position with a cartridge chambered in the hot barrel. A fully automatic firearm resting in closed bolt position may be hazardous as cook off may occur.

The possibility of a cartridge firing due to cook off may have disastrous consequences in battlefield and police situations. The involuntary detonation of ammunition has resulted in injury or loss of life in such instances. Therefore, it would be desirable to provide systems and methods for facilitating improved firearm function.

## BRIEF SUMMARY

According to a first aspect of the present invention, there is provided a firearm, including: a bolt carrier; a trigger group including: a trigger having a trigger sear, wherein the trigger has a forward position for a fully automatic open bolt mode of operation that is different from a forward position for a semi-automatic closed bolt mode of operation; a hammer having a notch configured to be engaged by the trigger when the trigger is released in the semi-automatic closed bolt mode of operation for the firearm, and a trigger prop configured to contact the trigger to prevent engagement of the notch by the trigger sear in the fully automatic open bolt mode of operation; and an open bolt sear configured to block motion of the bolt carrier to prevent firing when the trigger is released in the fully automatic open bolt mode of operation for the firearm.

According to a second aspect of the present invention, there is provided a method of making the above firearm, the method including: assembling the trigger group; and inserting the trigger group into a lower receiver of the firearm.

According to a third aspect of the present invention, there is provided a method of operating the above firearm, the method including, when in the semi-automatic closed bolt mode of operation and a selector is moved from semi-auto to full auto: firing a first fully automatic burst from a closed bolt configuration; stopping the first fully automatic burst in an open bolt configuration; and firing a subsequent fully automatic burst from the open bolt configuration.

According to a fourth aspect of the present invention, there is provided a method of making the above firearm, the firearm further including: an open bolt sear assembly including: a sear arm with a first pivot point; and an open bolt sear comprising a substantially Y-shaped frame comprising a main body and two legs extending therefrom, each of the legs comprising an engagement surface such that the engagement surfaces abut opposing interior

surfaces of the firearm to provide a second pivot point; wherein the sear arm is configured to be engaged by the trigger of the firearm and is coupled to the open bolt sear; wherein the open bolt sear is configured to pivot toward the bolt carrier and block motion of the bolt carrier to prevent firing when the trigger of the firearm is released in the fully automatic open bolt mode of operation for the firearm; and wherein the open bolt sear is configured to pivot away from the bolt carrier and allow motion of the bolt carrier when the trigger is pulled in the fully automatic open bolt mode of operation, the method including: assembling the open bolt sear assembly; and inserting the open bolt sear assembly into a lower receiver of the firearm.

According to a fifth aspect of the present invention, there is provided a method of operating the open bolt sear assembly of the above firearm, the method including: engaging a first end of the sear arm with a rear portion of the trigger when the trigger of the firearm is pulled; pivoting the sear arm about the first pivot point; moving the main body of the open bolt sear away from the bolt carrier by a second end of the sear arm such that the sear arm pivots the open bolt sear about the second pivot point and moves the main body of the open bolt sear away from the bolt carrier, wherein the moving of the main body releases the bolt carrier and allows motion of the bolt carrier; and allowing the sear arm to oppositely pivot about the first pivot point such that the open bolt sear oppositely pivots about the second pivot point when the trigger is released, wherein the main body of the open bolt sear moves toward the bolt carrier and blocks the motion of the bolt carrier.

According to a sixth aspect of the present invention, there is provided a firearm including: a bolt carrier; a trigger group including: a trigger having a trigger sear, a hammer having a notch configured to be engaged directly by the trigger when the trigger is released in a semi-automatic closed bolt mode of operation for the firearm, and a selector; and an activator configured to cooperate with the selector such that the activator is configured to prevent a movement of the selector from a first position through a second position to a third position unless the activator is activated; and an open bolt sear configured to block motion of the bolt carrier to prevent firing when the trigger is released in a fully automatic open bolt mode of operation for the firearm, wherein the trigger has a forward position for the fully automatic open bolt mode of operation that is different from a forward position for the semi-automatic closed bolt mode of operation.

In accordance with embodiments further described herein, features are provided that may be advantageously used in one or more firearm designs. More specifically, in accordance

with an embodiment, a firearm is provided that fires fully automatic from the open bolt position to prevent cook off and have greater controllability, and fires semi-auto from a closed bolt position for accuracy. Furthermore, in accordance with an embodiment, a simple and reliable selector mechanism is provided for selection of mode of operation (e.g., semi-auto closed bolt or fully automatic open bolt) of the firearm. According to an embodiment, a selective fire firearm having a fully automatic mode and a semi-automatic mode may be provided with a trigger group having a trigger prop that, in the automatic mode, functions to ensure that, when the trigger is released following fully automatic fire, the firearm will cease fire in an open bolt position. In this way, the risk of cook off due to a cartridge chambered in a hot barrel after fully automatic fire may be reduced or eliminated.

For controllable full auto we use a variation of the Davis Recoilless Gun Principal that shot a bullet out the front and a sandbag out the rear so all the recoil was in the weight of the sandbag, none in the gun, no matter what the gun weighed. Instead of the sandbag we use the weight of the bolt carrier group and buffer and instead of throwing them out the back, we gave them enough room and spring force to gradually stop them before they hit a rear wall. Our gun is therefore not recoilless, but it delivers the lowest possible recoil force stretched out over the longest possible time (the time between one shot and the next) and it doesn't matter what the gun weighs. It does however require that each cycle be the same and should deliver half the recoil impulse while the cycling weight is decelerating rearward and half as the spring is accelerating the weight forward. If the second half of the first cycle is omitted from first shot of a full auto burst (as do most Assault Rifles), the first shot of the burst has up to twice the recoil impulse of subsequent shots which reduces full auto controllability of that burst.

CLAIMS:

1. A firearm, comprising:

a bolt carrier;

a trigger group comprising:

a trigger having a trigger sear, wherein the trigger has a forward position for a fully automatic open bolt mode of operation that is different from a forward position for a semi-automatic closed bolt mode of operation;

a hammer having a notch configured to be engaged by the trigger when the trigger is released in the semi-automatic closed bolt mode of operation for the firearm, and

a trigger prop configured to contact the trigger to prevent engagement of the notch by the trigger sear in the fully automatic open bolt mode of operation; and

an open bolt sear configured to block motion of the bolt carrier to prevent firing when the trigger is released in the fully automatic open bolt mode of operation for the firearm.

2. The firearm of claim 1, wherein:

the trigger has a rear portion;

the trigger prop has a foot; and

the foot is configured to prop the rear portion of the trigger to prevent engagement of the notch by the trigger sear in the fully automatic open bolt mode of operation.

3. The firearm of claim 2, further comprising a trigger prop spring configured to cause the trigger prop foot to swing under the rear portion of the trigger on a first trigger pull in the fully automatic open bolt mode of operation.

4. The firearm of claim 3, further comprising:

an auto sear;

an auto sear spring; and

an axle that extends through the auto sear, the auto sear spring, the trigger prop, and the trigger prop spring.

5. The firearm of claim 4, further comprising a selector operable to select the fully automatic open bolt mode of operation, the semi-automatic closed bolt mode of operation, or a safe mode for the firearm.

6. The firearm of claim 5, wherein a selection of the selector from a first position associated with the fully automatic open bolt mode of operation to a second position associated with the safe mode causes the selector to:

move the foot rearward from under the rear portion of the trigger so that the trigger sear engages the notch; and

retract the auto sear so that the hammer rests on the trigger sear.

7. The firearm of claim 6, wherein a subsequent selection of the selector from the second position to a third position associated with the semi-automatic closed bolt mode of operation causes the selector to release the open bolt sear so that the bolt carrier moves forward into a closed bolt position.

8. The firearm of claim 7, further comprising an activator disposed on the selector, wherein the activator is configured to prevent a selection of the selector from the first position through the second position to the third position unless the activator is activated.

9. The firearm of claim 8, wherein the activator is configured to allow a selection of the selector from the third position through the second position to the first position without activation of the activator.

10. The firearm of claim 9, wherein the activator is a button comprising:

a limited motion disk having a limited rotation track and a limited rotation block;

a plunger having tabs each with a ramp and a block; and

a receiver boss having at least one lobe, wherein the limited rotation track, the limited rotation block, the ramps, the blocks, and the at least one lobe are configured to cooperate to prevent a turn of the selector from the first position through the second position to the third position unless the button is compressed and to allow the turn of the selector from the third position through the second position to the first position without compression of the button.

11. The firearm of claim 1, further comprising:

a forward assist button; and

a snap-on cover releasably attached to the forward assist button and configured to prevent operation of the forward assist button.

12. A method of making the firearm of claim 1, the method comprising:

assembling the trigger group; and

inserting the trigger group into a lower receiver of the firearm.

13. A method of operating the firearm of claim 1, the method comprising, when in the semi-automatic closed bolt mode of operation and a selector is moved from semi-auto to full auto:

firing a first fully automatic burst from a closed bolt configuration;

stopping the first fully automatic burst in an open bolt configuration; and

firing a subsequent fully automatic burst from the open bolt configuration.

14. The firearm of claim 1, further comprising:

a charging handle; and

a lever arm, wherein, based on a position of the charging handle and a mode of operation of the firearm, the lever arm is configured to selectively block or allow a pull of the trigger.

15. The firearm of claim 14, wherein:

the charging handle has a forward position and a rearward position;

the lever arm is configured to block the pull of the trigger in the fully automatic open bolt mode of operation when the charging handle is in the rearward position; and

the lever arm is configured to allow the pull of the trigger in the semi-automatic closed bolt mode of operation when the charging handle is in the rearward position.

16. The firearm of claim 15, wherein the lever arm comprises a first end portion and an opposing second end portion and wherein the second end portion is configured to block the pull of the trigger in the fully automatic open bolt mode of operation responsive to a movement of the first end portion by the charging handle.

17. The firearm of claim 16, wherein the charging handle comprises a cam surface that moves the first end portion of the lever arm when the charging handle is moved toward the

rearward position, and wherein motion of the first end portion in a first direction by the cam surface of the charging handle moves the second end portion in a second direction opposite to the first direction from a first position to a second position, and wherein, in the second position, the second end portion is positioned to block the pull of the trigger in the fully automatic open bolt mode of operation and to allow the pull of the trigger in the semi-automatic closed bolt mode of operation.

18. The firearm of claim 1, further comprising:

an open bolt sear assembly comprising:

a sear arm with a first pivot point; and

an open bolt sear comprising a substantially Y-shaped frame comprising a main body and two legs extending therefrom, each of the legs comprising an engagement surface such that the engagement surfaces abut opposing interior surfaces of the firearm to provide a second pivot point;

wherein the sear arm is configured to be engaged by the trigger of the firearm and is coupled to the open bolt sear;

wherein the open bolt sear is configured to pivot toward the bolt carrier and block motion of the bolt carrier to prevent firing when the trigger of the firearm is released in the fully automatic open bolt mode of operation for the firearm; and

wherein the open bolt sear is configured to pivot away from the bolt carrier and allow motion of the bolt carrier when the trigger is pulled in the fully automatic open bolt mode of operation.

19. The firearm of claim 18, wherein the open bolt sear comprises a mating face configured to engage the bolt carrier when the trigger is released.

20. The firearm of claim 19, wherein the open bolt sear is configured to be elastic and disperse a force, from the bolt carrier impacting the mating face, into the opposing interior surfaces.

21. A method of making the firearm of claim 18, the method comprising:

assembling the open bolt sear assembly; and

inserting the open bolt sear assembly into a lower receiver of the firearm.

22. A method of operating the open bolt sear assembly of the firearm of claim 23, the method comprising:

engaging a first end of the sear arm with a rear portion of the trigger when the trigger of the firearm is pulled;

pivoting the sear arm about the first pivot point;

moving the main body of the open bolt sear away from the bolt carrier by a second end of the sear arm such that the sear arm pivots the open bolt sear about the second pivot point and moves the main body of the open bolt sear away from the bolt carrier, wherein the moving of the main body releases the bolt carrier and allows motion of the bolt carrier; and

allowing the sear arm to oppositely pivot about the first pivot point such that the open bolt sear oppositely pivots about the second pivot point when the trigger is released, wherein the main body of the open bolt sear moves toward the bolt carrier and blocks the motion of the bolt carrier.

23. The method of claim 22, further comprising a mating face of the open bolt sear engaging the bolt carrier when the trigger is released.

24. A firearm, comprising:

a bolt carrier;

a trigger group comprising:

a trigger having a trigger sear,

a hammer having a notch configured to be engaged directly by the trigger when the trigger is released in a semi-automatic closed bolt mode of operation for the firearm, and

a selector; and

an activator configured to cooperate with the selector such that the activator is configured to prevent a movement of the selector from a first position through a second position to a third position unless the activator is activated; and

an open bolt sear configured to block motion of the bolt carrier to prevent firing when the trigger is released in a fully automatic open bolt mode of operation for the firearm,

wherein the trigger has a forward position for the fully automatic open bolt mode of operation that is different from a forward position for the semi-automatic closed bolt mode of operation.

25. The firearm of claim 24, wherein an activation of the activator comprises a switching, sliding, rotating, and/or pushing of the activator.

26. The firearm of claim 24, wherein:
the first position is associated with the fully automatic open bolt mode of operation;
the second position is associated with a safe mode; and
the third position is associated with the semi-automatic closed bolt mode of operation.

27. The firearm of claim 1, wherein the trigger has a pulled position for the fully automatic open bolt mode of operation that is different from a pulled position for the semi-automatic closed bolt mode of operation.

28. The firearm of claim 24, wherein the activator is configured to cooperate with the selector such that the activator is further configured to allow a movement of the selector between the first position and the second position without activation of the activator.

29. The firearm of claim 24, wherein the activator configured to cooperate with the selector such that the activator is further configured to allow a movement of the selector between the second position and the third position without activation of the activator.

30. The firearm of claim 24, wherein the trigger has a pulled position for the fully automatic open bolt mode of operation that is different from a pulled position for the semi-automatic closed bolt mode of operation.