ABSTRACT

Firearms with improved systems and methods of attaching the barrels that can provide for quicker and easier replacement of the barrel. In particular embodiments, the attachment mechanism includes a door that opens to release the barrel from the receiver. In certain embodiments, the door is located on the firearm below the barrel, a latch releasably holds the door closed, the door is pivotally attached to the receiver at a first end of the door, the latch is at a second end of the door, the door includes a barrel clamp that contacts a flange at a rearward end of the barrel to secure the barrel to the receiver, a rotating cam in the door secures the barrel to the receiver, the barrel attaches to the receiver without screwing the barrel into the receiver and without screwing an attachment component onto threads on the receiver, or a combination thereof.
QUICK-RELEASE BARREL FIREARM

RELATED PATENT APPLICATIONS

[0001] This patent application claims priority to Provisional Patent Application No. 61/920,008, filed on Dec. 23, 2013, titled QUICK-RELEASE BARREL FIREARM, which has at least one inventor in common with the current patent application and the same assignee. The contents of this priority provisional patent application is incorporated herein by reference.

FIELD OF THE INVENTION

[0002] Various embodiments of this invention relate to firearms having removable barrels and methods of attaching barrels to firearms.

BACKGROUND OF THE INVENTION

[0003] Firearms have been used for several centuries for various purposes including as weapons for warfare, law enforcement, self-defense, hunting, and target practice. Although many new weapons and weapon systems have been developed, firearms are still widely used and soldiers are trained in firearm use and carry firearms in essentially all armies throughout the world. Over time, firearms have been improved in many ways, but opportunities for improvement still exist in particular areas and for particular aspects of these devices.

[0004] Firearms have been used that have removable or interchangeable barrels and in certain situations, it is beneficial to be able to change a barrel quickly. For example, a soldier in a protracted firefight may have the barrel of his rifle overheat and it may be beneficial to be able to change the barrel to let the hot barrel cool down while continuing to use the firearm with an alternate barrel. In another example, a marksman may wish to change to a longer barrel to improve accuracy hitting a target that is far away, but may prefer a shorter, less cumbersome barrel, for targets that are significantly closer. In the past, barrels have screwed onto the rifle, or have been held in place with a threaded locking ring around the barrel. Although these attachment mechanisms held the barrels adequately, they made removal and replacement of the barrel somewhat time consuming, particularly in a battlefield situation. A need or potential for benefit or improvement exists for firearms in which the barrel can be changed more easily, more quickly, or both. Room for improvement exists over the prior art in these and other areas that may be apparent to a person of skill in the art having studied this document.

SUMMARY OF PARTICULAR EMBODIMENTS OF THE INVENTION

[0005] This invention provides, among other things, firearms with improved systems and methods of attaching the barrel that provide for quicker and easier replacement of the barrel. Various embodiments provide, for example, as an object or benefit, that they partially or fully address or satisfy one or more of the needs, potential areas for benefit, or opportunities for improvement described herein, or known in the art, as examples. A number of embodiments provide firearms that have removable or interchangeable barrels that provide the ability to change a barrel quickly. For example, a soldier may change an overhanded barrel in a protracted firefight or may change to a longer barrel to shoot at a target that is far away. In various embodiments, prior mechanisms are eliminated wherein barrels have screwed onto the receiver or have been held in place with a threaded locking ring that went around the barrel, which made removal and replacement of the barrel somewhat time consuming, particularly in a battlefield situation. Various embodiments provide firearms in which the barrel can be changed more easily, more quickly, or both.

[0006] In a number of embodiments, improvements to firearms herein provide for firearms that are more reliable, that last longer, that are more adaptable, that can be used in conditions that are more extreme, that handle abuse well, that work better, that are easier to use, that are easier to maintain, that are less expensive to manufacture, that have a lower lifecycle cost, or a combination thereof. In addition, various other embodiments of the invention are also described herein, and other benefits of certain embodiments may be apparent to a person of skill in this area of technology.

[0007] Specific embodiments include firearms that include a receiver, a barrel, and an attachment mechanism that attaches the barrel to the receiver. Further, in a number of embodiments, the attachment mechanism includes a door that opens to release the barrel from the receiver. Moreover, in various embodiments, the door is located on the firearm below the barrel, the firearm includes a latch that releasably holds the door closed to secure the barrel to the receiver, or both. In different embodiments, the firearm is, for example, configured to fire in a fully-automatic mode and in a semi-automatic mode.

[0008] Furthermore, in some embodiments, the latch that releasably holds the door closed to secure the barrel to the receiver requires two separate actions of an operator of the firearm to detach the barrel. In a number of embodiments, this is to avoid inadvertent detachment of the barrel of the firearm. In particular embodiments, for example, the latch that releasably holds the door closed to secure the barrel to the receiver includes a sliding safety catch, a first spring that biases the sliding safety catch, a pivoting latch lever that is secured by the sliding safety catch, a sliding door-engagement feature, and a second spring that biases the sliding door-engagement feature. Further, in some embodiments, the pivoting latch lever is pivotably attached to the sliding door-engagement feature. In certain embodiments, for example, an operator of the firearm detaches the barrel by sliding the sliding safety catch, which releases the pivoting latch lever, and then by sliding the sliding door-engagement feature by applying a force to the pivoting latch lever.

[0009] In various embodiments, the door has a first end and a second end opposite the first end, and in a number of embodiments, the door is pivotably attached to the receiver at the first end, the latch is located at the second end of the door, or both. Further, in a number of embodiments, the second end of the door is forward of the first end of the door. Still further, in various embodiments, the door includes a barrel release cover and a barrel clamp. Even further, in particular embodiments, the barrel clamp includes a clamping surface that contacts a flange at a rearward end of the barrel to secure the barrel to the receiver. Further still, some embodiments include an adjustment system, for example, that provides for adjustment of a location of the barrel clamp relative to the barrel release cover, for instance, to adjust a clamping force between the clamping surface and the flange at the rearward end of the barrel. Even further still, in certain embodiments, the adjustment system includes a clamp adjusting screw, for
example, that extends through a hole in the barrel release cover, for instance, into a cavity in the barrel clamp.

Moreover, in some embodiments, the adjustment system further includes an adjusting screw holder, for example, that holds the clamp adjusting screw. In a number of embodiments, this can prevent inadvertent rotation of the clamp adjusting screw. What’s more, in some embodiments, the adjustment system further includes a clamp adjusting nut, for instance, located within the cavity in the barrel clamp. In some embodiments, for example, the clamp adjusting screw threads into the clamp adjusting nut, and in particular embodiments, the clamp adjusting nut includes an inclined nut surface, for instance, that engages an inclined engagement surface, for example, within the cavity in the barrel clamp.

In certain embodiments, the door includes a rotating cam that secures the barrel to the receiver. Further, some embodiments include a spring that biases the cam against the barrel, and in particular embodiments, the cam engages a feature on the barrel. In some embodiments of firearms (e.g., that do not necessarily include the door, but that include a receiver, a barrel, and an attachment mechanism that attaches the barrel to the receiver), the attachment mechanism includes a rotating cam that secures the barrel to the receiver. Further still, other specific embodiments include other firearms that include a receiver, a barrel, and an attachment mechanism that attaches the barrel to the receiver. In various embodiments, for example, the barrel attaches to the receiver without screwing the barrel into the receiver and without screwing an attachment component onto threads on the receiver such that the attachment component contacts a flange at a rearward end of the barrel to secure the barrel to the receiver. In addition, various other embodiments of the invention are also described herein, and other benefits of certain embodiments may be apparent to a person of ordinary skill in the art.

BRIEF DESCRIPTION OF THE DRAWINGS

The drawings illustrate, among other things, examples of certain aspects of particular embodiments. Other embodiments may differ. Various embodiments may include aspects shown in the drawings, described in the specification (including the claims), known in the art, or a combination thereof, as examples. Other embodiments, however, may differ.

FIG. 1 is a right side view of an embodiment of a firearm that includes an attachment mechanism that attaches the barrel to the receiver, wherein the attachment mechanism includes a door that opens to release the barrel from the receiver;

FIG. 2 is a top view of the firearm of FIG. 1;

FIG. 3 is a bottom view of the firearm of FIGS. 1 and 2, and illustrates various components of the attachment mechanism;

FIG. 4 is a right side cross-sectional detail view of a portion of the firearm of FIGS. 1 to 3, taken along section A-A in FIG. 2, illustrating the attachment mechanism with the door in a closed position, the barrel secure, and the firearm ready to fire;

FIG. 5 is a right side view of the firearm of FIGS. 1 to 4 illustrating the attachment mechanism with the door in an open position with the barrel ready to be removed;

FIG. 6 is a bottom view of the firearm of FIGS. 1 to 5 with the door in the open position and the barrel ready to be removed;

FIG. 7 is a right side cross-sectional detail view of the portion of the firearm of FIG. 4 except illustrating the attachment mechanism with the door in the open position with the barrel ready to be removed;

FIG. 8 is a cross-sectional detail view of the door of the attachment mechanism of the firearm of FIGS. 1-7 taken along section C-C in FIG. 5;

FIG. 9 is a cross sectional right side view of another embodiment of a firearm that includes a different attachment mechanism that attaches the barrel to the receiver, also wherein the attachment mechanism includes a door that opens to release the barrel from the receiver, but this embodiment including a rotating cam that secures the barrel to the receiver, this view taken along a centerline of the barrel of the firearm and illustrating the attachment mechanism with the door in a closed position, the barrel secure, and the firearm ready to fire; and

FIG. 10 is a cross sectional right side view of the embodiment of a firearm of FIG. 9, also taken along the centerline of the barrel of the firearm, but illustrating the attachment mechanism with the door in an open position with the barrel ready to be removed.

DETAILED DESCRIPTION OF EXAMPLES OF EMBODIMENTS

This patent application describes, among other things, examples of certain embodiments, and certain aspects thereof. Other embodiments may differ from the particular examples described in detail herein. Many embodiments are, or concern, firearms having improvements over the prior art. In a number of embodiments, for example, a firearm (e.g., 11 and 91 shown in FIGS. 1-9) includes a receiver (e.g., 12, 92), a barrel (e.g., 13, 93), and an attachment mechanism (e.g., 14, 94) that attaches the barrel to the receiver (e.g., the upper receiver). In various embodiments, the barrel (e.g., 13, 93) attaches to the receiver (e.g., 12, 92) without screwing the barrel into the receiver, without screwing a lock ring onto the receiver (e.g., around the barrel), or both. Further, in a number of embodiments, the barrel attaches to the receiver without screwing the barrel into the receiver and without screwing an attachment component (e.g., a locking ring or one of one or more screws, for instance, 3, 4, 5, 6, or 8 screws) onto threads (e.g., internal threads for screws or external threads for a lock ring, as examples) on the receiver such that the attachment component contacts the flange (e.g., 43 shown in FIGS. 4 and 7) at the rearward end (e.g., 44) of the barrel to secure the barrel to the receiver. As used herein, a “rearward end” (e.g., 44) of a barrel, (e.g., 13) includes the rearward 25 percent of the length of the barrel. In FIGS. 1-7, 9, and 10, “forward” is to the left side of the view, and “front” is to the right side of the view.

As used herein, a “barrel” (e.g., 13, 93) is a gun barrel and is a straight cylindrical tube through which a controlled explosion or rapid expansion of gases takes place in order to propel a projectile or bullet out of the forward end of the firearm and out of the barrel at a high velocity. The barrel is capable of withstanding the pressure produced by the controlled explosion or rapid expansion of gases that propels the bullet. Most barrels are made of steel. Further, as used herein, the receiver (e.g., 12, 92) is the part of the firearm that houses the operating parts, which may include, in various embodi-
ments, a bolt carrier group, a trigger, and magazine port, among other things. In some embodiments, the receiver includes an upper receiver and a lower receiver, which may be attached to each other when the firearm is assembled.

[0025] In various embodiments, the attachment mechanism (e.g., 14, 94) includes a door (e.g., 15, 95) that opens to release the barrel (e.g., 13, 93) from the receiver (e.g., 12, 92). As used herein, a door is a cover to an opening (e.g., in the receiver) that is hinged at one side of the opening. Further, in some embodiments, the door (e.g., 15) includes a barrel release cover (e.g., 41 shown in FIGS. 4, 7, and 8) and a barrel clamp (e.g., 72). Even further, in particular embodiments, the barrel clamp (e.g., 72) includes a clamping surface (e.g., 73), for example, that contacts a flange (e.g., 43) at a rearward end (e.g., 44) of the barrel (e.g., 13) to secure the barrel to the receiver (e.g., 12). In the embodiment shown, barrel clamp 72 includes concave upper surface 74, as shown in FIG. 8, that fits part way around barrel 13. In different embodiments, concave upper surface 74 extends over an angle between 90 and 180 degrees, between 120 and 180 degrees, between 140 and 180 degrees, between 160 and 180 degrees, or between 170 and 180 degrees, as examples. In some embodiments, barrel clamp 72 extends upward to the centerline of barrel 13. In different embodiments, however, barrel clamp 72 extends upward past the centerline of barrel 13 or does not reach the centerline of barrel 13. In some embodiments, concave upper surface 74 contacts barrel 13 (e.g., to the right of flange 43 shown in FIGS. 4 and 7, or forward of the flange on the firearm), but in other embodiments, clearance exists between concave upper surface 74 and barrel 13, to the right of flange 43 shown in FIGS. 4 and 7 (forward of the flange on the firearm), even when door 15 is closed. In various embodiments, however, clamping surface 73 contacts flange 43 when door 15 is closed, securing barrel 13 within receiver 12.

[0026] Further still, in some embodiments, the barrel release cover (e.g., 41 shown in FIGS. 4, 7, and 8) and the barrel clamp (e.g., 72) are different regions of the same piece. In other embodiments, however, the barrel release cover (e.g., 41) and the barrel clamp (e.g., 72) are separate pieces, for instance, of the door (e.g., 15), for example, that are attached or connected to each other, for instance, in an adjustable manner. Still further, some embodiments include an adjustment system (e.g., 75 shown in FIGS. 4, 7, and 8), for example, that provides for adjustment of the location of the barrel clamp (e.g., 72) relative to the barrel release cover (e.g., 41), for instance, to adjust the clamping force between the clamping surface (e.g., 73) and the flange (e.g., 43) at the rearward end (e.g., 44) of the barrel (e.g., 13). In various embodiments, for example, the location of the barrel clamp is adjusted relative to the barrel release cover in a direction (when the door is closed) parallel to the axis of the barrel, perpendicular to the clamping surface (e.g., 73), or both. Even further still, in certain embodiments, the adjustment system (e.g., 75) includes a clamp adjusting screw (e.g., 76 shown in FIGS. 1 and 3-8, best shown in FIGS. 4 and 7), for example, that extends through a hole (e.g., 77) in the barrel release cover (e.g., 41), for instance, into a cavity (e.g., 78) in the barrel clamp (e.g., 72).

[0027] Moreover, in some embodiments, the adjustment system (e.g., 75) further includes an adjusting screw holder (e.g., 49 shown in FIGS. 4 and 7), for example, that holds the clamp adjusting screw (e.g., 76). In a number of embodiments, the adjusting screw holder (e.g., 49) prevents inadvertent rotation or adjustment of the clamp adjusting screw (e.g., 76). Further, in the embodiment illustrated, adjusting screw holder 49 is a detent that includes a detent ball and a detent spring (e.g., a helical spring loaded in compression). In a number of embodiments, the detent spring pushes the detent ball into an indentation or shallow hole in the underside of the head of the clamp adjusting screw (e.g., 76) to hold and prevent the clamp adjusting screw from inadvertently rotating. A clamp adjusting screw (e.g., 76) may have multiple (e.g., 2, 3, 4, 5, 6, 7, 8, 10, or 12) such indentations or shallow holes, for example.

[0028] In various embodiments, the adjustment system (e.g., 75) further includes a clamp adjusting nut (e.g., 79 shown in FIGS. 4 and 7), for instance, located within the cavity (e.g., 49) in the barrel clamp (e.g., 72). In some embodiments, for example, the clamp adjusting screw (e.g., 76) threads into the clamp adjusting nut (e.g., 79). Further, in particular embodiments, the adjustment system (e.g., 75) or the clamp adjusting nut (e.g., 79) includes an inclined nut surface (e.g., 71), for instance, that engages an inclined engagement surface (e.g., 42), for example, within the cavity (e.g., 78) in the barrel clamp (e.g., 72). In a number of embodiments, including the embodiment shown, the inclined engagement surface (e.g., 42) is on the barrel clamp (e.g., 72). Other embodiments may have the inclined engagement surface on another component of the adjustment system. Further, as used herein, in this context “inclined” means more than 10 degrees and less than 80 degrees, for example, from a centerline of the threaded portion of the clamp adjusting screw (e.g., 76) or the threads of the clamp adjusting nut (e.g., 79). In a number of embodiments, these inclined surfaces are, for example, more than 20 degrees and less than 70 degrees, more than 30 degrees and less than 60 degrees, or more than 40 degrees and less than 50 degrees, as examples, from a centerline of the threaded portion of the clamp adjusting screw (e.g., 76) or of the clamp adjusting nut (e.g., 79). An example is illustrated in FIGS. 4 and 7, for instance. Further still, in a number of embodiments, a barrel clamp return spring (e.g., 725), biases the barrel clamp (e.g., 72) or the inclined engagement surface (e.g., 42) against the clamp adjusting nut (e.g., 79) or the inclined nut surface (e.g., 71), or a combination thereof, for example, relative to the barrel release cover (e.g., 41).

[0029] In some embodiments, the adjustment system (e.g., 75) is adjusted by loosening the clamp adjusting nut (e.g., 79) when the door (e.g., 15) is opened, then closing the door, and then tightening (e.g., hand tightening) the clamp adjusting nut (e.g., 79) when the door (e.g., 15) is installed or (e.g., 15) is closed. In certain embodiments, the clamping force between the clamping surface (e.g., 73) and the flange (e.g., 43) is further adjusted by opening the door and then tightening the clamp adjusting nut (e.g., 79) a certain number of additional turns or clicks of the adjusting screw holder (e.g., 49), for instance, of the dent or dent ball in the indentations or shallow holes in the underside of the head of the clamp adjusting screw (e.g., 76) that hold and prevent the clamp adjusting screw from inadvertently rotating. The number of additional clicks of the clamp adjusting screw (e.g., 76) may be, for example, 1, 2, 3, 4, 5, 6, 7, 8, 10, or 12 clicks of the dent in the indentations or shallow holes, for example, in different embodiments. In particular embodiments, for example, the number of additional clicks of the clamp adjusting screw (e.g., 76) is two 2 clicks of the adjusting screw holder (e.g., 49).
Further still, in some embodiments, the attachment mechanism includes a rotating cam that secures the barrel to the receiver. FIGS. 9 and 10 illustrate an example of such an embodiment, firearm 91, wherein attachment mechanism 94 includes rotating cam 105 that secures barrel 93 to receiver 92. Certain embodiments, including firearm 91 shown, include both a rotating cam (e.g., 105) and a door (e.g., 95) that opens to release the barrel (e.g., 93) from the receiver (e.g., 92). Other embodiments, however, may differ. Even further, in some embodiments, firearm 91, a rotating cam (e.g., 105) may be used instead of a barrel clamp (e.g., 72), and in other embodiments (e.g., firearm 11), a barrel clamp (e.g., 72) may be used instead of a rotating cam (e.g., 105). Still other embodiments can include a rotating cam and a barrel clamp.

In a number of embodiments (e.g., firearm 91) having a door and a cam, the cam (e.g., 105) is pivotally mounted on the door (e.g., 95), for example, as shown in FIGS. 9 and 10. Moreover, in various embodiments, including the embodiment shown, the door (e.g., 95) includes the rotating cam (e.g., 105) that secures the barrel (e.g., 93) to the receiver (e.g., 92). In a number of such embodiments, when the door (e.g., 95) is opened, the cam (e.g., 105) is pulled away from the barrel (e.g., 93), releasing the barrel for removal. In other embodiments, however, the attachment mechanism (e.g., 14 shown in FIGS. 1-8) includes a door (e.g., 15) but not a cam (e.g., 105 shown in FIGS. 9 and 10) that rotates with respect to the door. Further, other embodiments include a cam but not necessarily a door. In some embodiments, for example, a firearm includes a receiver, a barrel, and an attachment mechanism that attaches the barrel to the receiver, and the attachment mechanism includes a rotating cam that secures the barrel to the receiver. Some embodiments, for example, that include a cam but that do not include a door, may have a cam retraction mechanism to retract the cam in order to remove the barrel. Even further, various embodiments include more than one cam, for example, 2, 3, or 4 cams.

In a number of embodiments that include a door, the door (e.g., 15, 95) has a first end (e.g., 31, 101) and a second end (e.g., 32, 102) opposite the first end. Further, in various embodiments, the door (e.g., 15, 95) is located on the firearm (e.g., 11, 91) below the barrel (e.g., 13, 93), for example, on the receiver (e.g., 12, 92). This is the case in all of the embodiments illustrated in FIGS. 1-9. As used herein, “below”, and any other indicators of direction herein, apply to the normal orientation of the firearm when the barrel is horizontal and the trigger is below the centerline through the barrel that is parallel to the direction of travel of a bullet in the barrel when the firearm is fired. In FIGS. 1, 4, 5, 7, 9, and 10, down is toward the bottom of the view. Further still, as used herein, a door being located below a barrel means that at least some part of the door is any distance directly below at least some part of the barrel.

In a number of embodiments, the firearm (e.g., 11, 91) includes a latch (e.g., 33, 103) that releasably holds the door (e.g., 15, 95) closed (e.g., as shown in FIGS. 1, 3, 4, and 9), for example, to secure the barrel (e.g., 13, 93) to the receiver (e.g., 12, 92). Furthermore, in some embodiments, the latch (e.g., 33) requires two separate actions of an operator of the firearm (e.g., 11) to detach the barrel (e.g., 13). In a number of embodiments, this is to avoid inadvertent detachment of the barrel of the firearm. More broadly speaking, in various embodiments having a cam, a door, or both, two separate actions of an operator of the firearm are required to detach the barrel. Further, as used herein, pulling the barrel out of the receiver is not included as one of these two separate actions. In particular embodiments, for example, the latch includes a sliding safety catch (e.g., 45 shown in FIGS. 3, 4, and 7), a first spring or a sliding safety catch spring (e.g., 451 shown in FIGS. 4 and 7) that biases (e.g., pushes) the sliding safety catch (e.g., 45), and a pivoting latch lever (e.g., 46 shown in FIGS. 4 and 7) that is secured by the sliding safety catch (e.g., 45). In a number of embodiments, the first spring (e.g., 451) biases the sliding safety catch (e.g., 45), against the pivoting latch lever (e.g., 46) to secure the pivoting latch lever, for example, by inserting a projection into an indentation, for instance, perpendicular the direction of motion (i.e., downward in the embodiment shown) of the pivoting latch lever.

In the embodiment illustrated in FIGS. 1-8, latch 33 further includes sliding door-engagement feature 47 (shown in FIGS. 4, 5, and 7), and second spring or sliding door-engagement feature spring 472 (shown in FIGS. 4 and 7) that biases sliding door-engagement feature 47, in this embodiment, by pushing sliding door-engagement feature 47 to the left (i.e., left in these views, rearward on the firearm). In this embodiment, first spring 451 and second spring 472, as well as barrel clamp return spring 725, are helical springs loaded in compression. Other embodiments may use different types of springs. Further, some embodiments, including the embodiment illustrated, include all of these components of latch 33, whereas other embodiments include some of these components but not others. Other embodiments may differ.

Moreover, in the embodiment illustrated, pivoting latch lever 46 of latch 33 is pivotably attached at pivot point 465 to sliding door-engagement feature 47, for example, with a pin or a screw. In certain embodiments, an operator of the firearm (e.g., 11) detaches the barrel (e.g., 13) by sliding the sliding safety catch (e.g., 45) rearward, which releases the pivoting latch lever (e.g., 46) to rotate downward about pivot point 465. The operator then slides the sliding door-engagement feature (e.g., 47) by applying a force to the pivoting latch lever (e.g., 46), which allows the door (e.g., 15) to open. In the embodiment depicted, pivoting latch lever 46 rotates about pivot point 465 about 90 degrees. In different embodiments, the pivoting latch lever rotates about the pivot point between 70 and 110 degrees, between 75 and 105 degrees, between 80 and 100 degrees, or between 85 and 95 degrees, as examples. In this example, the two separate actions are sliding the sliding safety catch (e.g., 45), and sliding the sliding door-engagement feature (e.g., 47) by applying a forward force to the pivoting latch lever (e.g., 46). Other embodiments may use other actions, may have different components of the latch, or both.

Additionally, in various embodiments, the door (e.g., 15, 95) is pivotably attached to the receiver (e.g., 12, 92), for example, at the first end (e.g., 31, 101). In the embodiments illustrated, for example, door 15 is pivotably attached to receiver 12 at first end 31 at pivot point 145 shown in FIGS. 1 and 3-7, and door 95 is pivotably attached to receiver 92 at first end 101 at pivot point 945 shown in FIGS. 9 and 10. In different embodiments, pivot points 145 and 945 may include a screw, a bolt, or a pin, as examples, for instance, a roll pin.

Further, in particular embodiments, the latch (e.g., 33, 103) that releasably holds the door (e.g., 15, 95) closed is located, for example, in the receiver (e.g., in the upper receiver, for example, 12, 92), for instance, at the second end (e.g., 32, 102) of the door. In various embodiments, the door
(e.g., 15, 95) is pivotably attached to the receiver (e.g., 12, 92) at the first end (e.g., 31, 101), for instance, at a pivot point (e.g., 145, 945) and the latch (e.g., 33, 103) that releasably holds the door closed (e.g., 33, 103) is located at the second end (e.g., 32, 102) or opposite end of the door. Further still, in a number of embodiments, including the embodiments illustrated, the second end (e.g., 32, 102) of the door (e.g., 15, 95) is forward of the first end (e.g., 31, 101) of the door. As used herein, “forward” means the direction that the bullet travels in the barrel (e.g., 13, 93). In various embodiments, rotation of the door (e.g., 15) about the pivot point (e.g., 145), when the door is closed, brings the clamping surface (e.g., 73), into contact with the flange (e.g., 43) to secure the barrel (e.g., 13) to the receiver (e.g., 12).

[0038] Even further, in particular embodiments that include a cam (e.g., firearm 91 shown in FIGS. 9 and 10 that includes cam 105), the (e.g., rotating) cam is located at the second end (e.g., 102) of the door (e.g., 95), for instance, pivotally attached to the door. In addition, a number of embodiments include a cam spring (e.g., 106) that biases (e.g., rotates) the cam (e.g., 105) against the barrel (e.g., 93). In the embodiment shown, for example, cam spring 106 is a helical spring loaded in compression. Other embodiments, however, may differ.

[0039] In various embodiments, the cam engages a feature on the barrel. In certain embodiments, such a feature can be a change (e.g., an increase) in outside dimension (e.g., diameter) of the barrel, for example. In the embodiment illustrated, for example, cam 105 engages feature 107 on barrel 93, and feature 107 is an increase in outside diameter of barrel 93, as shown. In other embodiments, the feature can be an indentation in the barrel, as another example, such as a hole that does not extend through to the interior of the barrel. Other features, such as one or more projections, can be used in other embodiments. Still other embodiments include a cam that engages an outside surface of the barrel that does not include a feature where the cam engages the barrel. Such a cam can have a curved (e.g., spiral) surface, for example, that contacts the outside surface of the barrel.

[0040] In a number of embodiments, including the embodiment illustrated, the firearm is a rifle. In particular embodiments, for example, the firearm is an assault rifle, such as an AR-15 or an M-16. In different embodiments, the firearm can be a semi-automatic firearm or a fully automatic firearm, as examples. In certain embodiments, for example, the firearm is a rifle configured to fire in a fully-automatic mode, in a semi-automatic mode, or both, for example, selectable with a switch on the firearm. Other embodiments, however, may differ. For instance, in particular embodiments the firearm can be a pistol. The embodiment shown in FIGS. 1-7, firearm 11, also includes hand guard 16 forward of receiver 12. Other embodiments, however, may not include a hand guard.

[0041] Further, certain embodiments include combinations of features described herein and in one or more of different patent applications that are incorporated herein by reference. All conceivable combinations of such features are contemplated herein including all conceivable combinations of the subject matter described herein and described in these different patent applications. For example, other embodiments contemplated include each of the embodiments described herein further including one or more of the embodiments claimed or described in each of these different patent applications.

[0042] Examples of methods include various methods of attaching a barrel (e.g., 13, 93) of a firearm (e.g., 11, 91) to a receiver (e.g., 12, 92) of the firearm, for instance. In a number of embodiments such methods can include an act of obtaining or providing an attachment mechanism (e.g., 14, 94) that attaches the barrel to the receiver. In particular embodiments, for example, the attachment mechanism includes a rotating cam (e.g., 105 shown in FIGS. 9 and 10) that secures the barrel to the receiver. Moreover, in certain embodiments, the attachment mechanism includes a door (e.g., 15, 95) that opens to release the barrel from the receiver. In various embodiments, particular methods can include acts of obtaining or providing, as examples, other features, components, or aspects described herein. All possible combinations are contemplated. Further, methods described herein contain various acts. The order in which these acts are described is an example of the order in which these acts can be performed, but in other embodiments, unless stated otherwise herein, the acts may be performed in a different order. In some embodiments, acts may overlap or be performed at the same time, as another example.

[0043] Still further, various embodiments of the subject matter described herein include various combinations of the acts, structure, components, and features described herein, shown in the drawings, described in documents that are incorporated by reference herein, or that are known in the art. Moreover, certain procedures can include acts such as manufacturing, obtaining, or providing components that perform functions described herein or in the documents that are incorporated by reference. The subject matter described herein also includes various means for accomplishing the various functions or acts described herein, in the documents that are incorporated by reference, or that are apparent from the structure and acts described.

[0044] Further, as used herein, the word “or”, except where indicated otherwise, does not imply that the alternatives listed are mutually exclusive. Even further, where alternatives are listed herein, it should be understood that in some embodiments, fewer alternatives may be available, or in particular embodiments, just one alternative may be available, as examples.

What is claimed is:
1. A firearm comprising a receiver, a barrel, and an attachment mechanism that attaches the barrel to the receiver, wherein the attachment mechanism comprises a door that opens to release the barrel from the receiver.
2. The firearm of claim 1 wherein the door is located on the firearm below the barrel.
3. The firearm of claim 1 further comprising a latch that releasably holds the door closed to secure the barrel to the receiver.
4. The firearm of claim 3 wherein the latch that releasably holds the door closed to secure the barrel to the receiver requires two separate actions of an operator of the firearm to detach the barrel to avoid inadvertent detachment of the barrel of the firearm.
5. The firearm of claim 3 wherein the latch that releasably holds the door closed to secure the barrel to the receiver comprises a sliding safety catch, a first spring that biases the sliding safety catch, a pivoting latch lever that is secured by the sliding safety catch, a sliding door-engagement feature, and a second spring that biases the sliding door-engagement feature, wherein the pivoting latch lever is pivotally attached to the sliding door-engagement feature, and wherein an
operator of the firearm detaches the barrel by sliding the sliding safety catch, which releases the pivoting latch lever, and then by sliding the sliding door-engagement feature by applying a force to the pivoting latch lever.

6. The firearm of claim 3 wherein: the door has a first end and a second end opposite the first end; the door is pivotably attached to the receiver at the first end; and the latch is located at the second end of the door.

7. The firearm of claim 6 wherein the second end of the door is forward of the first end of the door.

8. The firearm of claim 1 wherein: the door comprises a barrel release cover and a barrel clamp and wherein the barrel clamp comprises a clamping surface that contacts a flange at a rearward end of the barrel to secure the barrel to the receiver.

9. The firearm of claim 8 further comprising an adjustment system that provides for adjustment of a location of the barrel clamp relative to the barrel release cover to adjust a clamping force between the clamping surface and the flange at the rearward end of the barrel.

10. The firearm of claim 9 wherein: the door has a first end and a second end opposite the first end; the door is pivotably attached to the receiver at the first end; the door is located on the firearm below the barrel; the firearm comprises a latch that releasably holds the door closed to secure the barrel to the receiver; the latch is located at the second end of the door; and the second end of the door is forward of the first end of the door.

11. The firearm of claim 9 wherein: the adjustment system comprises a clamp adjusting screw that extends through a hole in the barrel release cover into a cavity in the barrel clamp.

12. The firearm of claim 11 wherein the adjustment system further comprises adjusting a screw holder that holds the clamp adjusting screw to prevent inadvertent rotation of the clamp adjusting screw.

13. The firearm of claim 11 wherein: the adjustment system further comprises a clamp adjusting nut located within the cavity in the barrel clamp, wherein the clamp adjusting screw threads into the clamp adjusting nut, and wherein the clamp adjusting nut comprises an inclined nut surface that engages an inclined engagement surface within the cavity in the barrel clamp.

14. The firearm of any of claim 1 wherein: the barrel attaches to the receiver without screwing the barrel into the receiver and without screwing a lock ring onto the receiver around the barrel.

15. The firearm of claim 1 wherein the door comprises a rotating cam that secures the barrel to the receiver.

16. The firearm of claim 15 further comprising a spring that biases the cam against the barrel.

17. The firearm of claim 16 wherein: the cam engages a feature on the barrel.

18. The firearm of any of claim 1 wherein the firearm is a rifle configured to fire in a fully-automatic mode and in a semi-automatic mode.

19. A firearm comprising a receiver, a barrel, and an attachment mechanism that attaches the barrel to the receiver, wherein the attachment mechanism comprises a rotating cam that secures the barrel to the receiver.

20. A firearm comprising a receiver, a barrel, and an attachment mechanism that attaches the barrel to the receiver, wherein the barrel attaches to the receiver without screwing the barrel into the receiver and without screwing an attachment component onto threads on the receiver such that the attachment component contacts a flange at a rearward end of the barrel to secure the barrel to the receiver.