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Frear, Jr.

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(54) **COLLIMATOR MOUNTING APPARATUS FOR BORE SIGHTING A FIREARM**

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(51) **Int. Cl.**[7] **F41G 3/00**
(52) **U.S. Cl.** **33/234**
(58) **Field of Search** 33/234, 233; 42/103

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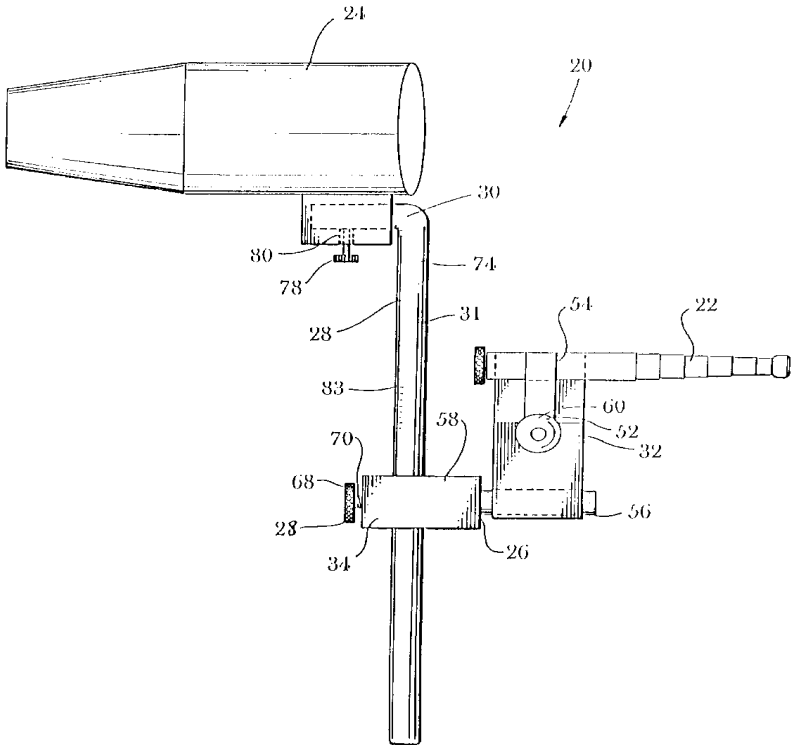
(57) **ABSTRACT**

Apparatus for use with a bore spud for mounting and positioning a collimator with respect to a sighting device or scope on a firearm for bore sighting the firearm provides for adjustment of the collimator to an unlimited number of linear positions from below the center of the bore spud to positions above the bore spud. Greater bore sighting accuracy and more accurate adjustment of the sighting device or scope of the firearm is attained by enabling the collimator to be elevated and held at a precise location which matches that of the elevation of the sighting device or scope from the center of the firearm bore. The apparatus also enables angular adjustment of the collimator to an unlimited number of positions to permit alignment of the collimator with the firearm sighting device when the sighting device is offset and positioned at a location which is angularly displaced from a location directly above the bore of the firearm. The apparatus also enables adjustment of the position of the collimator so the grid screen of the collimator can be aligned vertically and horizontally with the reticle of the offset firearm sighting device.

11 Claims, 9 Drawing Sheets



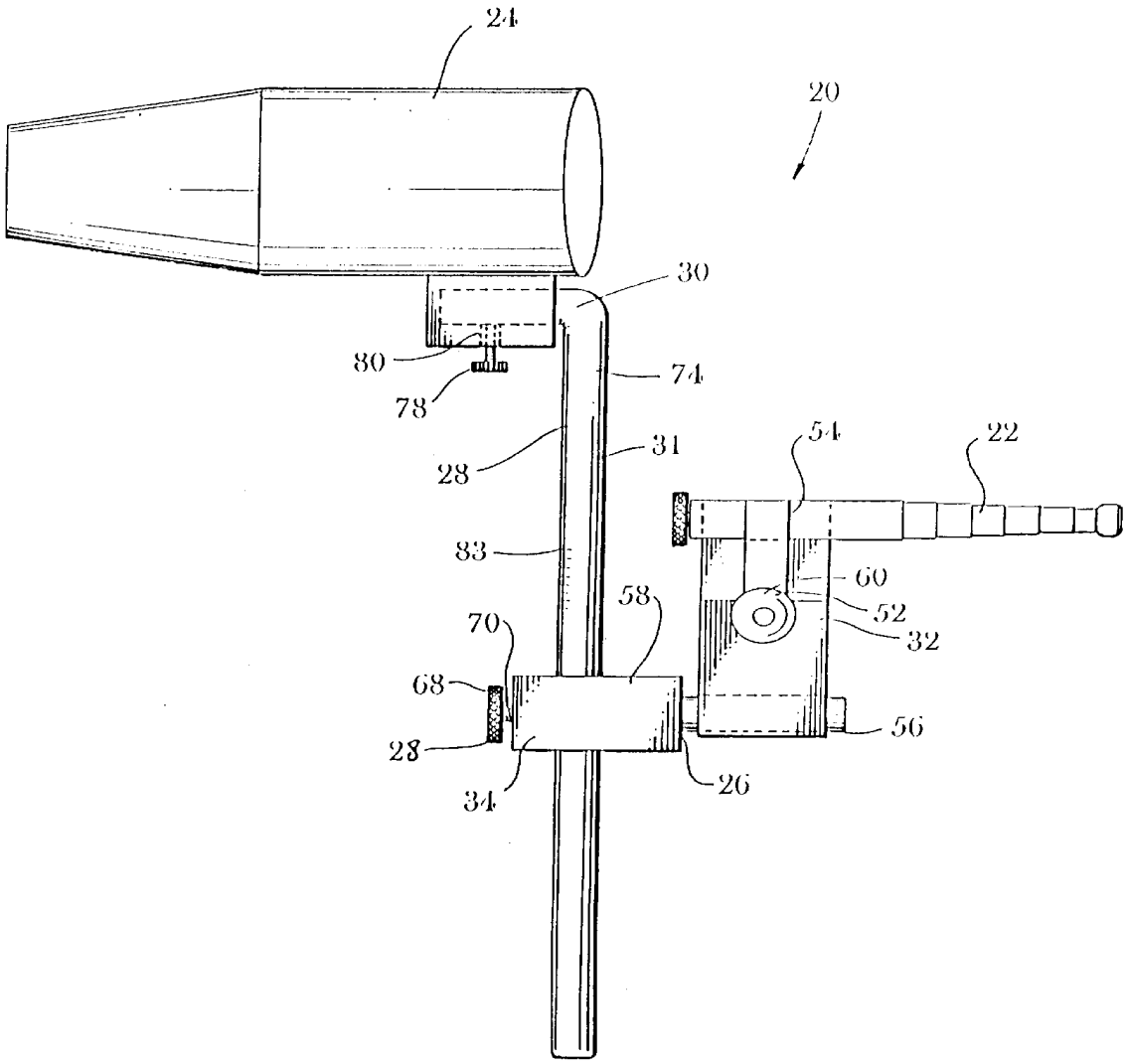


Fig. 1

Fig. 2

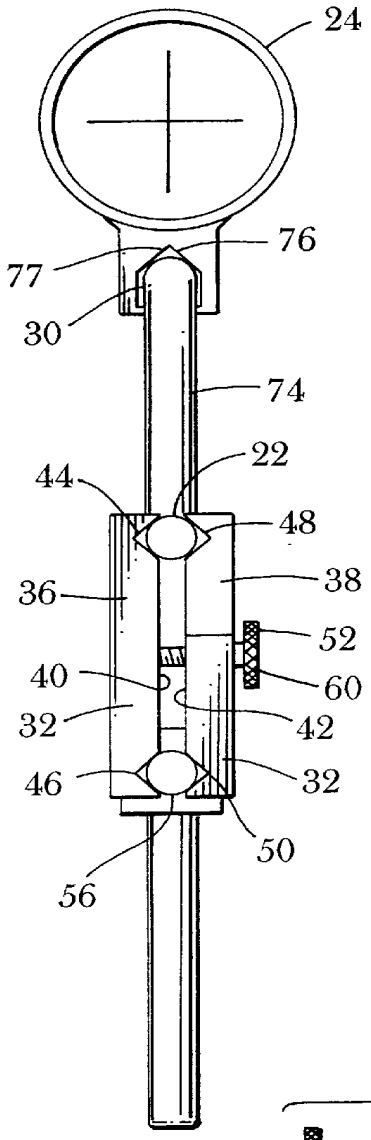


Fig. 3A

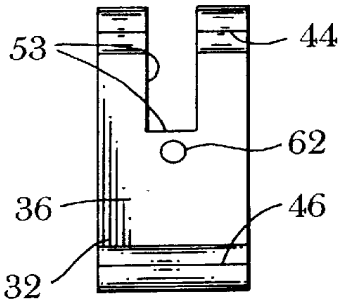


Fig. 3B

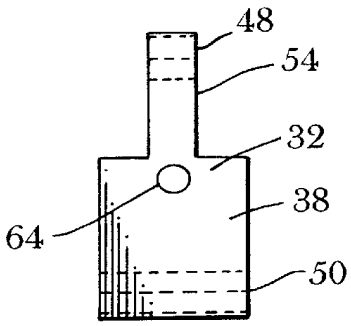


Fig. 3C

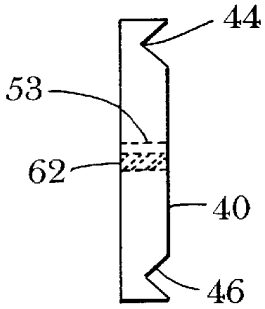


Fig. 3D

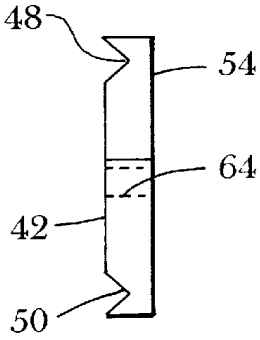


Fig. 3E

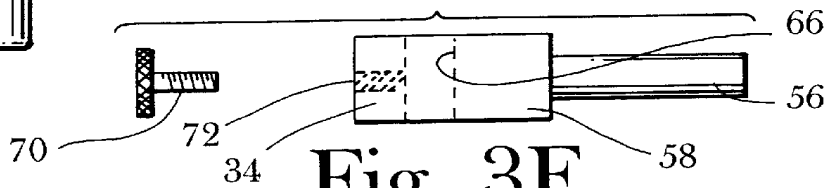
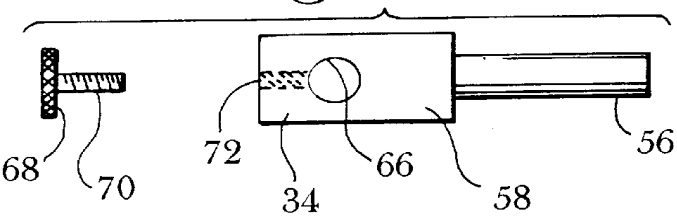


Fig. 3F



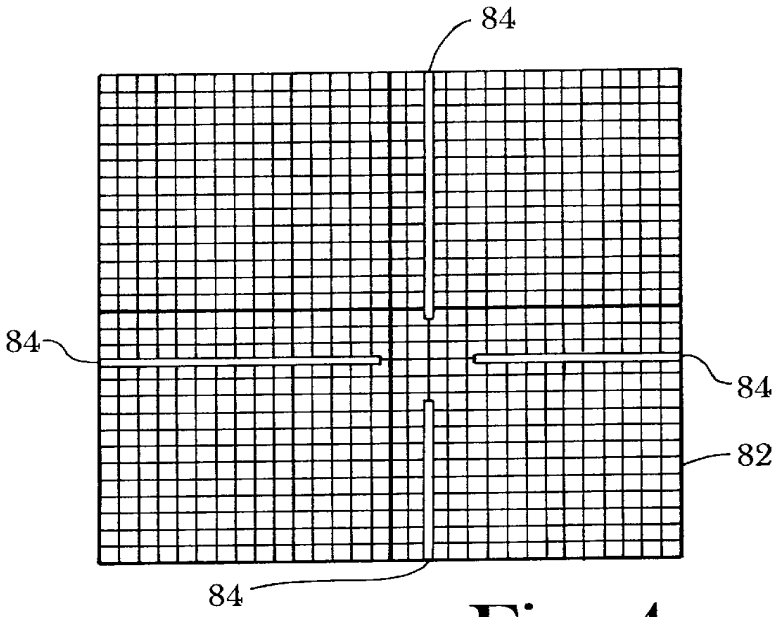


Fig. 4

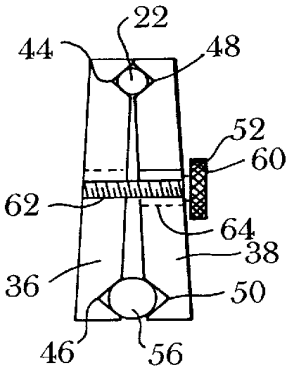


Fig. 5

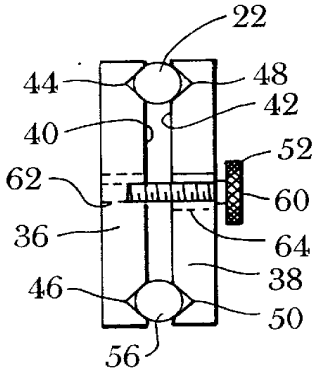


Fig. 6

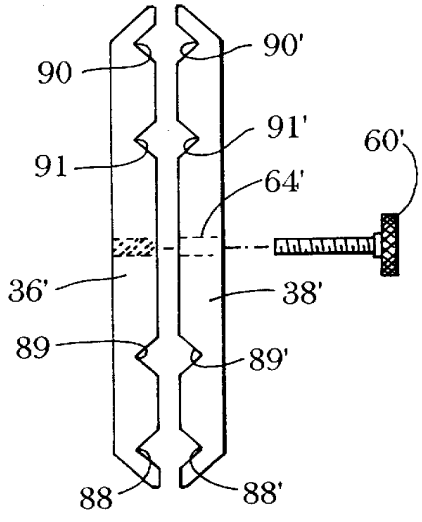


Fig. 9

Fig. 10

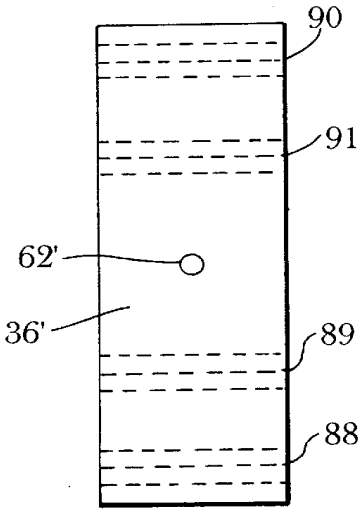


Fig. 7

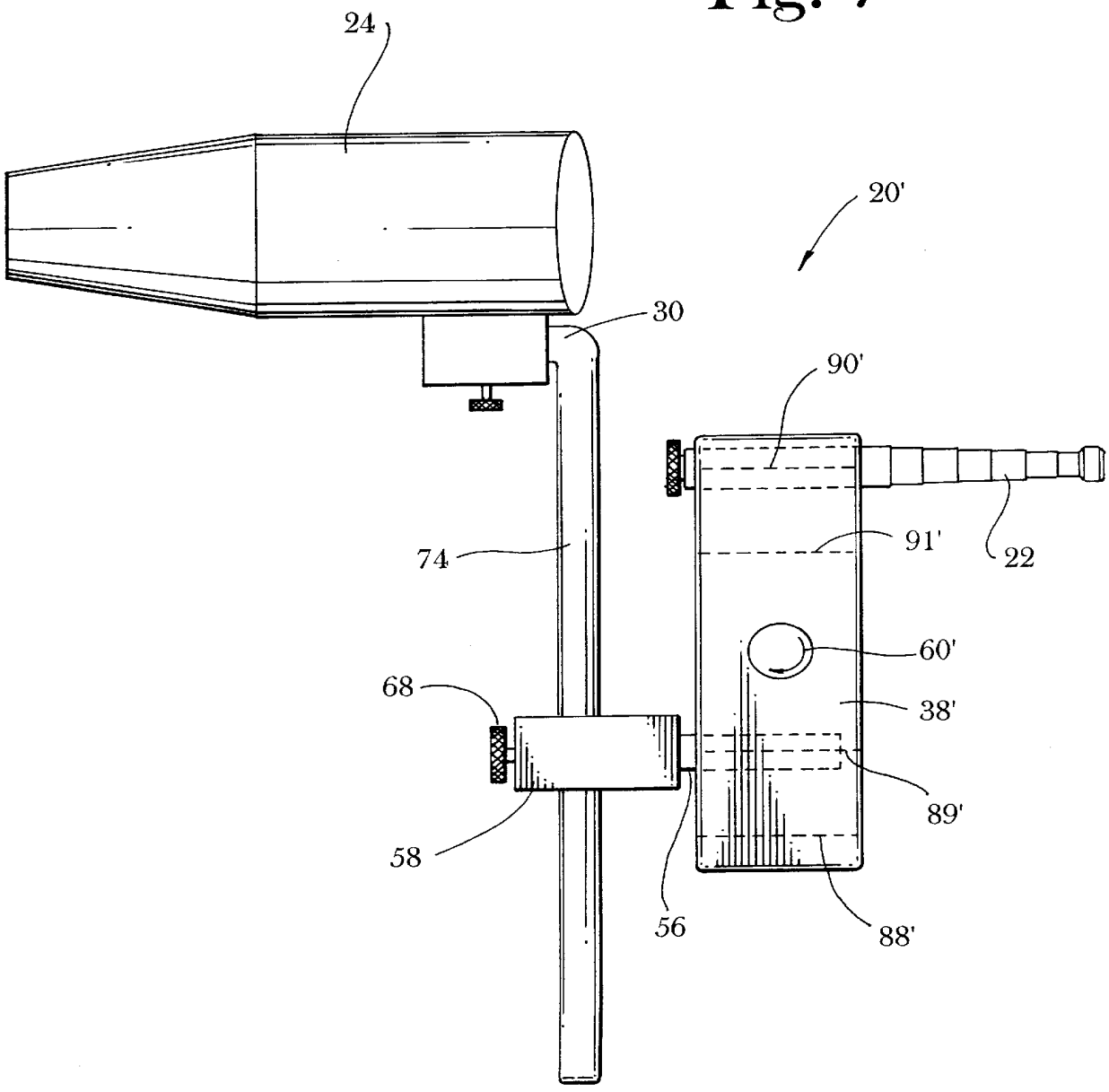
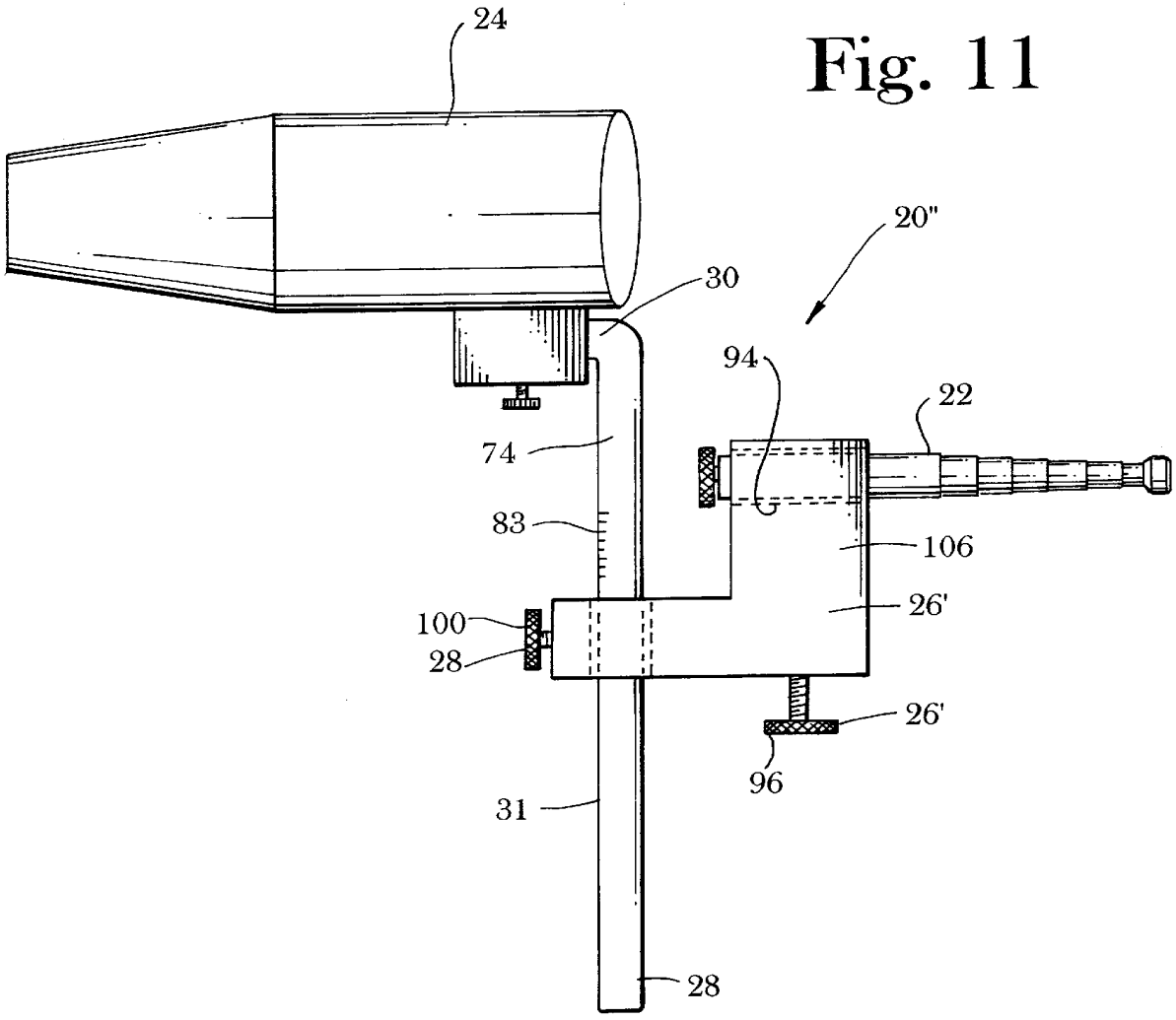


Fig. 11



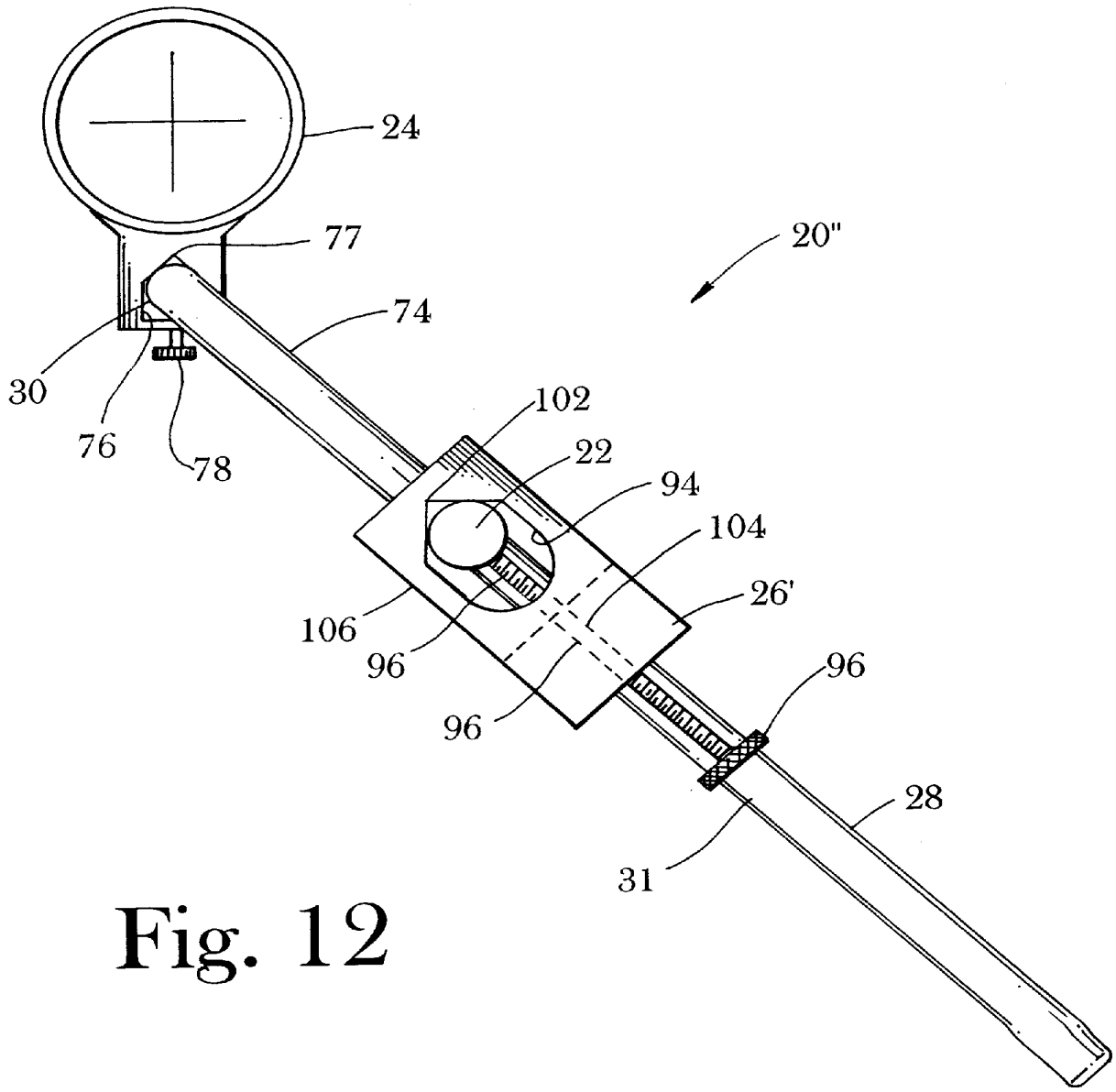
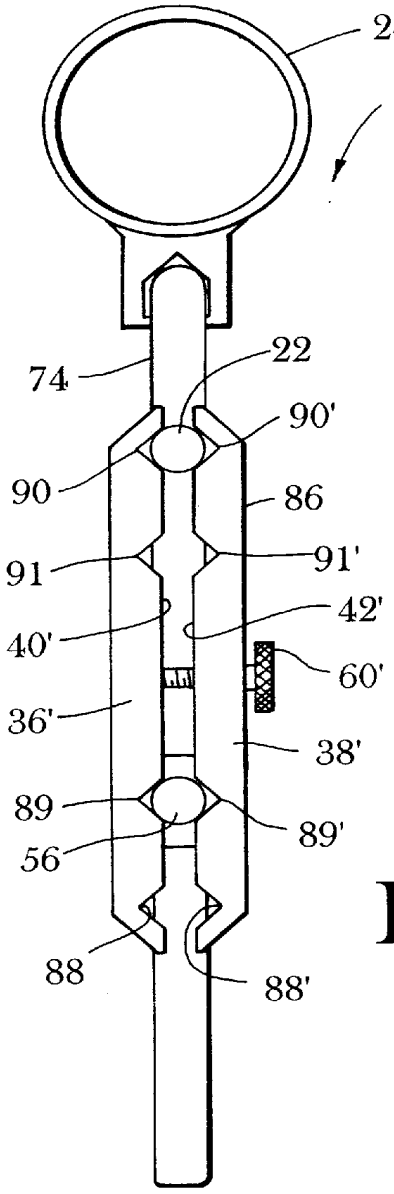


Fig. 12

Fig. 8



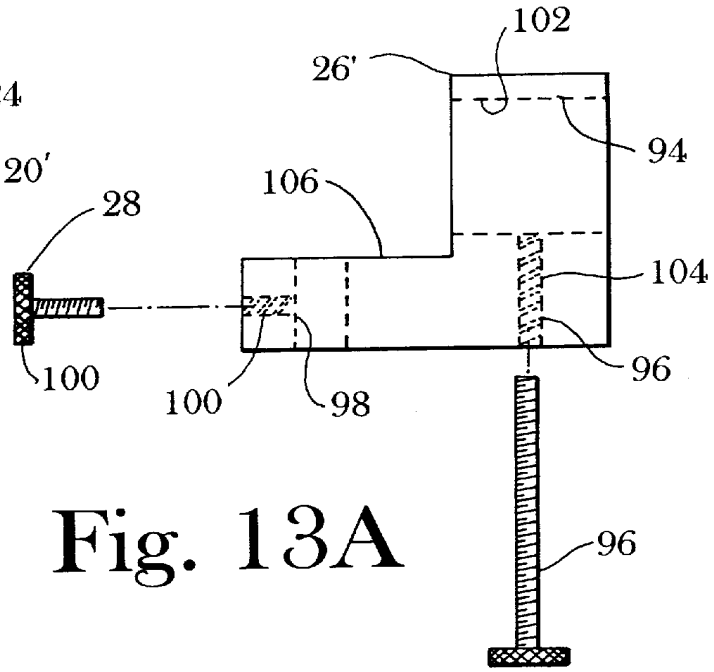


Fig. 13A

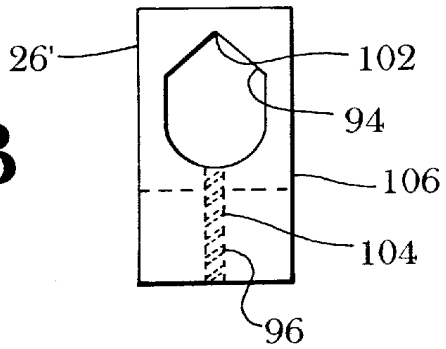


Fig. 13B

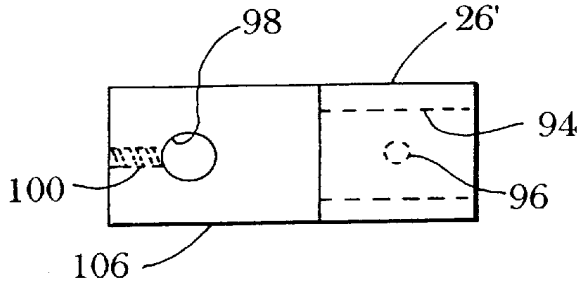


Fig. 13C

Fig. 14

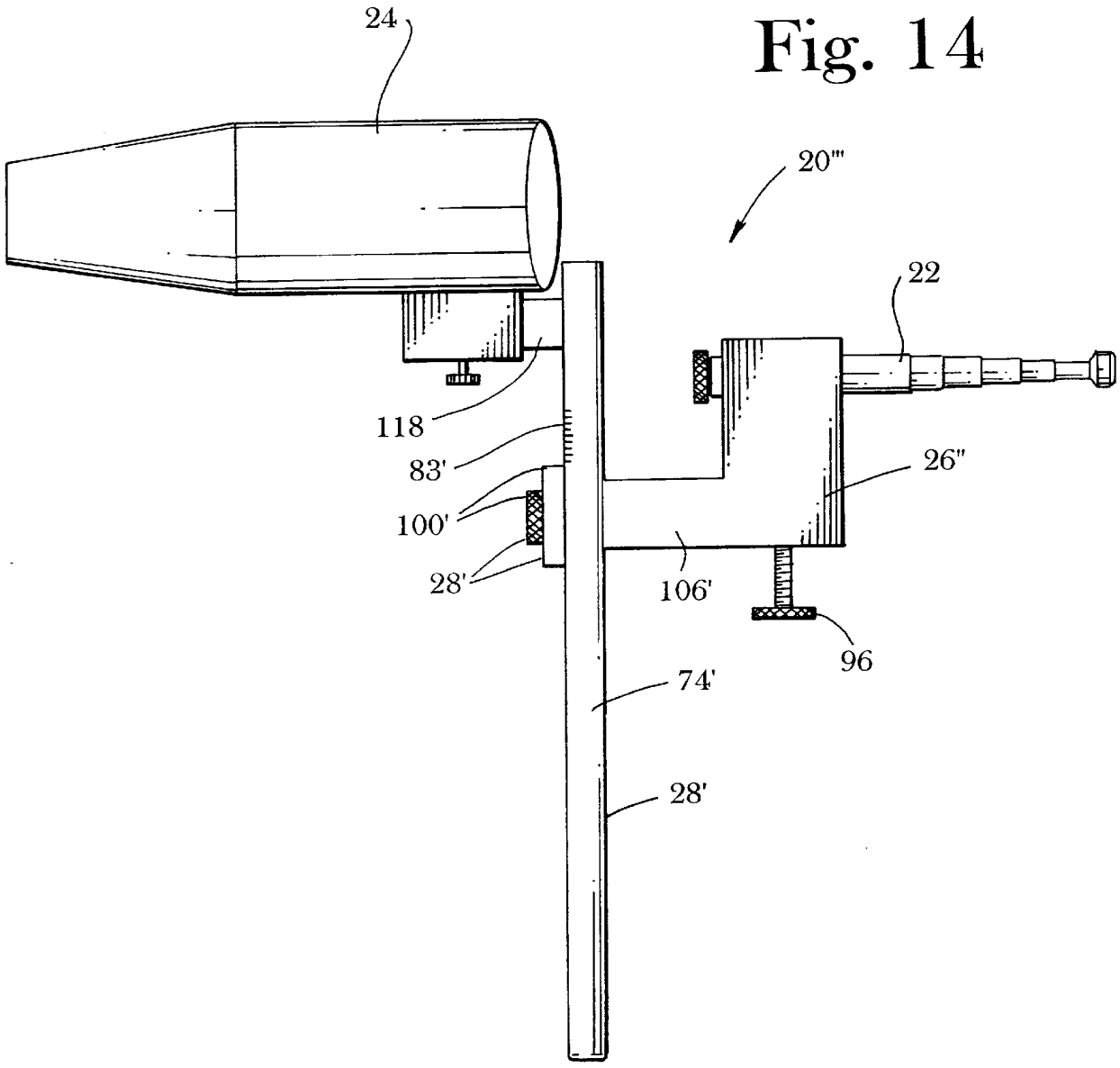


Fig. 15A

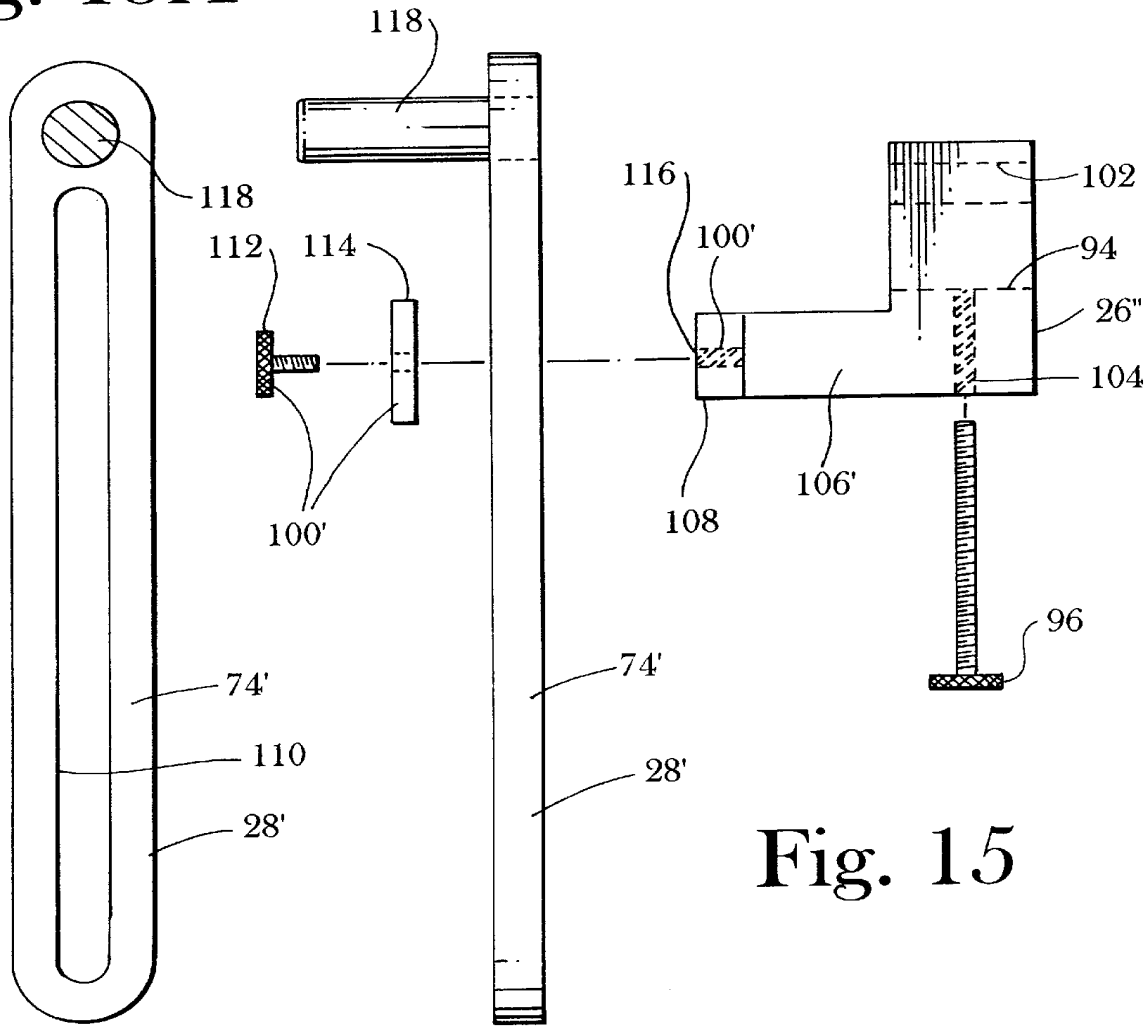


Fig. 15

Fig. 15B

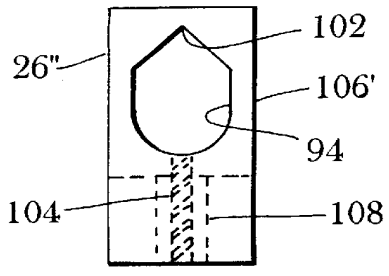
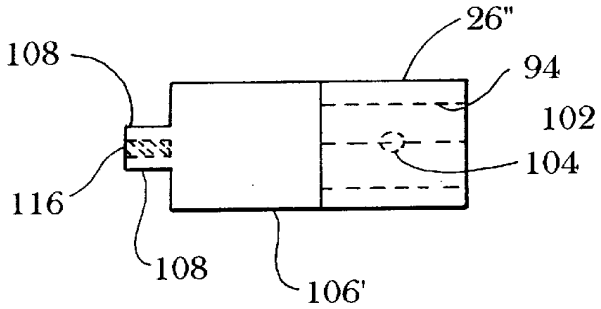


Fig. 15C



COLLIMATOR MOUNTING APPARATUS FOR BORE SIGHTING A FIREARM

BACKGROUND OF THE INVENTION

This invention relates to apparatus for use with a conventional bore spud for mounting and positioning a conventional collimator with respect to a sighting device or scope on a firearm for bore sighting the firearm and more particularly to such apparatus which provides for adjustably positioning the collimator to an unlimited number of linear and angular positions with respect to the bore spud for enabling the collimator to be precisely aligned with the sighting device or scope.

A scope is an optical sighting device which is mounted on a rifle, shotgun or handgun. All scopes serve to enhance the shooter's ability to acquire a given target. Some scopes do this by magnification, which provides great accuracy at long distances. Others have little or no magnification but rather provide faster acquisition of a given target. All scopes must have a reticle or point of aim, the means by which to adjust the point of aim, a casing in which to house the reticle, and the means or ability with which to mount the scope onto a firearm.

A reticle, which is a center point in a scope, often appear as a cross hair, or in some scopes as a colored dot, often red. The cross hair or dot is placed on the intended target by the shooter looking through, from the rear of the scope. When a scope is first installed onto a firearm, be it a rifle, pistol or shotgun, the scope must first be "sighted in" before it will serve to accurately aim the firearm. A scope is typically "sighted in", by way of mechanical adjustments, for elevation and windage. The process of sighting in can be performed at a target range by shooting at a target and adjusting the scope's reticle to the point of impact. However, this process can be both time consuming and costly to the shooter.

In order to expedite this "sighting in" process, others have developed a means and a device to accurately adjust a scope with respect to the barrel of the firearm onto which the scope is mounted. This process is commonly referred to as "bore sighting", and the device, developed by others, by which this is accomplished is commonly referred to as a collimator.

A collimator is attached to the front of the firearm by way of a "bore spud". A bore spud is a rod of metal approximately three and one-half inches in length which either fits the inner diameter of the firearm's barrel or mechanically expands to match the barrel's inner diameter. The bore spud is placed inside the muzzle of the firearm with approximately one inch protruding. The collimator is then fastened onto the bore spud, placing it directly above the bore of the firearm.

A collimator has an opening on one end which faces the rear of the firearm. Inside the collimator is a very small grid screen with cross hair lines running both vertically and horizontally through the center. With the collimator installed, the shooter sights through the scope and into the collimator. The shooter can now make windage and elevation adjustments to the scope and align the cross hair or dot of the scope with that of the collimator's cross hair. This process, when performed correctly, can be very close to the firearm's "true" point of impact on a real target at roughly one hundred yards.

When a firearm is brought to a gun shop for service it may already be equipped with a scope or optical sighting device. In order to properly service the firearm, the scope is removed.

Before removing the scope, the technician will note where the scope's reticle is adjusted in relation to the firearm's bore. This is done by first installing a collimator. The technician then sights through the scope and into the collimator, viewing the point at which the scope's reticle vertically and horizontally intersects on the collimator's grid screen. This enables the technician to write down precisely where the fire-arm's owner has adjusted the scope. The technician can now remove the scope along with the collimator assembly and proceed with the repair. When service to the firearm is complete, the technician installs the scope along with the collimator assembly and adjusts the scope's reticle to the previously noted point on the collimator.

Various types of collimator mounting devices are known. Examples are described in U.S. Pat. No. 5,222,302 and in UK patent application GB2194621A. Although such devices have served the purpose, they have not proved entirely satisfactory because they allow for only a limited number of discrete positions for the collimator with respect to the firearm sighting device or scope. These devices often allow for positioning of the collimator only at a too low or too high location for proper alignment with the firearm scope, and in some situations the collimator cannot be properly viewed through the scope for accurately bore sighting the firearm. Some collimator mounting devices will partially obstruct the view of the collimator through the scope, thus compromising the accuracy of alignment of the collimator with the scope. Some collimator mounting devices also do not permit for angular positioning of the collimator with respect to the firearm bore to permit proper alignment of the collimator with the firearm scope when the scope is offset and not positioned directly above the firearm bore.

It is, therefore, an object of the present invention to provide apparatus for use with a bore spud for mounting and positioning a collimator with respect to a sighting device or scope on a firearm for bore sighting the firearm.

Another object is to provide such apparatus which enables the collimator to be adjusted to an unlimited number of linear and angular positions with respect to the firearm bore.

A further object of the invention is the provision of such apparatus which will enable precise alignment of a collimator with a firearm sighting device or scope during the bore sighting process.

A further object of the invention is the provision of such apparatus which allows positioning of a collimator above or below the center of the firearm bore.

Another object of the invention is to provide such apparatus which enables positioning of a collimator at an angularly displaced location to the left or to the right of the center line of the firearm bore to position the collimator in precise alignment with an offset firearm sighting device or scope.

Yet another object of the present invention is the provision of such apparatus which enables positioning of a collimator at an angularly displaced location to the left or to the right of the center line of the firearm bore while maintaining the grid screen of the collimator in vertical and horizontal alignment with the reticle of the offset firearm scope or sighting device.

A still further object is to provide such apparatus which can be used with bore spuds of various sizes and diameters.

Additional objects and advantages of the invention will be set forth in part in the description which follows, and in part will be obvious from the description, or may be learned by practice of the invention. The objects and advantages are realized and attained by means of the instrumentalities and combinations particularly pointed out in the appended claims.

SUMMARY OF THE INVENTION

To achieve these and other objects, the present invention provides apparatus for use with a bore spud for mounting and positioning a collimator with respect to a sighting device or scope on a firearm for bore sighting the firearm, the apparatus comprising: first means for adjustably connecting to the bore spud; and second means for adjustably connecting to the first means and for adjustably supporting the collimator, the second means adjustable to an unlimited number of linear and angular positions with respect to the first means and with respect to the bore spud for enabling the collimator to be precisely aligned with the sighting device or scope.

It is to be understood that both the foregoing general description and the following detailed description are exemplary and explanatory but are not restrictive of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings, which are incorporated in and constitute a part of this specification, illustrate preferred embodiments of the invention and, together with the description, serve to explain the principles of the invention.

FIG. **1** is a side elevation view showing a first invention embodiment;

FIG. **2** is a front elevation view of the embodiment shown in FIG. **1**;

FIGS. **3**A and **3**B are side elevation views showing plate members of the embodiment shown in FIG. **1**;

FIGS. **3**C and **3**D are end elevation views of the plate members shown in FIGS. **3**A and **3**B;

FIGS. **3**E and **3**F are side elevation and top plan views, respectively, showing the clamp member of the embodiment illustrated in FIG. **1**;

FIG. **4** is a view showing what a user will see when looking through a sighting device or scope and a collimator;

FIG. **5** is an end elevation view showing the plate members of the embodiment illustrated in FIG. **1** holding a bore spud **22** of a smaller diameter than port element **56**;

FIG. **6** is an end elevation view as in FIG. **5** but showing the plate members holding a bore spud **22** of equal diameter to that of port element **56**;

FIG. **7** is a side elevation view showing a second invention embodiment;

FIG. **8** is a front end elevation view of the embodiment shown in FIG. **7**;

FIG. **9** is an exploded end elevation view showing the plate members of the embodiment illustrated in FIG. **7**;

FIG. **10** is a side elevation view of plate element **36'** shown in FIG. **9**;

FIG. **11** is a side elevation view showing a third invention embodiment;

FIG. **12** is a front end elevation view of the embodiment shown in FIG. **11**;

FIG. **13**A is an exploded side elevation view of block **106** in the embodiment illustrated in FIG. **11**;

FIG. **13**B is an end elevation view of block **106**;

FIG. **13**C is a top plan view of block **106**;

FIG. **14** is a side elevation view of a fourth invention embodiment;

FIG. **15** is an exploded side elevation view of block **106'** and arm **74'** in the embodiment shown in FIG. **14**;

FIG. **15**A is an elevation view of arm **74'** in the embodiment shown in FIG. **14**;

FIG. **15**B is an elevation view of block **106'**; and

FIG. **15**C is a top plan view of block **106'**.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

With reference now to the drawings, wherein like reference characters designate like or corresponding parts throughout the several views, there is shown in FIGS. **1–6** a preferred embodiment **20** of the invention for use with a conventional bore spud **22** for mounting and positioning a conventional collimator **24** with respect to a sighting device or scope (not shown) on a firearm (not shown) for bore sighting the firearm. Apparatus **20** comprises first means **26** for adjustably connecting to bore spud **22**. Apparatus **20** further comprises second means **28** for adjustably connecting to first means **26** and for adjustably supporting collimator **24**, second means **28** being adjustable to an unlimited number of linear positions with respect to first means **26** and with respect to bore spud **22** for enabling collimator **24** to be precisely aligned with the sighting device or scope (not shown).

First means **26** is rotatably connected with respect to bore spud **22** for enabling angular adjustment of first means **26** about bore spud **22**, and collimator **24** is rotatably connected to a predetermined portion **30** of second means **28** for enabling angular adjustment of collimator **24** about predetermined portion **30**.

First means **26** in apparatus embodiment **20** include a first support **32** adjustably connected to bore spud **22** and a second support **34** adjustably connected to first support **32**. Second means **28** is adjustably connected to second support **34** for adjustably supporting collimator **24** in an unlimited number of linear positions with respect to second support **34** and with respect to bore spud **22**.

First support **32** includes first and second plate members **36**, **38**. Plate members **36**, **38** define surfaces **40**, **42**, respectively. Surface **40** defines notches **44**, **46**, and surface **42** defines notches **48**, **50** therein.

First support **32** further includes means **52** in operative relationship with plate members **36**, **38** for adjustably connecting the plate members together with surfaces **40**, **42** in opposed relationship with each other and with notches **44**, **48** and **46**, **50** in opposed relationship with each other, respectively. Notches **44**, **48** preferably receive and hold bore spud **22** therebetween when plate members **36**, **38** are connected together by connecting means **52**.

Surface **40** defines a centrally positioned gap **53** therein and surface **42** defines a centrally positioned projecting portion **54** in opposed relationship with respect to gap **53** when plate members **36**, **38** are connected together by connecting means **52** with surfaces **40**, **42** in opposed relationship with each other. As a result of this configuration, projecting portion **54** can extend into gap **53** in interlaced relationship therewith when the diameter of bore spud **22** is smaller than the diameter of post element **56**. See FIG. **5**.

Second support **34** includes a clamp member **58** having post element **56** connected thereto, and post element **56** is preferably positioned and held between notches **46**, **50** of plate members **36**, **38** when the plate members are connected together by connecting means **52**. Second means **28** is adjustably connected to clamp **58** for adjustably supporting collimator **24** in an unlimited number of linear positions with respect to clamp member **58** and with respect to bore spud **22**.

Notch or notches **44** in plate member **36** are positioned in contiguous relationship with and on opposite sides of gap

53, and notch 48 in plate member 38 is positioned within projecting portion 54. Notches 44, 48 are positioned for receiving and holding bore spud 22 therebetween when plate members 36, 38 are connected together by connecting means 52 in opposed relationship with respect to each other. See FIG. 6.

Connecting means 52 include threaded fastener 60 and circular openings 62, 64 within plate members 36, 38, respectively. Opening 64 is larger in diameter than opening 62, and opening 62 is threaded to threadably receive threaded fastener 60.

Clamp member 58 defines circular opening 66 therein, and fastening means 68 includes a threaded post 70 which threadably engages and is adjustable within threaded opening 72 within clamp 58.

Second means 28 includes an elongated cylindrical arm 74 which is L-shaped to define predetermined portion 30 extending orthogonally from primary portion 31 of arm 74. Primary portion 31 of arm 74 is slideably positioned within opening 66, and fastening means 68 fasten arm 74 in any one of an unlimited number of linear positions within opening 66 by engaging arm 74 through threaded opening 72.

In operation and use of apparatus embodiment 20, collimator 24 is fastened onto portion 30 of arm 74 by positioning portion 30 through opening 76 in collimator 24 and by fastening collimator 24 in position by threaded fastener 78. Fastener 78 threadably engages opening 80 in collimator 24 to contact portion 30 of arm 74. Opening 76 preferably defines a ninety degree vertex 77 at the top of opening 76 and fastener 78 secures portion 30 against vertex 77.

Plate members 36, 38 are connected together by fastener 60 with bore spud 22 positioned between notches 44, 48 and with post element 56 positioned between notches 46, 50. Arm 74 is positioned within opening 66 of clamp member 58, and bore spud 22 is inserted into the bore of the firearm (not shown).

Collimator 24 can be adjusted in position to be precisely aligned with the sighting device or scope (not shown) of the firearm (not shown). This can be done by taking a measurement from the side/center of the bore or chamber of the firearm to the side/center of the sighting device or scope which is mounted on the firearm. This measurement is then used to adjust the distance between the center of bore spud 22 and the center of collimator 24. This positioning of collimator 24 with respect to bore spud 22 is accomplished by adjusting the position of arm 74 within clamp 58. Indicia or markings of distance 83 along the length of arm 74 can be used for adjusting the position of arm 74 within clamp 58 to provide for the proper positioning of collimator 24 with respect to the scope. When the desired position of arm 74 and collimator 24 has been obtained, fastener 68 is tightened within threaded opening 72 to secure arm 74 in fixed position within clamp 58.

If the firearm sighting device or scope is offset and is not positioned directly above the firearm bore, the angular position of collimator 24 can be adjusted to allow precise alignment of the collimator with the offset scope. This can be accomplished by rotating post element 56 within notches 46, 50 and by tightening fastener 60 to hold plate members 36, 38 together when the desired angular position of collimator 24 with respect to the scope has been achieved. This can also be accomplished by rotating notches 44, 48 about bore spud 22 and by tightening fastener 60 to hold plate members 36, 38 together when the desired angular position of collimator 24 with respect to the scope has been achieved.

It is also important to position collimator 24 with respect to the firearm sighting device or scope so that the grid screen 82 of collimator 24 is maintained in vertical and horizontal alignment with reticle 84 of the offset firearm scope or sighting device. See FIG. 4. This orientation of collimator 24 is accomplished by rotating opening 76 of collimator 24 about portion 30 of arm 74 and by fastening collimator 24 in a desired fixed position on portion 30 by tightening fastener 78 through opening 80 against portion 30.

With collimator 24 in precise alignment with the sighting device or scope of the firearm, the technician or operator sights through the scope and into the collimator. He can now make windage and elevation adjustments to the scope and align reticle 84 of the scope with the appropriate position in relationship to collimator grid screen 82. See FIG. 4.

The configuration of plate members 36, 38 enables the plate members to firmly grasp and hold a relatively small diameter bore spud 22 within notches 44, 48 while holding a larger diameter post element 56 within notches 46, 50. See FIG. 5. This is accomplished because of the interlacing design of plate members 36, 38 whereby projecting portion 54 can fit into gap 53 in interlaced relationship. This interlaced and angled relationship of plate members 36, 38 with respect to each other is further provided for by opening 64 in plate member 38 having a diameter larger than the diameter of the threaded portion of threaded fastener 60 and by providing for threaded portion of fastener 60 to threadably engage opening 62 in plate member 36. This permits the angled and interlaced connection of plates 36, 38 together by threaded fastener 68, as shown in FIG. 5. As a result of this configuration of plate members 36, 38, apparatus 20 can be used with all conventional bore spuds 22 having diameters smaller or larger than the diameter of post element 56. If the diameter of bore spud 22 is greater than the diameter of post element 56, plate members 36, 38 can still be tightly fastened together in angled relationship with each other. The diameter of larger bore spud 22 and of post element 56 are such that plate surfaces 40, 42 do not contact or interfere with each other when bore spud 22 has a diameter greater than post element 56. See FIG. 6.

Another invention embodiment 20' is shown in FIGS. 7–10. Apparatus 20' is identical to apparatus embodiment 20 with the exception that plate members 36', 38' and threaded fastener 60' are a known B-Square universal spud bracket 86.

The traditional role of B-Square universal spud bracket 86, formed by plate members 36', 38' and threaded fastener 60', is to hold a collimator in one of three fixed positions over the barrel of a firearm for bore sighting the firearm. B-Square bracket 86 is traditionally utilized by placing a conventional bore spud between one of two lower clamping notches 88, 88' or 89, 89' of plate members 36', 38' and by positioning a two inch long rod (not shown) between notches 90, 90' or 91, 91' of plate members 36', 38'. The rod and bore spud are held in place by tightening fastener 60' which brings plate members 36', 38' together. The collimator is then installed onto the rod (not shown) which is positioned and held between notches 90, 90' or 91, 91'. That assembly is then installed onto the muzzle of a firearm (not shown) by placing the bore spud into the barrel of the firearm.

B-Square bracket 86 is used in invention embodiment 20' with clamp member 58 and with arm 74 to enable adjustment of collimator 24 to an unlimited number of linear and angular positions with respect to a bore spud so that the collimator can be precisely aligned with the firearm sighting device or scope.

Bore spud 22 is positioned and held between notches 90, 90' or 91, 91' and post element 56 of clamp 58 is positioned

and held between notches **89, 89'** or **88, 88'** of plate members **36', 38'**. Positioning of collimator **24** in precise alignment with the sighting device or scope (not shown) of the firearm (not shown) is accomplished in the same manner as described with respect to apparatus embodiment **20**. However, because of the configuration of B-Square universal spud bracket **86**, it may be difficult or impossible to use apparatus **20'** when bore spud **22** is significantly smaller in diameter than the diameter of post element **56**. The smaller diameter bore spud cannot be firmly grasped and held between notches **90, 90'** or **91, 91'** when a larger diameter post element **56** is positioned within notches **89, 89'** or **88, 88'**. This is because surfaces **40', 42'** of plate members **36', 38'** will contact each other before the relatively small diameter bore spud **22** can be tightly gripped between notches **90, 90'** or **91, 91'** when threaded fastener **60'** is tightened to hold plate members **36', 38'** together. This problem can be avoided by use of plate members **36, 38** of invention embodiment **20**.

Another invention embodiment **20"** is shown in FIGS. **11–13**.

Apparatus **20"** includes first means **26'** which defines a bore spud receiving opening **94** therein. Opening **94** extends in a first direction, and first means **26'** further includes fastening means **96** in operative relationship with opening **94** for fastening bore spud **22** in position within opening **94**.

First means **26'** further defines a second opening **98** therein extending in a second direction orthogonally positioned with respect to opening **94**. Second means **28** are provided for adjustably connecting to first means **26'** and for adjustably supporting collimator **24**. Second means **28** are adjustable to an unlimited number of linear positions with respect to first means **26'** and with respect to bore spud **22** for enabling collimator **24** to be precisely aligned with the sighting device or scope.

Second means **28** include arm **74** and fastening means **100** in operative relationship with opening **98** and with arm **74** for fastening arm **74** in any one of an unlimited number of linear positions within opening **98**.

Opening **94** preferably defines an upper portion which defines a ninety degree vertex **102**. As previously described, arm **74** is L-shaped and defines a primary elongated portion **31** for positioning through opening **98**. Arm **74** also defines a secondary portion **30** extending orthogonally from primary portion **31**, and collimator **24** is adjustably connected to secondary portion **31** as previously described.

When a cylindrical bore spud **22** is placed into bore spud opening **94** of apparatus **20"**, fastener **96**, which is positioned beneath and in perpendicular relationship with respect to vertex **102**, is rotated to threadably engage and move within threaded opening **104**, which also extends perpendicularly with respect to vertex **102**. Fastener **96** secures bore spud **22** against vertex **102**. See FIG. **12**.

Means **26'** preferably includes an L-shaped block **106**, and block **106** can be angularly adjusted or rotated with respect to bore spud **22** to an unlimited number of positions for enabling collimator **24** to be precisely aligned with an offset sighting device or scope of the firearm. See FIG. **12**. Collimator **24** can be rotated and adjusted in position with respect to portion **30** of arm **74** in a manner as previously described so that grid screen **82** of collimator **24** can be maintained in vertical and horizontal alignment with reticle **84** of the offset firearm scope or sighting device. See FIG. **4**.

In operation and use of apparatus embodiment **20"**, a conventional bore spud **22** of the correct size for the firearm is installed within opening **94** and is clamped into fixed position by fastener **96**. Collimator **24** is then installed onto portion **30** of arm **74** as previously described. Bore spud **22** is then placed into the muzzle end of the firearm (not shown). A vertical measurement is then made from the side/center of the bore or chamber of the firearm to the side/center of the mounted sighting device or scope. The length of this measurement is then used to determine the distance between the center of bore spud **22** and the center of collimator **24**. Adjustment of the position of collimator **24** to be precisely aligned with the scope is accomplished by movement of arm **74** through opening **98** of block **106**. Indicia or markings **83** on arm **74** can be used for this purpose. When the proper position of collimator **24** with respect to the scope has been achieved, arm **74** is fixed into position by tightening of fastener **100**.

With collimator **24** in precise alignment with the sighting device or scope of the firearm, the technician or operator sights through the scope and into the collimator. He can now make windage and elevation adjustments to the scope and align reticle **84** of the scope with respect to collimator grid screen **82**.

Angular adjustment of the position of collimator **24** with respect to bore spud **22** can be accomplished by rotating block **106** about bore spud **22** until collimator **24** is aligned with an offset sighting device or scope of the firearm. Collimator **24** can then be rotated in position about portion **30** of arm **74** so that grid screen **82** of the collimator is in vertical and horizontal alignment with reticle **84** of the scope. See FIG. **4**.

Another invention embodiment **20'"** is illustrated in FIGS. **14–15C**.

Apparatus **20'"** is identical to apparatus embodiment **20"** with the exception that first means **26"** of embodiment **20'"** defines a projection **108** and second means **28'** includes an elongated arm **74'** defining an elongated opening **110** therein for slideably receiving projection **108** therein. Fastening means **100'** are provided in operative relationship with arm **74'** and with projection **108** for fastening arm **74'** to L-shaped block **106'** in any one of an unlimited number of Linear positions.

Fastening means **100'** include a threaded fastener **112**, a washer **114** and a threaded opening **116** within the end of projection **108**. Fastener **112** is positioned through washer **114** and is threaded into opening **116** while fastener **112** extends through opening **110** of arm **74'**. Projection **108** extends into opening **110** to prevent lateral or rotational movement of arm **74'** with respect to block **106'** and to permit only linear adjustment of the position of arm **74'** with respect to projection **108** along the length of opening **110**.

Arm **74'** includes a mounting element or post **118** which projects outwardly at a right angle from arm **74'**, and collimator **24** is adjustably connected to mounting element **118** in the manner previously described with respect to the connection of collimator **24** to arm portion **30** in embodiments **20–20"**.

Operation and use of apparatus embodiment **20'"** is identical to that of embodiment **20"** with the exception that arm

74' is adjusted linearly along the length of opening **110** with projection **108** extending through opening **110**.

Angular adjustment of the position of collimator **24** with respect to bore spud **22** can be accomplished by rotating block **106'** about bore spud **22** until collimator **24** is aligned with an offset sighting device or scope of the firearm. Collimator **24** can then be rotated in position about mounting element **118**, in a manner as previously described with respect to rotation of collimator **24** about portion **30** in embodiments **20–20"**, so that grid screen **82** of the collimator is in vertical and horizontal alignment with reticle **84** of the scope. See FIG. **4**.

This invention provides apparatus for adjusting the position of a collimator to an unlimited number of linear and angular positions with respect to a bore spud during the process of bore sighting a firearm. Greater bore sighting accuracy and more accurate adjustment of the firearm sighting device or scope is attained by enabling the collimator to be precisely aligned with the scope as provided by this invention.

The invention in its broader aspects is not limited to the specific details shown and described, and departures may be made from such details without departing from the principles of the invention and without sacrificing its chief advantages.

What is claimed is:

1. Apparatus for use with a bore spud for mounting and positioning a collimator, said apparatus comprising:

first means for adjustably and fixedly connecting to said bore spud;

second means for adjusteably and fixedly connecting to said first means and for adjustably supporting said collimator, said second means adjustable to an unlimited number of linear positions with respect to said first means and with respect to said bore spud;

said first means being rotatably connected to said bore spud for enabling angular adjustment of said first means about said bore spud to a plurality of fixed positions with respect to said bore spud;

said collimator being rotatably connected to a predetermined portion of said second means and wherein said collimator is angularly adjustable about said predetermined portion to a plurality of fixed positions with respect to said predetermined portion; and

wherein said first means defines a first bore spud receiving opening therein extending in a first direction and wherein said first means includes first fastening means in operative relationship with said first opening for fastening said bore spud in position within said first opening.

2. Apparatus as in claim **1** wherein said first means further defines a second opening therein extending in a second direction substantially orthoganally positioned with respect to said first opening, and wherein said second means includes an arm and second fastening means in operative relationship with said second opening and with said arm for fastening said arm in any one of said unlimited positions within said second opening.

3. Apparatus as in claim **2** wherein said arm is substantially L-shaped and defines a primary elongated portion for positioning through said second opening and defines a secondary portion extending orthoganally from said primary portion, said collimator adjustably connected to said secondary portion.

4. Apparatus as in claim **3** wherein said collimator is rotatably connected to said secondary portion for enabling said angular adjustment of said collimator about said secondary portion.

5. Apparatus as in claim **1** wherein said first means defines a projection and wherein said second means includes an elongated arm defining an elongated opening therein for slideably receiving said projection therein, and second fastening means in operative relationship with said arm and with said projection for fastening said arm in any one of said unlimited positions.

6. Apparatus as in claim **5** wherein said arm includes a mounting element projecting outwardly from said arm, said collimator adjustably connected to said mounting element.

7. Apparatus for use with a bore spud for mounting and positioning a collimator, said apparatus comprising:

first means for adjustably and fixedly connecting to said bore spud;

second means for adjustably and fixedly connecting to said first means and for adjustably supporting said collimator, said second means adjustable to an unlimited number of linear positions with respect to said first means and with respect to said bore spud;

said first means being rotatably connected to said bore spud for enabling angular adjustment of said first means about said bore spud to a plurality of fixed positions with respect to said bore spud;

said collimator being rotatably connected to a predetermined portion of said second means and wherein said collimator is angularly adjustable about said predetermined portion to a plurality of fixed positions with respect to said predetermined portion; and

said first means including a first support adjustably connected to said bore spud and a second support adjustably connected to said first support, said second means adjustably connected to said second support for adjustably supporting said collimator in said unlimited number of linear positions with respect to said second support and with respect to said bore spud.

8. Apparatus as in claim **7** wherein said first support includes:

first and second plate members, each of said plate members defining a surface having a plurality of notches therein; and

means in operative relationship with said plate members for adjustably connecting said plate members together with said surface in opposed relationship with each other and with predetermined of said notches in said plate members in opposed relationship with each other and with two of said notches in said first and second plate members, respectively, receiving and holding said bore spud therebetween.

9. Apparatus as in claim **8** wherein said second support includes a clamp member having a post element, said post element positioned and held between predetermined of said notches in said plate members when said plate members are connected together, said second means adjustably connected to said clamp member for adjustably supporting said collimator in said unlimited number of linear positions with respect to said clamp member and with respect to said bore spud.

10. Apparatus as in claim 9 wherein said first plate member surface defines a substantially centrally positioned gap therein and wherein said second plate member surface defines a substantially centrally positioned projecting portion in opposed relationship with respect to said gap when said first and second plate members are connected together by said connecting means with said plate member surfaces in said opposed relationship with each other, whereby said projecting portion can extend into said gap in interlaced relationship therewith when a diameter of said bore spud is smaller than a diameter of said post element.

11. Apparatus as in claim 10 wherein at least a first one of said notches in said first plate member is positioned in contiguous relationship with said gap and wherein at least a second one of said notches in said second plate member is positioned within said projecting portion, whereby said first and second notches are positioned for receiving and holding said bore spud therebetween when said first and second plate members are connected together in said opposed relationship.

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