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## BOLT ACTION SAFETY SYSTEM ANALYSIS

This report is a summary of the information accumulated in a design analysis of the popular current bolt action safety systems. The systems are listed as to how they function, with a description of the design advantages and disadvantages.

Blocked Trigger Safety

This safety works on the principle of employing a mechanical means to block the rotation of the trigger. The trigger is the only element in the triggering mechanism which is blocked. This type of safety has been utilized extensively in hunting type rifles and shotguns. The M/1100, M/870 and M/742 utilize this type of safety.

The blocked trigger safety has the following advantages:

1. It is easy to determine how the mechanism operates even by a novice shooter.
2. The safety operation is not dependent on the position of the striker or some other integral part. The safety can be operated with the bolt open, bolt closed, or striker cocked or fired. The blocked sear safety can normally not be moved to the "On Safe" position when the striker has fallen. The blocked striker type safety cannot be actuated unless the rifle is cocked and the bolt locked closed.
3. The blocked trigger safety locks the trigger in position, if the shooter fidgets with the rifle while he is waiting for a big trophy deer the trigger will remain locked unless the safety is repositioned. With

a safety system where the trigger is free to move if the hunter fidgets with the rifle and pulls the trigger with the safety in the "On Safe" position, the trigger could possibly bind on the trigger guard, stock, or trigger housing. If this happened the rifle would fire off safe.

4. The designer has much greater freedom on where the physical position of the safety can be located with this type of safety. With the blocked striker or blocked trigger safety, the physical position of the safety mechanism is determined by where the force has to be applied to cam the striker or sear.

The blocked trigger safety has the following disadvantages:

1. In firearms where the trigger directly supports the sear (trigger surface engages sear surface to inhibit rotation) the tolerances and clearances in the trigger block (safety) allow movement when the trigger is pulled with the firearm in the "On Safe" position, decreasing the amount of sear trigger engagement.
  - A. In the common fire control as used on the M/1100 and M/870, and M/742, there is a connecting link between the trigger and sear. The design calls for a clearance between the link and sear engagement surface, which when the trigger is pulled with the firearm in the "On Safe" position allows the trigger to move slightly, taking up the tolerances and clearances in the safety block without moving the sear.

2. The blocked trigger design does not lend itself to target triggers as a target trigger demands a minimum preplay or initial clearance and a minimum engagement. If the trigger has a connecting link the trigger would normally have preplay. If the trigger connects directly to the sear the engagement cannot be decreased to target specifications as the safety tolerances and clearances are such as not to insure an adequate engagement if the trigger were pulled with the firearm in the "On Safe" position.

#### Blocked Sear Safety

This type of safety functions by having a mechanical means block the sear or cam the sear clear of the trigger. In this type of mechanism where the sear is disconnected from the trigger a mechanical cam is actuated against the sear, lifting the sear away from the trigger by actuation of the safety lever. The M/700 rifle uses a safety mechanism of this design. In the M/700 system when the sear is cammed free of the trigger the sear cams the striker assembly, retracting the firing pin slightly.

The blocked sear safety has the following advantages:

1. The system can be used successfully with either a hunting rifle or a target rifle. Because the system lifts the sear clear of the trigger, the system is not as sensitive to the amount of sear engagement as the blocked trigger safety.
2. The system blocks the striker, camming it rearward slightly.
3. The safety can be operated with the bolt in the open position or in the closed and cocked position.

4. The safety lever can be positioned in a convenient location.
5. The system is positive -- mechanical actuating means physically disconnecting sear from trigger. The trigger can be pulled with high force levels not affecting the safety operation.
6. The striker is blocked by the sear and will take a large amount of abuse without firing.
7. The sear, trigger and safety cam all are attached to the same housing making the system less tolerance sensitive.
8. Can be designed either as a two position or three position safety.  
The blocked sear safety has the following disadvantages:
  1. If the customer fidgets with the trigger when the gun is in the "On Safe" position and the trigger fails to return to position, the safety mechanism (can) will be holding the striker and when it is switched to the fire position the striker will fall. The trigger could be bound by the stock, trigger housing, trigger guard, or insufficient clearance between trigger and sear.
  2. The rifle cannot be put in the "On Safe" position when the striker is forward.

Blocked Striker System

The system is actuated by camming the striker rearward with a mechanism located on the bolt plug. The M/70 Winchester utilizes this type of system.

Advantages of blocked striker system:

1. Can be designed as a two or three position safety system.
2. This type of safety holds or retains the last link in the firing mechanism. This could possibly be an advantage under drop test circumstances and for advertising or sales appeal.

Disadvantages of the blocked striker system:

1. Located in a position which interferes with scope mounted rifles.
2. The system is very tolerance sensitive as the mechanism parameters are determined by the sear position located in the receiver assembly and the camming mechanism located in the bolt assembly.
3. The mechanism can only be actuated when the bolt is closed and cocked. To load the rifle with the safe in the "On Safe" position requires closing the rifle, putting the safe in the "On Safe" position, opening the bolt and loading the rifle. If one shot is fired and the following shot fed from the magazine, the bolt must be locked in the fire position before the safety can be actuated.
4. If the hunter fidgets with his rifle, squeezing the trigger while the rifle is in the "On Safe" condition, the trigger could possibly lock back from binding on the trigger housing, stock, trigger guard, or excessive dry lubrication and cause the rifle to fire when the safe is moved to the "On Safe" position.

SAFETY LEVER LOCATION

The safeties located on the bolt plug normally are difficult to actuate with scoped rifles.

The safety buttons located on the top center of the tang are very difficult to operate when the bolt is in the rear open position. If the hunter carries his rifle with his hand around the grip he could inadvertently reposition the safety without realizing it, with the safety positioned on the top tang.

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2. It holds the last link in the firing cycle mechanism.

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OBSERVATIONS OF SAFETY LEVER LOCATION

The safeties located on the bolt plug normally are difficult to actuate with scoped rifles.

The safety buttons located on the top center of the tang are very difficult to operate when the bolt is in the open position (bolt action rifles).

The safety buttons located on the trigger bow are easy to actuate but tend to be confusing as to which is the safe position.

The safeties located along the side of the receiver are easy to actuate, do not interfere with the gun operation, but normally work in the same direction as the trigger. This could cause a problem if the customer previously operated a Winchester M/94 lever action where to put the gun on half cock he has to pull the trigger while retarding the fall of the hammer with his thumb. If the customer pulls the trigger while releasing the safety with a blocked sear safety the rifle will naturally fire.

#### Safety Design

The safety should have two clearly defined positive positions; "ON SAFE" and "OFF SAFE". The safety should require 3 to 10 pounds to move to the "Off Safe" position. The safety mechanism should not be overly sensitive to lubrication; that is, the actuation forces should not vary dramatically due to lubrication.

The safety mechanism should have an endurance life such that it will not wear to create a dangerous condition. The safety clearances and checks performed at the plant should allow for wear.

The operation of the safety mechanism should be easily understood by the customer without consulting the owner's manual.

The safety lever or button should not protrude in such a manner where it can be easily knocked out of position. The safety should not be positioned such that operation of the bolt or some other member is in line with the safety such that it could be repositioned by said mechanism operation. An example would be having the safety lever project up on the right rear tang such that operating the bolt handle back and forth by the customer could reposition the safety.

The safety operation should not be noisy such that its operation will scare off game animals.

If a clearance or interference is required in the mechanism it should be in a place where it can be readily inspected and understood by the people servicing the firearm.

With the safety in the "On Safe" position the rifle should tolerate a 30 pound pull on the trigger without firing.

The safety mechanism should be able to withstand a drop test without repositioning itself in all six planes.

The safety should allow the rifle to be loaded and unloaded with the safety in the "On Safe" position.

Three position safeties can be confusing to a new shooter. What does the center or middle position mean? 1/2 safe. The motion required on a three position safety to go from the fire to the middle position is the same as the total motion in a two position safety to obtain an equivalent mechanical advantage. The motion required on the three position safety from the second to third position must be substantial to allow for a positive central detent position. It is easier to develop and manufacture a two position detent system which goes from stop to stop than it is to develop a three position system where the mechanism is supposed to stop in an intermediate position.

People who own three position safeties leave them in the intermediate position so they can operate them quicker.



Bolt Locks

A bolt lock is important to insure proper function of a bolt action rifle. The bolt lock holds the bolt in the ready position to insure that the protruding bolt doesnot catch on some object and partially unlock the action. If the action becomes partially unlocked the rifle will not fire when the trigger is pulled as the firing pin head will bottom on the cam surface on the bolt before the tip can impinge on the shell primer. To insure the rifle is ready to fire, particularly when hunting dangerous game, it is important to incorporate a bolt lock into a bolt action rifle. If the bolt catches on an obstacle it can unlock the rifle, unloading the action.