

INTERIM REPORT

9/15/48

SUBJECT: FUNCTIONAL AND ENDURANCE TEST OF STANDARD FIRE CONTROL
AND ALTERNATE SAFETY TYPE #1 FIRE CONTROL FOR M/721-722 RIFLES

INTRODUCTION

Firing of M/721 rifles when the Safety is moved to the "off" position is the complaint received from three customers, which resulted in an investigation of the present fire control. As a result of this investigation an alternate design incorporating a ball bearing between the Trigger and Connector and an extension on the Sear was constructed and submitted for test.

OBJECTIVE

The objective of this test was to determine if the gun will fire when the Bolt is cocked and the Safety is moved to the "off" position by submitting the standard fire control and the alternate Safety Type I Fire Control to a functional and endurance test.

CONCLUSIONS

1. Both fire controls will not fire when the Bolt is cocked and the Safety is moved to the "off" position after 20,300 dry cycles of cocking and firing, and 10,000 dry cycles of functioning of the Safety.
2. That the Trigger Stop Screw in both Fire Controls needed adjusting and cementing during the test.

COMMENTS

Correct adjustment of the M/721 Fire Control is essential in providing a clean, crisp trigger and one with enough Sear engagement to prevent accidental discharge caused by a "jar off" condition. The adjustment in the present fire control is variable and is determined by the assembler, whereas the adjustment in the alternate Safety Type I Fire Control is determined largely by dimensions of the various parts and a control of the adjustment by the limiting dimensions of a ball bearing.

PLAINTIFF'S
EXHIBIT

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AL 0031905

1 of 12

RECOMMENDATIONS

It is recommended:

1. That use of the present M/721 Fire Control be continued as results fail to indicate any need for a change.
2. That the Type I Safety (ball bearing between the Trigger and Connector) be considered in any future design change of the M/721 Fire Control as its adjustment characteristics are superior to the Fire Control now used.
3. That the present practice of cementing the Trigger Screws be supplemented with a positive locking mechanism and that this locking mechanism be sealed with a sealing compound before shipment of the gun to the customer.

TESTING DETAILS

1. One of each of the subject fire controls was tested functionally by three individuals of the Test Group. These tests were as follows:
 - a. Drop Test - The gun was dropped and allowed to fall freely for a distance of 10". Repeat 10 times.
 - b. Cock the gun, position the Safety to the "on" position, pull the Trigger, release the pressure exerted by the finger on the Trigger, and position the Safety to the "off" position. Repeat 25 times.
 - c. Cock the Bolt and slam the Bolt forward. Repeat 25 times.
2. Both fire controls were then subjected to 10,000 functions in the dry cycle machine which cocks the Bolt and fires the Trigger. The Safety was then functioned 10,000 dry cycles. Repeat a, b, and c of Test I.
3. Both fire controls were subjected to a standard dust test after which an additional 10,000 dry cycles of Bolt, Trigger and Safety functioning were performed. Repeat a, b, and c of Test I.

RESULTS OF TEST

1. It was not possible in this test to fire either of the fire controls by moving the Safety to the "off" position when the fire controls are in adjustment.
2. Both Fire Controls would not stay in adjustment until after a second application of adjustments made during the first 10,000 dry cycle period.

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A G E N D A

DESIGN MEETING - ELION

September 16, 1948

I - NEW IDEAS FOR RESEARCH & DEVELOPMENT

- (a) C. S. Collier Report
- (b) Accuracy Device - Progress Report
- (c) Mercast Process - Precision Castings
(Orders placed for experimental Tooling)
- (d) Pattern Control Device
(In Model Shop)

II - CENTER FIRE RIFLES

- (a) M/721-722 - Safety
- (b) M/742-762 - Progress Report

III - SLIDE ACTION SHOTGUN

M/870 - Review model and economics

IV - MODEL 521-T

V - MODEL 11-48 & SPORTSMAN 140

VI - BARREL BEDDING DEVICE

(Reports of D. S. Foote & J. H. Lewis)

AL 0031907

Elion, New York
August 25, 1943

PROGRESS REPORT

MODEL 721-722 FIRE CONTROL AND SAFETY

INTRODUCTION

Three field complaints have been received which reported the M/721 Rifle firing when the Safety is moved to the "off" position. Two guns representing two of the complaints were tested at Elion without it being possible to reproduce the defect.

It is, however, theoretically possible under very remote conditions to reproduce this problem and the Elion Design Meeting of July 14, 1943, recommended that an immediate investigation be made to develop an alternate design which would eliminate the hazard.

OBJECTIVE

It has been the objective of this study to prepare alternate designs for the Model 721-722 fire control and safety to eliminate any "hazardous" possibility of the gun firing when the safety is moved to the "off" position and to maintain as far as practical the present desirable features of the trigger.

The only apparent method of assuring a "fool-proof" design, as shown in Patent No. 2,191,521 assigned to the Western Cartridge Company, has been the consideration of safeties which positively block the trigger.

SUMMARY AND CONCLUSIONS:

Three alternate designs have been derived from this study as follows:

Type I is an entirely new type of safety with, we believe, patentable novel features. It operates by blocking the trigger connector with a ball bearing between the trigger connector and an extension on the sear. Easy safety operation is obtained. In the currently manufactured trigger assembly, the present feature of blocking the trigger pin is eliminated and accounts for easy safe operation. A model of this design is available for examination.

Type II maintains the current trigger assembly design and adds the feature of blocking the trigger prior to the operation of blocking the trigger. A model of this design is available for examination.

AL 0031908

Type III eliminates the current trigger feature of blocking the firing pin and eliminates a block on the rear of the trigger. This design is a simplification of the Type II proposal and has the advantage similar to Type I of eliminating hard safety operation.

The economics of each trigger type are as follows:

	<u>Present Design</u>	<u>Proposed Type I</u>	<u>Proposed Type II</u>	<u>Proposed Type III</u>
Expenditures to Date	----	(\$3,000 on all Proposed Design)		
Expenditures to Complete	----	\$21,380.	\$ 7,800.	\$12,900
Standard Material	\$50.588/100	\$34.105/100	\$34.038/100	\$29.358/100
Standard Labor	\$25.268/100	\$27.262/100	\$29.238/100	\$25.565/100

RECOMMENDATIONS

In view of the lack of additional complaints covering the question of the Model 721 firing when moving the safe to the "off" position and the inability to duplicate the complaints received from the field, we recommend that action be considered as follows:

1. Consideration be given to maintaining the current M/721 trigger "as is".
2. If a change is to be made to eliminate any remote theoretical possibility of the gun firing when moving the safe to the "off" position, we consider type I which in our opinion is the best design. Its disadvantages lay in the high expenditure required to make the conversion.
3. Consideration of the Type III design for the lowest product cost with adequate safety.
4. Last, the consideration of the Type II design. A "hard safety" would always be prevalent in this version as well as high product cost. This design is presented primarily to give Sales an opportunity to maintain their advertising feature of the safety blocking the firing pin.

D. S. Froese
D. S. Froese
Design Unit
Arms Technical Division

DSF:EL
8/16/48

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MODEL 721-722 ALTERNATE SAFETY DESIGNS
Expenditures Required

	Type #1	Type #2	Type #3
Processing	\$ 750	\$ 375	\$ 500
Design - Fixtures)			
Tools	3,200	950	1,880
Gages			
General Engineering & Adminis- tration (1/3 of Design & Process Cost)	250	125	165
Build - Fixtures)			
Tools	11,100	3,320	6,100
Gages			
Tool Design Revisions (approx 20% Design)	640	190	375
Tool Revisions (Tool Design Revisions x 3.50)	2,240	665	1,300
Trial Run			
Machine Operations)			
Machine Setters	2,200	1,175	1,600
Machine Operator)			
Design Cost to Complete	<u>1,000</u>	<u>1,000</u>	<u>1,000</u>
	\$ 21,380	\$ 7,800	\$ 12,920

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AL 0031910

6 of 12

MODEL 721 MODIFICATION OF SAFETY DESIGN
Material & Labor Cost per 100

Part Name	Present Design		Type #1 Proposed Design		Type #2 Proposed Design		Type #3 One Piece Sear	
	Material	Labor	Material	Labor	Material	Labor	Material	Labor
Trigger Connector	4.200	.016	6.000	.016	4.200	.016	4.200	.016
Trigger Spring	.335	-----	.335	-----	.335	-----	.335	-----
Trigger Adj. Screw	.580	.011	1.500	.020	.580	.011	.580	.011
Trigger Stop Screw	.325	.009	.500	.015	.325	.009	.325	.009
Safety Adj. Scr. Lock Nut	-----	-----	-----	-----	1.500	.010	1.500	.010
Safety Pivot Pin	.588	.006	1.000	.006	.588	.006	.588	.006
Sear Spring	.360	-----	3.000	-----	.360	-----	.360	-----
Sear	3.200	1.329	.900	5.101	3.200	1.329	.900	2.601
Fire Control Housing	2.200	5.308	2.200	5.750	2.200	5.308	2.200	5.308
Safety	2.000	3.559	2.500	3.559	2.500	4.059	2.500	4.059
Trigger	11.300	.015	11.300	.765	12.000	1.765	12.000	1.765
Safety Cam	2.380	2.590	-----	-----	2.380	2.590	-----	-----
Sear Assembly	-----	1.105	-----	-----	-----	1.105	-----	-----
Trigger Adj. Screw Lock Nut	-----	-----	1.500	.010	-----	-----	-----	-----
Safety Ball	-----	-----	.250	-----	-----	-----	-----	-----
Safety Adj. Screw	-----	-----	-----	-----	.75	.010	.750	.010
Trigger Guide Plate	3.120	.020	3.120	.020	3.120	.020	3.120	.020
Trigger Housing Assembly	-----	11.300	-----	12.000	-----	13.000	-----	11.750
	30.588	25.268	34.105	27.262	34.038	29.238	29.358	25.565

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3/25/48

TYPE I - CONNECTOR BLOCKING SAFETY

Parts Change Summary

Following is a list of new parts required for the proposed Blocked Connector Safety and the parts obsoleted by their use:

<u>Proposed Parts</u>	<u>Current Parts</u>
A-18498-X Trigger Connector	A-17050 Trigger Connector
A-18499-X Trigger Spring	A-17978 Trigger Spring
A-18500-X Trigger Spring Screw	A-17049 Trigger Adjusting Screw
A-18501-X Trigger Stop Screw	A-17053 Trigger Stop Screw
A-18502-X Safety Pivot Pin	A-17043 Safety Pivot Pin
A-18503-X Sear Spring	A-17047 Sear Spring
B-18504-X Sear	2B-17946 Sear
C-18505-X Fire Control Housing	C-17039 Fire Control Housing
C-18506-X Safety	C-17040 Safety
C-18507-X Trigger	C-18442 Trigger
A-18508-X Safety Ball	

New or revised tooling is indicated on all of these parts, the approximate extent of change being as follows:

Trigger Connector - A-18498-X:

A swaged projection has been added to the lower end of the part, a ground surface provided at 5° to the front face and the location of the hole changed.

Trigger Spring - A-18499-X:

One half turn removed to shorten spring.

Trigger Spring Screw - A-18500-X:

An internal-external threaded bushing replaces one of the current trigger adjusting screws.

Trigger Stop Screw - A-18501-X:

Revision in dimensions of current part.

Safety Pivot Pin - A-18502-X:

Addition of annular groove to current part.

Sear Spring - A-18503-X:

Torsion spring replaces present compression spring.

Bear - B-18504-X:

Contour of lower surfaces modified to provide a downwardly projecting lug at front, a spring support at rear, and suitable ground surfaces to cooperate with connector and ball.

Fire Control Housing - C-18505-X:

Remove tabs that retain current trigger stop screw; provide a single tab at lower position and provide slot in right hand side of housing.

Safety - C-18506-X:

Remove cam on inside leg and provide intumed slotted lug at front.

Trigger - C-18507-X:

Grind revised contour on front and top of present trigger as blank.

Safety Ball - A-18508-X:

Additional.

Trigger Stop Screw Jam Nut - A-18511-X:

Additional.

TYPE II - TRIGGER BLOCKING SAFETY

Parts Change Summary

Following is a list of new parts required for the proposed Trigger Blocking Safety. This design is presented primarily with the idea of maintaining the present sales promotion feature of blocking the firing pin as well as the trigger.

<u>Proposed Parts</u>	<u>Current Parts</u>
Safety	C-17040 Safety
Safety Adjusting Screw	
Safety Adjusting Screw Lock Nut	
Trigger	C-18442 Trigger
Trigger Guide Plate	B-17055 Trigger Guide Plate

New or revised tooling is indicated on all of these parts, the approximate extent of change being as follows:

Safety - C-17040:

A projection is added with an acting surface which alters the safety contour.

Safety Adjusting Screw:

Additional.

Safety Adjusting Screw Lock Nut:

Additional.

Trigger - C-18442:

A projection is added on the rear of the trigger and a drilled and tapped hole provided in the projection.

Trigger Guide Plate - B-17055:

The trigger slot in the guide plate is lengthened.

TYPE III - SIMPLIFICATION OF TYPE II

Parts Change Summary

Following is a list of new parts required for this proposed design of a Trigger Blocking Safety. The design eliminates the sear and safety cam combination and no longer blocks the firing pin as does the Type II Trigger. The safety operation blocks the trigger only.

<u>Proposed Parts</u>	<u>Current Parts</u>
Safety	C-17040 Safety
Safety Adjusting Screw	B-17945 Safety Cam
Safety Adjusting Screw Nut	B-17946 Sear
Sear	C-18442 Trigger
Trigger	B-17055 Trigger Guide Plate
Trigger Guide Plate	

New or revised tooling is indicated on all of these parts, the approximate extent of change being as follows:

Safety - C-17040:

A projection is added with an acting surface which alters the safety contour.

Safety Adjusting Screw:

Additional.

Safety Adjusting Screw Lock Nut:

Additional.

Trigger - C-18442:

A projection is added on the rear of the trigger and a drilled and tapped hole provided in the projection.

Trigger Guide Plate - B-17055:

The trigger slot in the guide plate is lengthened.

Sear - B-17946:)

Safety Cam - B-17945:)

These two stamped pieces are combined as one machined piece whose outside contour duplicates the present sear.

DSF:NL
8/25/48

AL 0031915

R. M. T. Smith

December 3, 1946

TO: P. B. Rutherford

FROM: M. H. Walker

SUBJECT: THEORETICAL UNSAFE CONDITION OF M/721 SAFETY

Straight calculation of the amount the Safety lifts the Sear off the Trigger gives a max. lift of .0147" and a min. lift of min. .0024". However, fourteen (14) different dimensions are used in the calculation. The actual amount of lift by statistical analysis would be a max. of .009" and a min. of .0032".

Objections have been raised to the above theoretical unsafe condition. According to L. T. Murphy, the necessary dimension changes on the Sear to eliminate this condition can be made without changes to tooling or gaging. With a minimum lap of .026" between Sear and Firing Pin head the change can be made by changing the depth of grind on the Sear notch.

This change will be incorporated in the drawing as soon as tool procurement is completed.

MHW
M. H. Walker,
Design Section,
Arms Technical Division

MHW:LJ

AL 0031916

12 of 12