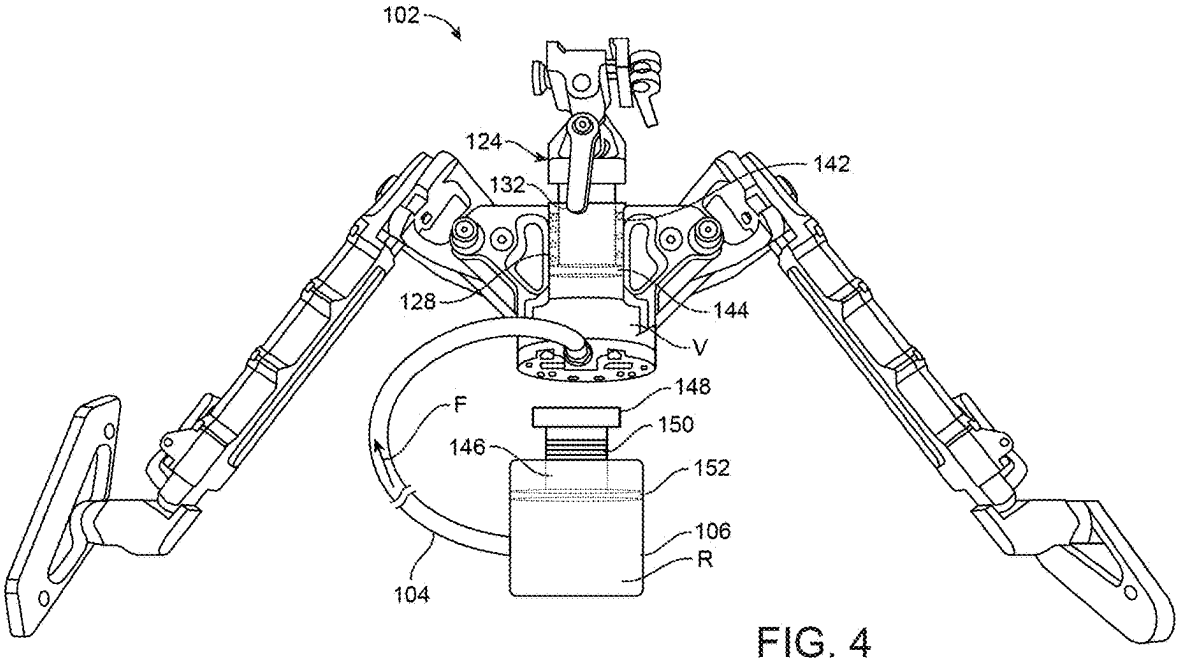

FIG. 4

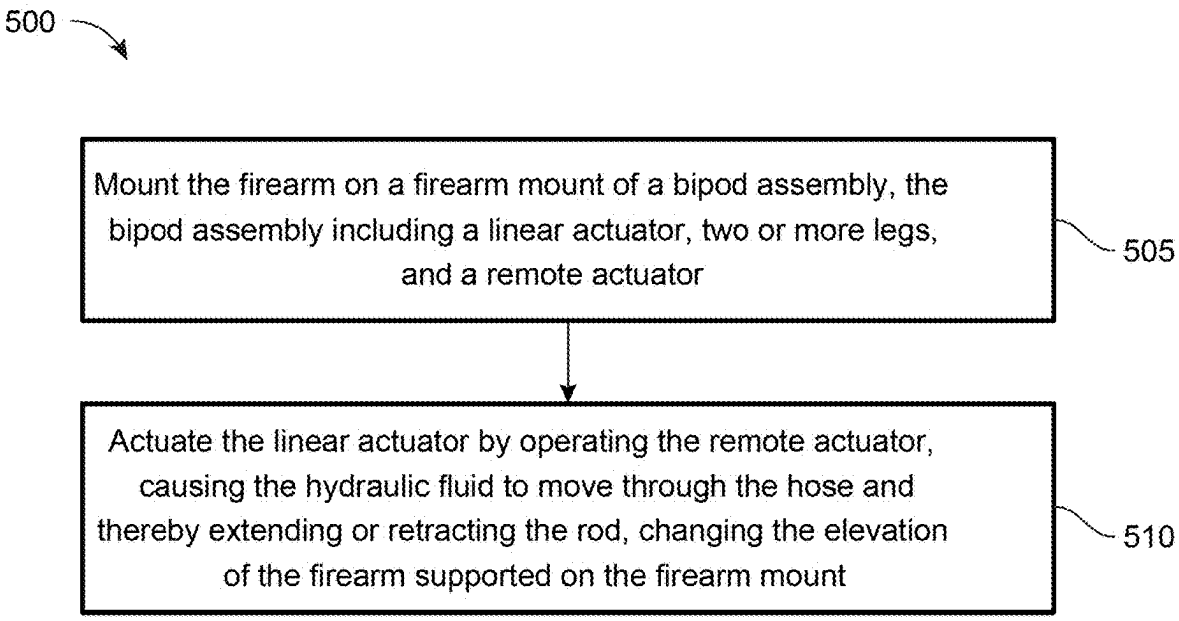
500
Mount the firearm on a firearm mount of a bipod assembly, the bipod assembly including a linear actuator, two or more legs, and a remote actuator
505
Actuate the linear actuator by operating the remote actuator, causing the hydraulic fluid to move through the hose and thereby extending or retracting the rod, changing the elevation of the firearm supported on the firearm mount
510

FIG. 5

ADJUSTABLE BIPOD

CLAIM OF PRIORITY

[0001] This application is a continuation of U.S. patent application Ser. No. 18/354,538, filed on Jul. 18, 2023, the entire contents of which are hereby incorporated by reference.

TECHNICAL FIELD

[0002] This disclosure relates to legged supports, and more particularly to bipods.

BACKGROUND

[0003] Legged supports are frames with one or multiple legs that support a weight of an object. A bipod is a two-legged support that bears part or all of the weight of firearms such as rifles, carbines, machine guns, and other devices such as mortars. A bipod supports a front portion of the firearm such as the barrel, handguard, or forestock of a rifle. Bipods provide support and stability against unwanted movements while allowing pivoting movements of the firearm to aim the firearm. Methods and equipment to improve bipods are sought.

SUMMARY

[0004] Implementations of the present disclosure include a firearm support that includes a housing, two or more legs, a column, a firearm mount, and a remote actuator. The housing including a first hydraulic cylinder. The two or more legs are pivotally coupled to and extending from the housing. The column resides at least partially within the first hydraulic cylinder. The firearm mount supports a firearm and is attached to a distal end of the column opposite the first hydraulic cylinder. The remote actuator is fluidly coupled to the first hydraulic cylinder through a hydraulic hose. The remote actuator adjusts a height of the column by moving hydraulic fluid through the hydraulic hose in response to rotation of a height adjustment knob on the remote actuator.

[0005] In some implementations, the hydraulic hose has a length such that the remote actuator is positionable proximate an operator of the firearm supported on the firearm mount and operable by the operator in an aiming position. In some implementations, the hydraulic hose is longer than 20 centimeters such that the height adjustment knob is rotatable by the operator while the operator looks through a scope of the firearm. In some implementations, the hydraulic hose is between 20 and 75 centimeters long.

[0006] In some implementations, one full rotation of the height adjustment knob changes an elevation of the column between 0.1 and 1 millimeter.

[0007] In some implementations, the housing includes a spring that pushes, as the height adjustment knob is rotated in an opposite direction, the column into the first hydraulic cylinder such that the central column pushes the hydraulic fluid through the hose and into a second hydraulic cylinder of the remote actuator, retracting the column. In some implementations, the spring is disposed within the first hydraulic cylinder between a piston of the column and an inwardly-projecting shoulder of the first hydraulic cylinder.

[0008] In some implementations, the legs include telescoping legs, and the firearm mount includes a mount bracket that engages the firearm.

[0009] Implementations of the present disclosure include a firearm support that includes a linear actuator, a firearm support, and a remote actuator. The linear actuator includes a cylinder and a rod that extends and retracts with respect to the cylinder. The firearm mount is coupled to an end of the rod. The firearm mount supports a firearm. The remote actuator extends or retracts, in response to an operator input, the rod of the linear actuator by moving hydraulic fluid through a hose connected between the cylinder of the linear actuator and the remote actuator, thereby changing an elevation of the firearm supported on the firearm mount.

[0010] In some implementations, the linear actuator includes a hydraulic actuator, and the cylinder includes a first hydraulic cylinder, the remote actuator including a second hydraulic cylinder fluidly coupled to the first hydraulic cylinder through the hose and operable to move the hydraulic fluid along the hose, extending or retracting the rod and thereby changing the elevation of the firearm supported on the firearm mount. In some implementations, the second hydraulic cylinder includes a piston residing within the second hydraulic cylinder. The piston is movable as a function of the operator input to push the hydraulic fluid to the first hydraulic cylinder and extend the rod or receive a portion of the hydraulic fluid and retract the rod. In some implementations, the piston is movable by a knob threadedly attached to the second hydraulic cylinder. The piston pushes, as the knob is threaded into the second hydraulic cylinder, the hydraulic fluid through the hose so that a portion of the hydraulic fluid enters the first hydraulic cylinder, causing the rod to extend out of the first hydraulic cylinder.

[0011] In some implementations, the hose is between 20 and 75 centimeters long such that the knob is rotatable by an operator of the firearm while the operator is in an aiming position looking through a scope of the firearm.

[0012] In some implementations, one full rotation of the knob changes an elevation of the rod between 0.1 and 1 millimeter.

[0013] In some implementations, the linear actuator includes a spring that retracts the rod as the remote actuator allows a portion of the hydraulic fluid to flow into the remote actuator.

[0014] Implementations of the present disclosure include a method of adjusting a firearm. The method includes mounting the firearm on a firearm mount of a bipod assembly. The bipod assembly includes a linear actuator, two or more legs, and a remote actuator. The linear actuator includes a hydraulic cylinder and a rod that extends and retracts with respect to the hydraulic cylinder. The firearm mount is attached to an end of the rod and is configured to support the firearm. The two or more legs are coupled to and extend from the linear actuator. The remote actuator is fluidly coupled to the hydraulic cylinder through a hose and is operable to move hydraulic fluid through the hose. The method also includes actuating the linear actuator by operating the remote actuator, causing the hydraulic fluid to move through the hose and thereby extending or retracting the rod, changing an elevation of the firearm supported on the firearm mount.

[0015] In some implementations, the actuating includes actuating the linear actuator while in an aiming position.

[0016] In some implementations, the remote actuator includes a knob threadedly coupled to a housing of the remote actuator, and actuating the linear actuator includes threading the knob into the housing of the remote actuator to push hydraulic fluid through the hose and into the hydraulic

cylinder, causing the rod to extend out of the hydraulic cylinder under transferred hydraulic pressure and thereby change an elevation of the firearm supported on the firearm mount. In some implementations, the linear actuator includes a spring that retracts the rod, and the actuating comprises threading the knob out of the remote actuator such that the spring pushes the rod into the hydraulic cylinder such that the rod pushes the hydraulic fluid through the hose and into the remote actuator, retracting the rod. In some implementations, rotating the knob includes rotating the knob a full rotation, changing an elevation of the rod between 0.1 and 1 millimeter.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017] FIG. **1** is a schematic side view of a user adjusting a firearm with a bipod assembly according to an embodiment of the present disclosure.

[0018] FIG. **2** is a front perspective, schematic view of the bipod assembly supporting a firearm.

[0019] FIG. **3** is a front schematic view of the bipod assembly with a central column retracted.

[0020] FIG. **4** is a front schematic view of the bipod assembly with the central column extended.

[0021] FIG. **5** is a flow chart of a method of adjusting a firearm.

DETAILED DESCRIPTION OF THE DISCLOSURE

[0022] The present disclosure describes a portable bipod that has a housing with a linear actuator, two legs extending from the housing, and a remote actuator or control that operates the linear actuator from a relatively short distance. The remote actuator slowly changes the elevation of a column of the linear actuator as the operator (e.g., the shooter) of the bipod actuates the remote control to precisely change the elevation of the rifle as the operator is in an aiming position. Thus, the shooter can change the elevation of the bipod while aiming or without having to reach for the bipod to make adjustments.

[0023] The subject matter described in this specification can be implemented so as to realize one or more of the following advantages. For example, the bipod of the present disclosure allows a shooter to precisely change an elevation of the rifle while in an aiming position and while looking through the scope, which can improve the shooting accuracy quickly at long distances. Additionally, the bipod can move slowly as the shooter rotates the knob, allowing the shooter to accurately aim the rifle in long-range shooting.

[0024] FIG. **1** shows a bipod assembly **100** or firearm assembly that includes a bipod **102**, a hose **104**, and a remote actuator **106**. The bipod assembly **100** is used to support a firearm **110** operated by a user or operator **108** (e.g., a shooter). The operator **108** aims using a scope **112** of the firearm **110**. The bipod **102** supports a front portion of the firearm **110**. For example, the bipod **102** supports a handguard **114**, barrel **116**, or another portion of the firearm **110** such as the forestock of a rifle. The operator **108** can adjust the elevation of the bipod **102** and thereby adjust the elevation of the firearm **110** while the operator **108** is in an aiming position (e.g., while looking through the scope **112**). In some aspects, instead of a bipod **102**, the firearm assembly can include a firearm support with one, three, or more legs.

[0025] Referring to FIG. **2**, the bipod **102** has a housing **120**, two legs **122**, a column **124**, and a firearm mount **126**. The housing **120** is fluidly coupled, through the hose **104**, to the remote actuator **106**. As further described in detail below with respect to FIGS. **3-4**, the remote actuator **106** adjusts a height of the column **124** by moving fluid "F" (e.g., hydraulic fluid or pneumatic fluid) through the hose **104** in response to rotation of a height adjustment knob **130** of the remote actuator **106**. For example, the bipod assembly **100** includes a hydraulic or pneumatic circuit that allows the bipod **102** to be controlled from a distance.

[0026] In some aspects, the housing **120** includes a hydraulic cylinder **128**, connection ends **136**, and a bottom portion **138**. The column **124** has a rod **132** and a head **134** attached to the rod **132**. The rod **132** is at least partially disposed within the hydraulic cylinder **128**. The housing **120** is made of metal (e.g., steel or aluminum) or another rigid material such as plastic. The hydraulic cylinder **128** can be formed integrally with the housing **120**. The two connection ends **136** are each opposite each other and extend outwardly from the cylinder **128**. Each leg **122** is pivotally attached to and extends from one of the connection ends **136**. The bottom portion **138** of the housing **120** has a fluid port **140** attached to the hose **104**. The bottom portion **138** has a volume "V" that receives fluid from the hose **104** through the fluid port **140** to push the rod **132** (and thereby the column **124**) up, changing an elevation of the column **124**.

[0027] In some aspects, the legs **122** are made of metal such as steel or aluminum or another rigid material such as plastic. The legs **122** have feet **123** that support the bipod **102** on a surface (e.g., an even or uneven surface). The feet **123** can be pivotally connected to the elongated body of the leg to allow the feet **123** to pivot and be arranged in different positions to stand firmly on uneven surfaces. Each leg **122** is a telescoping leg that extends or retracts to change an elevation of the bipod **102**. The telescoping legs **122** can be extended or retracted manually.

[0028] In some aspects, each leg **122** has a connection arm **125** at an end of the elongated body of each leg and extends at an angle (e.g., at 90 degrees) with respect to the elongated body. Each connection arm **125** is connected to a respective one of the connection ends **136** of the housing **120**. Each connection arm **125** and connection end **136** forms a pivot joint with a large pivot range that allows the bipod **102** to have a large footprint. For example, the bipod **102** can be opened so that the wide open angle between the legs is about 160 degrees and the distance between the two feet **123** is about 50 centimeters with the legs retracted.

[0029] The column **124** can move up and down to change an elevation of the firearm **110**. Thus, the column **124** acts as a cylinder rod in a linear actuator, with the cylinder **128** housing the hydraulic fluid that pushes and extends the column **124**. The head **134** of the column **124** is attached to the firearm mount **126**. Thus, the firearm mount **126** is opposite the hydraulic cylinder **128**. In some aspects, the firearm mount includes a support surface and an interface that attaches to or engages the firearm **110**. For example, the firearm mount **126** includes a stud clamp, a mount bracket, a rail mount, or a latch that secures the bipod **102** to the firearm **110**. The mount **126** can be, e.g., a sling stud mount, a Picatinny mount, an ARCA mount, or an M-Lok mount. In some implementations, the mount type can be interchangeable, e.g., to allow for different rifle configurations.

[0030] In some aspects, the remote actuator **106** is a hydraulic actuator with a second hydraulic cylinder **107**. The second hydraulic cylinder **107** is fluidly coupled to the bipod's hydraulic cylinder **128** through the hose **104**. The hose **104** is a hydraulic hose long enough so that the remote actuator **106** can be placed proximate the operator of the firearm while the remote actuator **106** is fluidly connected to the bipod **102**. For example, the hose **104** is between 20 and 75 centimeters long (e.g., 30 to 60 centimeters long) so that the remote actuator **106** can reside near the rear end of the firearm **110** (e.g., by the trigger or stock of the firearm) while the bipod **102** supports the firearm **110**. Thus, the user can operate the remote actuator **106** to change an elevation of the firearm **110** while the user is in an aiming position (e.g., while the operator looks through the scope of the firearm) or otherwise operating the firearm **110**.

[0031] FIGS. **3** and **4** show sequential steps of changing an elevation of the bipod **102**. In some aspects, the bipod **102** has a spring **142** that resides within the hydraulic cylinder **128** and is disposed around the rod **132**. The spring **142** resides between (and bears against) a piston **144** of the rod **132** and an annular, inwardly-projecting shoulder **143** of the hydraulic cylinder **128**. The spring **142** pushes the piston **144** and rod **132** downwardly, reducing the volume "V" and moving the hydraulic fluid "F" along the hose **104**, pushing an amount of fluid into the remote control **106**.

[0032] In some aspects, the second hydraulic cylinder **107** defines an inner volume "R." The remote control **106** also includes a threaded rod **146**, a knob **148** (e.g., height-adjustment knob) fixed to an end of the threaded rod **146**, and a piston **150** coupled to the opposite end of the threaded rod **146**. The piston **150** resides inside the hydraulic cylinder **107** and the knob **148** resides outside of the hydraulic cylinder **107**. The hydraulic cylinder **107**, threaded rod **146**, knob **148**, and piston **150** are made of metal (e.g., steel or aluminum) or another rigid material such as plastic.

[0033] As shown in FIG. **4**, the knob **148** faces up and is operable to change an elevation of the column **124**. As the knob **148** is manually rotated by the operator of the firearm, the threaded rod **146** pushes the piston **150** down. As the piston **150** is pushed down, the piston **150** reduces the volume "R" and moves the fluid "F" along the hose **104**, expanding the volume "V" of the first cylinder **128**. As the volume "V" expands, the fluid in the volume "V" pushes the column **124** up. Thus, as the knob **148** is thread into the second hydraulic cylinder **107**, the piston **150** moves the hydraulic fluid "F" through the hose **104** and pushes fluid "F" into the cylinder **128**, causing the hydraulic fluid "F" to push and extend the central column **124**. As the central column **124** extends, the elevation of the firearm mount increases, increasing the elevation of the firearm.

[0034] Similarly, as shown in FIG. **3**, as the threaded rod **146** is threaded out of the second cylinder **107**, the fluid "F" moves backwards from the bipod **102** to the remote control **106**, decreasing the volume "V" and increasing the volume "R." The spring **142** pushes the piston **144** downward, helping move the hydraulic fluid "F" through the hose **104** and into the second hydraulic cylinder **107**, thereby retracting the central column **124**. The spring **142** pushes the piston **144** down, which can help push the fluid "F" back to the remote control **106** as the knob **148** is threaded out.

[0035] The remote controller **106** allows precise control of the elevation of the firearm. For example, the thread of the threaded rod **146** can be a fine thread and the sizes of the hydraulic cylinders **128**, **107** can be sized such that rotation of the knob **148** causes "micro changes" (or micro steps) in the elevation of the column **124**. For example, one full rotation of the knob **148** changes an elevation of the central column between 0.1 and 1 millimeter.

[0036] In some cases, the bipod can be controlled with a pneumatic circuit similar to the hydraulic circuit described herein. In some cases, the bipod can include an electric linear actuator and the remote control is an electric remote control connected to the electric linear actuator through a cable or wirelessly. The electric control remotely controls, in response to an operator input, the electric linear actuator to change an elevation of the column.

[0037] FIG. **5** shows a flow chart of a method (**500**) of adjusting a firearm. The method includes mounting the firearm on a firearm mount of a bipod assembly. The bipod assembly includes a linear actuator, two or more legs, and a remote actuator. The linear actuator includes a hydraulic cylinder and a rod that extends and retracts with respect to the hydraulic cylinder. The firearm mount is attached to an end of the rod and supports the firearm. The two or more legs are coupled to and extend from the linear actuator. The remote actuator is fluidly coupled to the first hydraulic cylinder through a hose and is operable to move hydraulic fluid through the hose (**505**). The method also includes actuating the linear actuator by operating the remote actuator, causing the hydraulic fluid to move through the hose and thereby extending or retracting the rod, changing the elevation of the firearm supported on the firearm mount (**510**).

[0038] While this specification contains many specific implementation details, these should not be construed as limitations on the scope of any inventions or of what may be claimed, but rather as descriptions of features specific to particular implementations of particular inventions. Certain features that are described in this specification in the context of separate implementations can also be implemented in combination in a single implementation. Conversely, various features that are described in the context of a single implementation can also be implemented in multiple implementations separately or in any suitable subcombination. Moreover, although features may be described above as acting in certain combinations and even initially claimed as such, one or more features from a claimed combination can in some cases be excised from the combination, and the claimed combination may be directed to a subcombination or variation of a subcombination.

[0039] Similarly, while operations are depicted in the drawings in a particular order, this should not be understood as requiring that such operations be performed in the particular order shown or in sequential order, or that all illustrated operations be performed, to achieve desirable results. In certain circumstances, multitasking and parallel processing may be advantageous. Moreover, the separation of various system components in the implementations described above should not be understood as requiring such separation in all implementations, and it should be understood that the described program components and systems can generally be integrated together in a single software product or packaged into multiple software products.

[0040] A number of implementations have been described. Nevertheless, it will be understood that various modifications may be made without departing from the spirit and scope of the disclosure. For example, example operations, methods, or processes described herein may include more

steps or fewer steps than those described. Further, the steps in such example operations, methods, or processes may be performed in different successions than that described or illustrated in the figures. Accordingly, other implementations are within the scope of the following claims.

1-20. (canceled)

21. A firearm support, comprising:

a housing;

two or more legs pivotally coupled with and extending from the housing;

a column coupled with and movable with respect to the housing;

a firearm mount configured to support a firearm and coupled to a distal end of the column opposite the housing; and

a remote controller operably coupled with the housing, wherein the remote controller is configured to adjust a height of the column in response to an operator input, causing the column to extend or retract with respect to the housing.

22. The firearm support of claim **21**, wherein the housing is a hydraulic cylinder and the remote controller is fluidly coupled with the hydraulic cylinder through a hydraulic hose, the remote controller being configured to adjust a height of the column by moving hydraulic fluid through the hydraulic hose in response to the operator input.

23. The firearm support of claim **22**, wherein the hydraulic hose has a length such that the remote controller is positionable proximate an operator of the firearm supported on the firearm mount and operable by the operator in an aiming position.

24. The firearm support of claim **21**, wherein the housing is attached between and supported by the two or more legs.

25. The firearm support of claim **24**, wherein the two or more legs are two legs and each of the two legs extend from opposite sides of the housing.

26. The firearm support of claim **21**, wherein the remote controller is an electric remote controller.

27. The firearm support of claim **26**, wherein the housing and the column are part of an electric linear actuator controllable by the electric remote controller.

28. The firearm support of claim **27**, wherein the electric remote controller is electrically coupled to the electric linear actuator by a wire that has a length such that the electric remote controller is positionable proximate an operator of the firearm supported on the firearm mount and operable by the operator in an aiming position.

29. A firearm support, comprising:

a housing;

two or more support legs coupled with and supporting the housing;

actuation means for extending and retracting a firearm mount coupled to the actuation means relative to the housing; and

a remote controller configured to control the actuation means to move the firearm mount relative to the housing in response to an operator input, thereby changing an elevation of a firearm supported on the firearm mount.

30. The firearm support of claim **29**, wherein the actuation means comprises hydraulic means and the remote controller is configured to adjust a height of the firearm mount by activating the hydraulic means.

31. The firearm support of claim **29**, wherein the actuation means comprises a hydraulic actuator comprising a first hydraulic cylinder and a rod, the remote controller comprising a second hydraulic cylinder fluidly coupled to the first hydraulic cylinder through a hose and operable to move hydraulic fluid along the hose, extending or retracting the rod and thereby changing the elevation of the firearm supported on the firearm mount.

32. The firearm support of claim **31**, wherein the second hydraulic cylinder comprises a piston residing within the second hydraulic cylinder, the piston movable as a function of the operator input to push the hydraulic fluid to the first hydraulic cylinder and extend the rod or receive a portion of the hydraulic fluid and retract the rod.

33. The firearm support of claim **32**, wherein the piston is movable by a knob threadedly attached to the second hydraulic cylinder and configured to push, as the knob is threaded into the second hydraulic cylinder, the hydraulic fluid through the hose so that a portion of the hydraulic fluid enters the first hydraulic cylinder, causing the rod to extend out of the first hydraulic cylinder.

34. The firearm support of claim **29**, wherein the remote controller is an electric remote controller.

35. The firearm support of claim **34**, wherein the actuation means is an electric linear actuator controllable by the electric remote controller.

36. A method of adjusting a firearm, the method comprising:

mounting the firearm on a firearm mount of a firearm support, the firearm support comprising:

a linear actuator comprising a cylinder and a rod configured to extend and retract with respect to the cylinder, the firearm mount attached to an end of the rod and configured to support the firearm;

two or more legs coupled to and extending from the linear actuator; and

a remote controller operable to move the rod with respect to the cylinder; and

actuating the linear actuator by operating the remote controller, causing the rod to be extended or retracted with respect to the cylinder, changing an elevation of the firearm supported on the firearm mount.

37. The method of claim **36**, wherein the actuating comprises actuating the linear actuator while in an aiming position.

38. The method of claim **36**, wherein the linear actuator is a hydraulic linear actuator and the cylinder is a hydraulic cylinder and the remote controller is fluidly coupled with the hydraulic cylinder through a hose, and the actuating comprises causing hydraulic fluid to move through the hose to extend or retract the rod, changing an elevation of the firearm supported on the firearm mount.

39. The method of claim **36**, wherein the remote controller is an electric remote controller, and actuating the linear actuator comprises controlling, through the remote controller, the linear actuator.

40. The method of claim **39**, wherein the linear actuator is an electric linear actuator and actuating the electric linear actuator comprises controlling, through the remote controller, the electric linear actuator.

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