REMINGTON ARMS COMPANY, INC.

INTER-DEPARTMENTAL CORRESPONDENCE

Remington DUPONT   PETERS DUPONT

"CONFINE YOUR LETTER TO ONE SUBJECT ONLY"

Ilion, New York
April 6, 1983

TO: C.E. RITCHIE

FROM: E.W. YETTER/S.R. FRANZ

Purpose:

The purpose of this study is to determine the effect on jar-off of the trigger clearance cut on the Model Seven trigger (see attached drawing). This study has two parts: Part One is an experimental comparison of moments of inertia of a standard trigger and one with the clearance cut. Part Two is a theoretical study of drop testing the Model Seven and the effect of changing the geometry of the trigger on drop test results.

Procedure and Results:

Part I

Theory:

The moment of inertia, I, of a body of mass M can be computed by treating the body as a simple pendulum with a pivot point a distance X_o from the body's center of gravity. The time, T, of one complete swing of the body is measured and the following formula applied:

$$I = \frac{MX_o gT^2}{4\pi^2}$$

BARBER - PRESALE R 0113559

To: C.E. Ritchie

Since the trigger is a complex shape, there is no way to determine its center of gravity so X_O is assumed to remain constant between the two triggers. This, in fact, is not the case; since material is being removed from the trigger, the center of gravity will change. For the purpose of this calculation, however, this effect is neglected. The constant quantities are canceled from the equation since a percentage change in I is the quantity of interest so the number calculated and compared is MT^2.

<u>Results</u>:

Two triggers of each type were weighed and the time of their swing measured.

Standard Trigger:

Weight = .48670Z
T = .4610 sec.
MT^2 = 2.009×10^{-4}

Modified Trigger:

Weight = .47730Z
T = .4883 sec.
MT^2 = 2.211×10^{-4}
Percentage Change = 10.1%

This means the moment of inertia for the new style trigger is 10% greater than the old style trigger.

To: C.E. Ritchie

Procedure and Results:

Part II

The Model Seven trigger with the clearance cuts was analyzed for jar-off characteristics in four loading directions. These four directions correspond to drop test directions where shock loads are applied by impact to the top, bottom, muzzle, and butt ends of the gun. A load in any one of these four directions that causes a net positive (counter-clockwise) moment of the trigger around the pivot point could result in a jar-off. (See Fig. A in appendix)

The clearance cuts change the center of gravity of the trigger and therefore change its moment of inertia about the pivot point. This change in the moment of inertia can decrease the possibility of jar-off when loaded from one direction and increase the probability when loaded from another. The four cases are analyzed below:

Case 1: Muzzle Drop

A shock load in this direction can cause a jar-off if the following condition exists:

$$\bar{Y}1W1 > \bar{Y}2W2$$ (Fig. 1)(neglects spring force on trigger)

where $\bar{Y}1$ and $\bar{Y}2$ is the distance from the pivot point to the c.g. and W1 and W2 are the weights of the top and bottom portions of the trigger respectively. The clearance cut decreased the weight of the bottom part of the trigger but also increases $\bar{Y}2$, the distance from the pivot point to the bottom c.g. However, the weight of the bottom part of the trigger is still greater than the top part.

Since the c.g.'s of the top and bottom portions of the trigger are not known we cannot say for sure which is larger, $W1\bar{Y}$ or $W2\bar{Y}$. If we assume that $\bar{Y}2W2$ is greater than $\bar{Y}1W1$ after the clearance cut, then inertia would tend to rotate the trigger clockwise and the gun shouldn't jar-off.

To: C.E. Ritchie

Procedure and Results:

Case 2: Butt Drop

Whichever way the trigger would tend to rotate from inertia during a muzzle drop, it would tend to rotate the opposite way during a butt drop. Therefore, if $\bar{Y}2W2$ is greater as assumed above, then the trigger would tend to rotate the trigger counter-clockwise and the gun could jar-off.

Case 3 and 4: Top and Bottom Drop

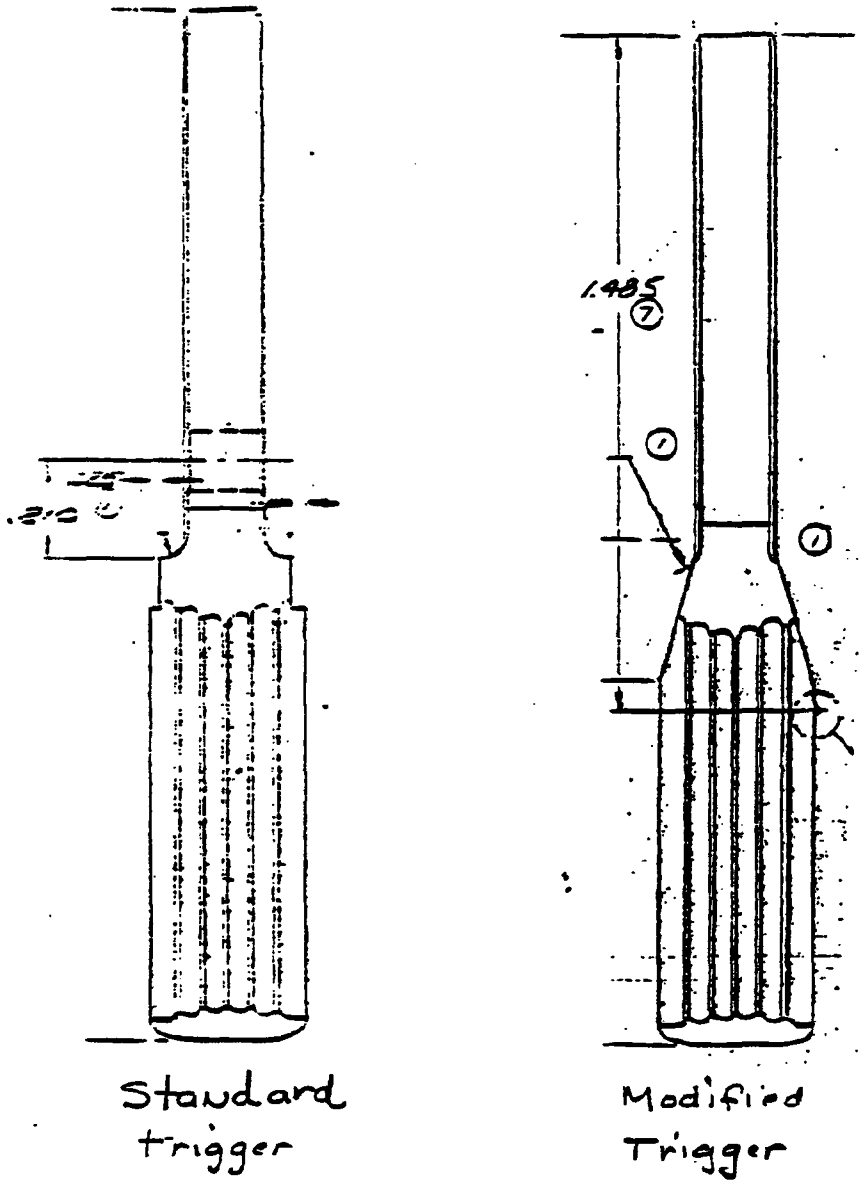
Using the same reasoning as above, whatever direction the trigger is forced to rotate when hit from the top is opposite to the direction of rotation from a bottom hit.

Conclusion:

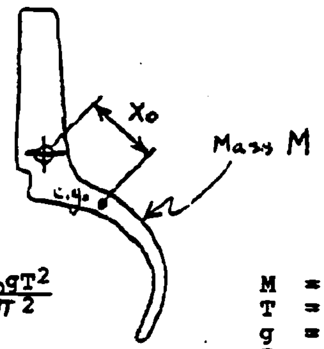
Although no definite conclusions could be drawn from this analysis, any dynamic unbalance caused by the clearance cut will decrease the possibility of a jar-off in certain loading directions and increase the possibility when loaded in the opposite directions, neglecting all other possible forces. Possible forces neglected here include trigger spring forces and forces due to impacting parts.

EWY/SRF:js
Ilion Research Division

APPENDIX



APPENDIX PART I



$$I = \frac{M X_o g T^2}{4\pi^2}$$

M = Mass of Trigger
T = Time for one swing
g = Acceleration of gravity
I = Moment of Inertia

Assume Xo = Constant

<u>Standard Trigger</u>

M = .486702/16 $\frac{oz}{lb}$ / 32.174 ft/sec^2
 = 9.454×10^{-4} $\frac{16\ sec^2}{ft}$ (slug)
T = .4610 sec.
$MT^2 = 2.009 \times 10^{-4}$

<u>Modified Trigger</u>

M = .477302/16 oz/lb/32.174 ft. sec.^{2}
 = 9.272×10^{-4} slugs
T = .4883 sec.
$MT^2 = 2.211 \times 10^{-4}$

% Change = $\frac{MT^2\ ST - MT^2\ Mod}{MT^2\ ST}$ x 100 = 10.1%

APPENDIX PART II

DIRECTION LOADING

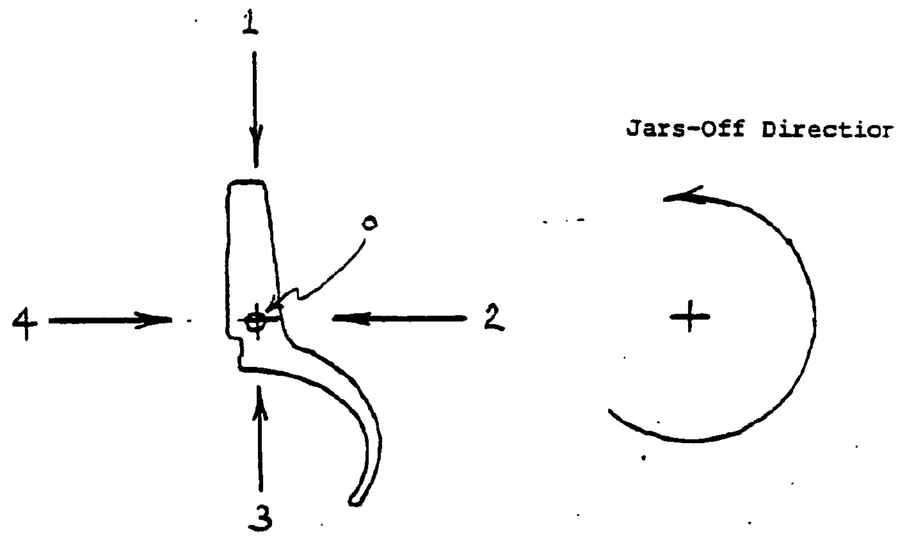


FIGURE A

Clearance cut changes the moment of Inertia and c.g. about Pt.0
Horizontal Shock loads - Directions 2 and 4
Break trigger up into two sections - above and below
Horizontal line:

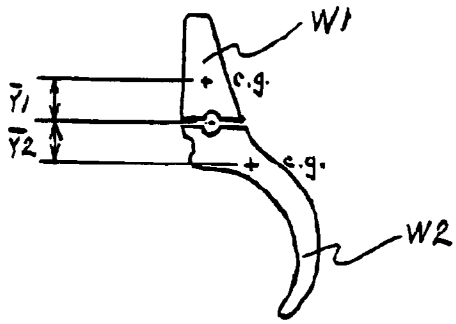


FIGURE 1

- 1 :

APPENDIX PART II - Contd.

Vertical Shock loads - Directions 1 and 3
Break trigger up into two sections - left and right of Vertical line:

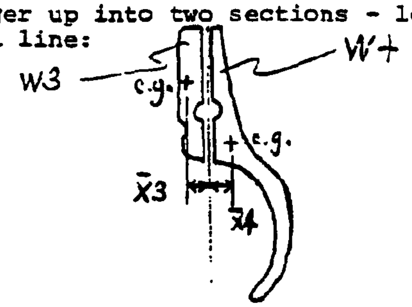


FIGURE 2

Trigger Weights

Standard Trigger	Mod. Trigger
1. .4908 oz.	.4748 oz.
2. .4827 oz.	.4797 oz.
Avg. .4867 oz.	.4773 oz.

$$\left(\frac{.4773}{.4867}\right) \times 100 = 98.12\%$$

Balance Experiment:

Proved that W2 > W1 and W4 > W3 on Std. and Mod. Trigger

Case 1: Shock Load in Direction 4 (Muzzle Impact)

Trigger must not rotate counter-clockwise + (Fig. A)
Want
W1Y1 < W1Y2

APPENDIX PART II - Contd.

Balance Experiment: - Contd.

Case 2: Shock Load in Direction 2 (butt impact)
Want
W2Y2 < W1Y1

Case 3: Shock Load in Direction 1 (Top Impact)
Want
W4X4 < W3X3

Case 4: Shock Load in Direction 3 (Bottom Impact)
Want
W3X3 <L W4X4

EWYetter/SRFranz:js
Ilion Research Division