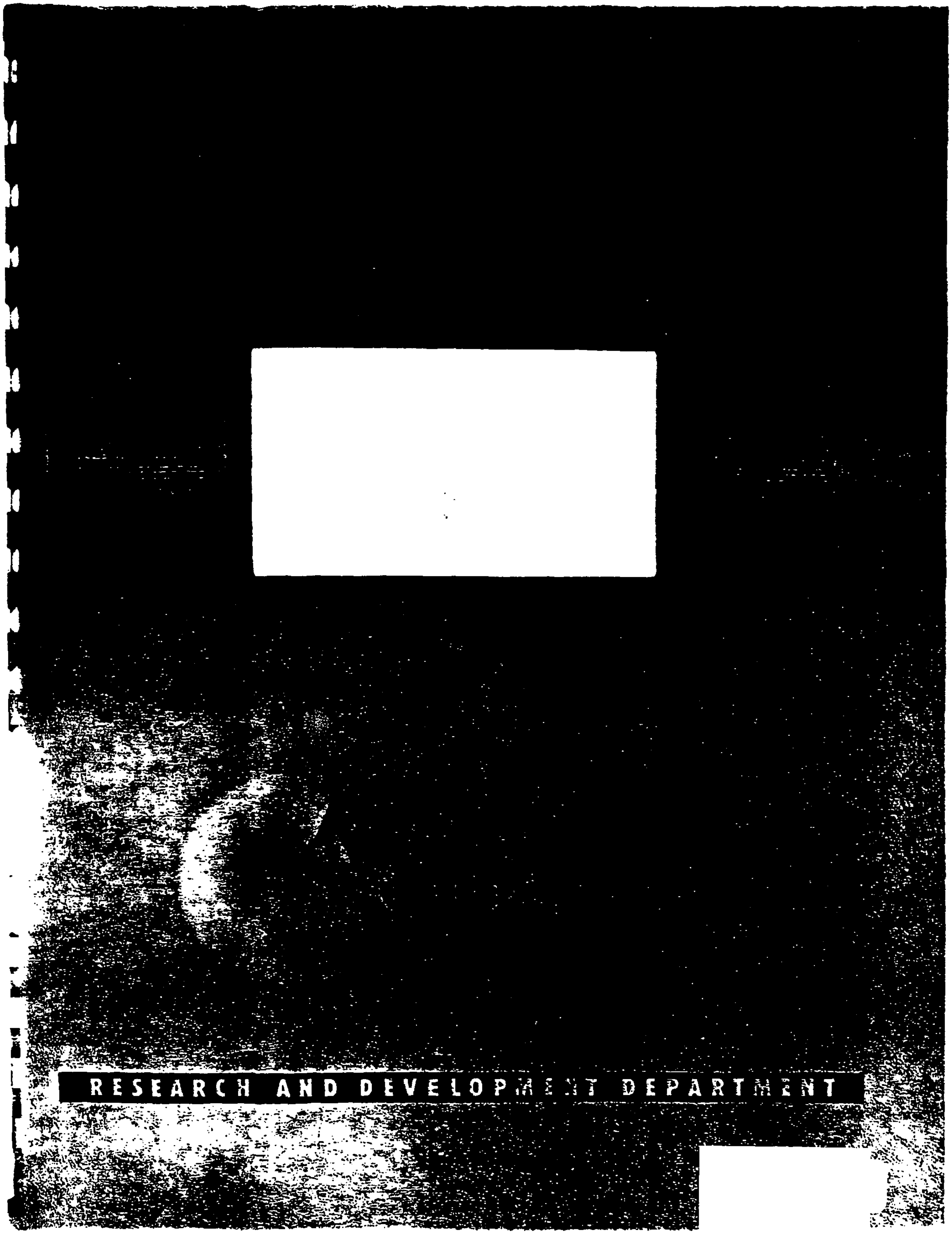

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PROGRESS REPORT
AI-56-12

MODEL 40X FIRE CONTROL INVESTIGATION

By

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MODEL 40X FIRE CONTROL INVESTIGATION

Period: June 1, 1956 to November 15, 1956
Project: TD-56628
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INTRODUCTION

Consistent reports and occasional customer complaints from the field, all voicing trouble with the performance of the Model 40X Fire Control prompted this investigation. These complaints have been varied in nature, from changes in trigger pull weight to complete failure in firing. Since design testing had revealed no justification of these complaints, there has been considerable doubt as to their validity, and if so, what could be done about it. Also, the question as to the M/721-722 which is of the same basic design.

OBJECTIVE

1. Does the fire control, if properly made, fail at any time?
2. Does the pull weight vary with extended cycling and how much?
3. Determination of causes, if any, which bring about the above.
4. Propose methods of eliminating these problems.
5. Take a general look at all the factors relating to good gun functioning in this model; i.e. Firing Pin, Bolt Lugs, Cocking Piece, Main Spring, Head Space, etc..

SUMMARY & CONCLUSIONS

1. The present fire control will fail to fire properly under continued use if not lubricated consistently. In extreme cold climatic condition this characteristic would present a problem in all our current line of bolt action rifles.

2. Under existing manufacturing and design standards the load-lubrication variable results in a change in pull weight (average) from 3 lbs. to 6 lbs..

3. Calculations affirm test data that the coefficient of friction of steel on steel between lubricated and dry surface straddles nicely the loads imparted to the connector from some minus value to a maximum of 3 lbs.. Actual measurements run 0 to 2 lbs.. Added to the above is the connector surface variable and spring weight in the pull adjustment spring. These considerations bring the test data and theoretical results into close agreement. Two out of three tests which were started dry, eventually failed even to fire. The Sear was being held in the cocked position with the Trigger disengaged.

4. The plating of the Sears with a low coefficient material to reduce the Mu variable proved very effective. "Electrolizing" completed 9600 cycles very satisfactorily before breaking down and reverting to "steel on steel" characteristics. Nickel plate lasted 2000 cycles. Molysulphide was no better. Chrome plated parts completed 10,000 cycles with no change in wear apparent after 2000-3000 cycles. Fired intermittently dry and oiled

4. after 10,000 cycles there was less change in overall variation than steel on steel in any one try of 10 cycles.

	Best	Worst
Steel on steel	∠ 2 oz.	2#10 oz. - 5#3 oz.
Chrome on chrome	∠ 1 oz.	2# 0 oz. - 2#15 oz.
Chrome dry to Chrome lubricated - 10 cycle Avg.	1½ oz.	
Steel dry to steel lubricated	3#3 oz. - 5#8 oz.	

5. Firing pin indent was maintained at .022 for 50,000 cycles on one sample and for 30,000 on second, where both dropped to .020 (satisfactory). Third sample: Start .022 - 30,000 .018 low.

Bolt lugs reacted in line with receiver mating surfaces but to a lesser degree.

Headspace developed early when the Bolt Lugs were not lubricated (start 0 - .042; 5000 - .0435; 10,000 - .0475; 15,000 - .052) accompanied by galling. Maintains .052" when lubricated, to 50,000 cycles. Second sample lubricated every 1000 cycles changes from .0435 to .0445 at 10,000. Maintained this to 50,000 cycles without change.

Unless the Bolt Lugs are "glass-hard" we would always expect a certain amount of galling in absence of any lubrication.

Sear engagement remained at initial setting throughout all testing (production assembly).

Cocking piece and bolt cam surface were lubricated throughout and were OK.

6. The similarity in design between the 40X and the 721-722 line gives immediate rise to the question of how much of the foregoing is applicable to these bolt action sporters. We believe that these characteristics are very real and under extreme cold-lubrication conditions could fail to fire.

7. The Main Spring showed some "set" but not excessive and maintained satisfactory indent to 50,000 cycles.

   A longer test would be necessary to establish "set rate" beyond the 50,000 cycle period of this test.

8. A better heat treat of bolt and receiver should be found to reduce the hazard of developing excess headspace early in the life of the rifle.

FUTURE PROGRAM

1. The quality of chrome plating on cyanide hardened surfaces is difficult to control and therefore adequate process and controls must be established before this system could be used.

2. No economics were considered, but a possible reduction in the grinding and stoning operations could conceivably be achieved on Model 40X parts by plating all of the Connectors and Sears in the "as produced" condition. Tests should verify this before acceptance.

3. Consultation with "Electrolizing" might produce a still better and lower cost coating than chrome plating. The results on the samples from the Electrolizing Corporation were very discouraging and at this time it is our belief this is the best they have to offer.

4. For the limited firing in Models 721 and 722, "Electrolizing" may be adequate if the cost picture is favorable when compared to chrome plating.

TEST PROCEDURE AND DETAILS

The first M/40X dry cycled was set up to investigate the rifle in the "as packed" condition. The action and parts were oiled and with about a 30 lb. load between the bolt and receiver to represent the residual load from the fired case. It was recognized that this load would be applied on the closing stroke as well as the opening stroke of the bolt. Further, this muzzle load was acting in conjunction with the normal mainspring-sear load. The (Firing Pin) sears were lubricated but, as field practice does not dictate lubrication of the lug areas, this was omitted. The rifle was dry cycled 52,200 cycles. At 1,000 cycle intervals headspace, firing pin indent, protrusion, sear engagement, and a ten cycle weight average taken on trigger pull.

Head space	Start: .0435	Finish: .048
Indent stayed constant at	.022 - 45,000 cycles	.020 - 50,000 cycles
Firing Pin protrusion	.035 constant	
Sear engagement	.015 constant	
Pull average 10 cycle	Low: 3# 6 oz.	High: 5# 3 oz.
Pull	Lowest Single: 2# 10 oz. Highest 5# 12 oz.	

Several times during this test the rifle refused to fire. No apparent mechanical reason could be found when dismantled. It always continued to function when inspection was under way. Some

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scouring of the bolt lugs was observed but at 52,000 (end of cycling) the scoured area had not completely covered the lug surfaces.

To verify the foregoing test another rifle was run through the same procedure and conditions. This followed closely the results of the first test.

Head space	Start: .0435	13,000 -	.052
		30,000 -	.052
Indent	Start: .022	30,000 -	.0185
Firing Pin protrusion	OK		
Sear Engagement	.010 - Stayed		
Pull average	Low: 2# 14 oz.	High:	3# 10 oz.
Pull - Single	Low: 2# 13 oz.	High:	3# 12 oz.

In this test the rifle did not refuse to fire during the 30,000 cycles. The pull was very consistent at all times, which was quite the reverse of #1 sample. However, the lugs of receiver and bolt responded early (10,000 cycles) to the lack of lubrication by galling and fast development of headspace --- .052 at 13,000 cycles.

The #3 rifle was then started on the above routine test to determine how soon it would refuse to fire. Failures occurred at 2,000 cycles and test was stopped at 8,000. This rifle could be set up by carefully moving the trigger back and forth on the connector (not firing). This action resulted in setting up the sears so the trigger could then be pulled fully, leaving the firing pin fully cocked supported only by the sear. A slight jar, or pressure, on the cocking piece, or movement of bolt handle, would release the firing pin. Had the rifle been loaded it would have fired the live round.

taken to get no oil on the parts. The parts were now oiled and tested pull was then back to 3# 6 oz., and after 6,000 more was still at the 3# 8 oz. setting with no change. The second sample followed in close agreement with the first tolerances and average remained the same as #1. The surprising fact still was the little influence lubrication had on the total pull weight. It would appear there is hope of having the parts such that an adjustment could be made and held for the life of the gun.

"Electrolizing" was next tried. These samples looked very uniform and high hopes for these were entertained, since this would remove the critical aspect of chrome plating. This test was an exact duplicate of the reaction experienced with the tests on chrome plate. Very uniform pulls, no change in the averages as the test progressed. This was the reaction till we reached 9,600 cycles, at which point the results suddenly changed. The weight looked like steel on steel. Under the microscope it was found that this was indeed what had happened. The "Electrolizing" had worn away and we were again getting steel on steel. No further testing was done with Electrolizing.

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