PROGRESS REPORT AI-48-5

DESIGN IMPROVEMENTS - M/37 "RANGEMASTER" TARGET RIFLE

Period:	12-15-47 to 6-15-48
Project:	TD-470 W.O. 72003
Amount Authorized: $3,200.	Spent: $1,900.
Previous Progress Reports:	None
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INTRODUCTION

Observations at the Camp Perry matches, as outlined in the report of that trip, and subsequent contacts with Sales, Technical, and Production Divisions, indicated that design improvements on the M/37 "Rangemaster" Target Rifle were advisable. Part I of Project TD-470 was authorized December 15, 1947, for $1,700. and Part II of Project TD-470 was authorized April 5, 1948, for an additional $1,500. to complete the work program.

OBJECTIVE

The objective of this Project was to make a design investigation of the various recommendations from the Camp Perry report.

SUMMARY AND CONCLUSIONS

Under Part I of this Project, the following changes or studies were undertaken:

1. Drawings were altered and tooling changes are in process to increase the height of the front scope block. This change was made to eliminate complaints that scopes with large objectives now in use will not "sight in".

2. Recommendations to alter the Receiver and Stock to bed the entire Receiver distance instead of the present partial bedding were investigated. Results of the investigation indicated that no definite improvement in accuracy

could be expected through this change. Also, in view of a $ 10,000. expenditure that would be involved, the investigations were dropped.

3. It was recommended to study the replacement of the present Redfield Front Sight with the Redfield Olympic Front Sight.

This study has been completed and presented to the Sales Department and Products Committee. The Redfield Olympic Front Sight was adopted as standard with the Redfield #63-18 optional. The Remington Rear Peep Sight has been maintained as standard, with the Redfield Olympic Rear Sight as optional.

4. Recommendations to alter the present Trigger Spring from a flat type to a coil spring were investigated, to eliminate the tendency of the flat spring setting down and causing variation in Trigger pull. Results of the investigation indicated variation in Trigger pull was not caused by the flat spring, so no design change was recommended.

5. A review of the M/37 Chamber dimensions was recommended. This has been accomplished in conjunction with work being done in the Bridgeport Physics Section on 22 caliber match ammunition. The investigation did not indicate sufficient improvements through changes in chamber dimensions to justify revisions in process.

6. Recommendations to improve the steel in the Bolt Stop and Sear were investigated and no significant advantage was found in departing from the present material specification.

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Under Part II of this project a study was undertaken to investigate the necessary design changes on the "Sweany" Trigger to reduce the variation in Trigger pull. Also, to evaluate the original M/37 Trigger in an attempt to incorporate the advantageous charecteristics of the "Sweany" Trigger without trigger pull variation.

The results of the investigation show that the best possible variation in Trigger pull attainable in a model of the "Sweany" Trigger is $\pm$ 4 ozs. From this fact the production tolerance of $\pm$ 8 ozs. on current manufactured M/37 Target Rifles is realistic.

It was concluded that no significant improvement may be expected for eliminating the variations in trigger pull and still maintain the other excellent features of the "Sweany" without completely redesigning a new Trigger mechanism and housing.

Based on these facts, it is recommended that the present M/37 Trigger design be retained, and that we recognize now, as we did at the time the "Sweany" Trigger was adopted for the M/37, that Trigger pull variations of as high as $\pm$ 8 ozs. can be expected.

PATENT SITUATION

No patent considerations entered into this project.

FUTURE PROGRAM

All phases of the work have been completed with exception of plant tooling now underway for increasing the height of the scope block.

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EXPERIMENTAL DETAILS

Items 1, 2 and 3

Experimental Details on these items are of a minor nature. It is felt that the summary statements provide adequate information and for this reason further detail has been omitted.

Trigger Mechanism - Items 4 and 6

The M/37 "Sweany" Trigger has been a source of trigger pull variation complaints since its adoption to the M/37 "Rangemaster" target rifle. It was recommended and approved by the Ilion Design Meeting of February 13, 1948, to review the "Sweany" Trigger design and see if this variation could be reduced and, also, review the 1935 Series M/37 Trigger to determine if this Trigger Mechanism could be altered to provide the excellent "feel" of the "Sweany" Trigger without the inherent variation in pull.

To accomplish the above recommendations, the following changes were incorporated in a shooting model of the 1935 Series Trigger.

Bolt

Widened chamfer in rear end of Bolt Stop Slot to clear Trigger Stop.

Bolt Handle

Altered left locking lug to clear Trigger Stop.

Bolt Stop Plunger

Reduced thickness of collar to obtain more travel against Bolt Stop.

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Bolt Stop Plunger Spring

Increased size of wire to obtain more pressure on Bolt Stop.

Receiver

Added holes for Trigger Stop and Key.

Sear

Added tapped hole for Trigger engagement screw and ground bottom end.

Stock

Added clearance for Trigger Stop.

Trigger

Added tapered hole for Trigger Stop Screw and lessened chamfer on top front end.

Trigger Engagement Screw

This component added to adjust Trigger Engagement with Sear.

Trigger Stop

This component added to fix pull-off travel of Trigger.

Trigger Stop Screw

This component added to compensate for manufacture variations, thereby being able to set Trigger travel at minimum.

Trigger Stop Spring

This spring added to restore Trigger Stop to Trigger.

Screw Driver

Lengthened to reach Trigger Engagement Screw.

Trigger Stop Key

This Key added to Receiver to prevent sticking of Trigger Stop.

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In a similar manner changes were also incorporated in a shooting model of the "Sweany" Trigger as follows:

Sear

Made of 8620 steel to current dimensions. Given a preliminary heat treatment. Ground very smooth on those surfaces as now designated and finally heat treated in an accellerated bath.

Sear Spring

Shortened present one to 4 coils instead of 5.

Trigger

Cut away portion at rear of upper arm to clear coiled Trigger Spring. Changed top front edge from 3°30" to 10° to prevent front end of Sear from rising and failing to return under Bolt Stop.

Trigger Spring

Substituted a helical spring at rear of Trigger in lieu of the present flat one in front.

Trigger Housing

Made a spring hole at rear of Trigger Pin Hole.

Bolt Stop

Made of 8620 steel to current dimensions except firing pin abutment moved rearward .040. Given a preliminary heat treatment. Ground very smooth on those surfaces as now designated and finally heat treated in an accellerated bath.

Bolt Stop Spring

Increased wire size from .018 to .022 dia.

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Firing Pin

Smoothed Bolt Stop surface on notch, and polished Main Spring Hole.

Main Spring

Changed number of coils from 25 to 24 to compensate for .04 over compression.

Bolt

Polished burr from Firing Pin Hole.

Bolt Handle

Moved Cam Pin Detent forward .040 to prevent Firing Pin jumping.

Trigger Mechanism - Conclusions

Series 1935

The lever arms of this Trigger have a ratio of 1 : 1.77.

A 5.3 oz. variable on the Trigger nose will react to a 3 oz. variable on the Finger Piece.

Series 1939 (Sweany)

These lever arms have a ratio of 1.37 : 1 in the opposite order of the 1935 series.

Therefore a 5.1 oz. variable on the Sear Contact Point will induce a 7 oz. variable on the Finger Piece.

The loading of the Sear on Trigger Nose in the 1935 Series is 50% less than the loading of the Bolt Stop to Sear in the 1939 Series. Hence, a lower frictional variable.

It appears that the Bolt Stop - Main Spring reaction is not as lively and uniform in the 1939 Series as the Sear - Main Spring reaction in the 1935 Series.

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The Trigger movement in the 1935 Series is therefore greater than the 1939 Series.

The pull variable is less in the 1935 than in the 1939 Series.

Typical trigger pull results reflecting the above conclusions with the two types of Triggers are as follows:

	Sweany		1935 Series	
	Pounds	Ounces	Pounds	Ounces
	3	3	3	8
	3	3	3	8
	3	2	3	6½
	3	2	3	7
	3	4	3	5
	3	1	3	6
	3	1	3	6
	3	3	3	7
	2	13	3	6½
	3	1	3	7
Max.	3	4	3	8
Min.	2	13	3	5
Var.		7		3

Chamber Dimensions: - Accuracy (Item 5)

Assistance was furnished the Bridgeport Physics Section's study on match ammunition to the extent of $200. under this project. The study itself has not been completed by Bridgeport but work to be performed by Ilion under authorized funds of this project is complete. Results to date indicate no recommendations forthcoming which justify any alterations to chamber dimensions for the improvement in accuracy of the M/37 Rifle.

The following letter from G. M. Calhoun to H. A. Brown summarizes the experimental details to date.

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CC: P. B. Rutherford
M. H. Walker
P. F. Darby
C. S. Cummings
J. J. O'Connor

Bridgeport, Connecticut
June 14, 1948

TO: H. A. BROWN

FROM: G. M. CALHOUN

SUBJECT: M37 ACCURACY

This letter summarizes results of a recent test on a variety of M37 barrels. The study is not complete, but the results obtained to date may be of interest to you. The study will be resumed as soon as other work permits. The indications are: (1) There is no advantage in changing from a pitch of 16" to a longer pitch; (2) There is no difference in accuracy between barrels rifled with the present Pope system of flattened grooves and barrels rifled with radial grooves (with center of curvature on axis of bore) so long as the land widths, bore diameters, and total cross-sectional areas are maintained equal in both cases; (3) A change in the lead of the chamber for 3°48' to 7° may be of some advantage; and (4) The presence of a slight choke (.0001" to .0003") at the muzzle of the barrel has no appreciable effect upon accuracy.

The barrels used in this test were prepared by M.H. Walker at Ilion and are remarkably uniform within lots. Bore diameters measured prior to rifling were .2172" - .2173". The air gage was used on the finished barrels to insure that no barrel contained constrictions or expansions in the bore except for a slight choke at the muzzle. The barrels were fitted to regular M37 actions and head space set at .043" - .044". The .2240" pickup length in the 7° chambers was .618" ± .002". The .2240" pickup length in the 3°48' chambers was .622" ± .005", according to present M37 specifications. The body diameter of the chamber in every case varied from .227" ± .0002" at the breech to .2250" ± .0002" at junction of body and lead. All barrels had groove and land widths according to M37 specifications.

For accuracy testing the barrels were clamped in a V-block with a bar along the top. The following ammunition was shot in some or all of the barrels; Targetmaster, AAAA8, 1071, EZX'S, BA, Supermatch Mark II, 55BC, Packer 15, and a pilot run of experimental ammunition. The accuracy figures given in the table attached represent average extreme spread in inches (measured inside edge to inside edge) of 10 ten shot groups shot over 100 yards. The first five barrels represent standard M37 in every respect. The second five are standard except for substitution of radial grooves for the flattened grooves. The third five are standard except for a change in lead angle and a slight change in chamber body length. The fourth five are standard except for substitution of a pitch of 17" for the 16" pitch. The fifth five are standard except for substitution of a pitch of 18" for the 16" pitch.

G. M. Calhoun /s/
Manager-Ammunition Division
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att.

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Pitch	Form of Rifling	Lead Angle	Groove Diameter	Choke	Accuracy Target	EZX'S	Mark II	Exp.
16	Standard	3°48'	.2197	.0002	1.14	1.18	1.13	1.00
16	Standard	3°48'	.2198	.0000	1.05	1.09	1.33	0.91
16	Standard	3°48'	.2198	.0002	1.16	0.95	1.19	0.98
16	Standard	3°48'	.2199	.0000	1.03	1.07	1.51	0.94
16	Standard	3°48'	.2200	.0001	1.11	1.09	1.01	0.99
				Averages	1.10	1.08	1.23	0.96
16	Radial	3°48'	.2196	.0002	1.15	1.04		
16	Radial	3°48'	.2204	.0002	1.01	1.20		
16	Radial	3°48'	.2206	.0003	1.15	0.99		
16	Radial	3°48'	.2214	.0000	1.13	0.98		
16	Radial	3°48'	.2215	.0003	1.11	1.11		
				Averages	1.11	1.06		
16	Standard	7°	.2197	.0002	1.08	0.88	0.96	
16	Standard	7°	.2198	.0000	0.98	1.12	1.13	
16	Standard	7°	.2198	.0001	1.00	0.86	0.98	
16	Standard	7°	.2198	.0002	1.13	0.83	1.19	
16	Standard	7°	.2200	.0001	1.01	0.84	1.04	
				Averages	1.04	0.91	1.06	
17	Standard	3°48'	.2195	.0000	1.29	1.02		
17	Standard	3°48'	.2197	.0000	1.07	1.15		
17	Standard	3°48'	.2197	.0002	1.07	1.13		
17	Standard	3°48'	.2198	.0003	1.06	1.20		
17	Standard	3°48'	.2199	.0003	1.00	0.91		
				Averages	1.10	1.08		
18	Standard	3°48'	.2196	.0000	1.34	1.26		
18	Standard	3°48'	.2198	.0002	1.03	0.96		
18	Standard	3°48'	.2199	.0001	1.14	1.25		
18	Standard	3°48'	.2199	.0002	1.26	1.38		
18	Standard	3°48'	.2200	.0002	1.01	1.22		
				Averages	1.16	1.21		

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