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REMINGTON ARMS COMPANY, INC.

RESEARCH DEPARTMENT

SECOND QUARTER PROGRESS REPORT - 1983

JUNE 1983

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HIGHLIGHTS

Firearms Research	Page No.
• Model 1100 Special Field Shotgun Research has approved the Model 1100 Special, LT-20 trial and pilot and is evaluating several design alternatives for the 12 Ga. fore-ends.	5
• Model 870 Special Field All drawings for the Model 870 Special have been transmitted and samples for Marketing are being prepared.	5
• Model 111 Autoloading Shotgun Two Model 111 samples are in test & have been fired to a combined total of 15,000 Magnum rounds.	5
• Parker Double Barrel Shotgun Initial drawings have been received and are being evaluated on a 20 ga. Parker shotgun.	6
• Model 870 Police Shotgun Model 870 12 ga. Riot shotgun testing is continuing with no apparent problems. Engineering drawings have been provided to Production for cost estimation.	6
• Bolt Action Rifle Development Marketing and Research have reviewed Model 700 Lightweight prototypes. A model has been selected. Preparation of a transmittal package including new drawings and parts lists has been initiated for a planned August 1, 1983 release to Production. Testing will start July 1, 1983 on 36 prototype .30-06, 270, and 280 caliber rifles.	6

HIGHLIGHTS

Firearms Research - Cont'd — Page No.

- Model 7400/7600 Center Fire Rifles — 7

  The Model 7400 .223 carbine project has been discontinued. Model 7400 7mm-08 and .25-06 work and testing have been completed and drawings will be updated for transmittal. The .308 caliber carbine testing has been delayed due to other priorities.

- Model Seven Lightweight Rifle — 7

  Twenty-five (25) Model Seven Lightweight rifles with floor plate assemblies made from heavier material were satisfactorily tested.

- Cut Checkering Machine Development — 8

  Runoff of a Bostomatic machine, for checkering pressed wood, is scheduled for July 18. A purchase requisition has been issued for a CO.RE.MA. machine to checker sanded wood.

- Four Slide Process Development — 8

  A cost savings has been claimed for manufacturing Model 7400 and Model 7600 magazine followers on the four-slide machine.

- Synethetic Shotgun Piston Seal — 8

  Piston seals made from Vespel®and Fluorel are in the Test Lab.

- Injection Molding of Firearms Components — 8

  Injection Molding of Model 700 Magazine followers began on June 20.

- Ceramic Development — 9

  An Appropriation Request has been approved to purchase and install a ceramic injection molding pilot line.

HIGHLIGHTS

Firearms Modernization	Page No.
• Receiver Flexible Manufacturing System We are continuing to define the scope of the control system with the Engineering Dept. Several automation options are being evaluated. A report to Management is scheduled for July 25.	10
• GFM Automation A program is underway to automate two shotgun barrel GFM groups. System installation will begin in October with full production of one automated GFM scheduled by year end.	10
• CNC Long Stock Inletting Machine controllability studies indicate that the Heian is producing more accurate stocks than existing production equipment. Operator training is in progress and the Heian is running limited Model Seven production.	10
• Rotary Bell Atomizers Initial start-up of the equipment was unsuccessful due to oil contamination of the atomizer air control lines. An air dryer has been ordered for the main compressed air line.	11
• Stock Sourcing Study A list of wood furniture manufacturers, (all previous Du Pont wood finishes customers) has been provided by F & F.P.	11

HIGHLIGHTS

Ammunition Research — Page No.

- New Unibody Shotshell Process — 12

  The new unibody process body former is back in production with standard 2-3/4" 12 ga. and 20 ga. product. Head splits were experienced in -20°F firing of 12 ga. 3" large volume bodies produced in semiworks. Preliminary testing of modified bodies indicates the splitting may be eliminated with relatively minor tooling changes. Start-up on large volume 3" 12 ga. is scheduled for mid-July.

- "Premier" Shotshell — 12

  "Premier" Shotshell 12 ga. 3" 1-7/8 oz. and 1-5/8 oz. ballistics, load fit and pattern were demonstrated during a June experimental run.

- Steel Shot Shotshell Loads — 13

  Steel shot waterfowl loads require new wads in both 12 and 20 ga. Samples of both a 1-3/8 oz. 12 ga. and 1 oz. 20 ga. wad have been made in semiworks.

- The 1 oz. Target Load — 13

  The 1 oz. Target Load recent experimental run using RD20 propellant has met all laboratory and field test requirements and has been approved for production.

- Shotshell Primer Basics — 13

  Shotshell Primer Basics test ammunition with domed primer cups quarter hard anvils and fuelless mixture is being evaluated at two State Shoots.

- ABC Battery Cup — 14

  ABC battery cup tooling has been altered to eliminate stress riser; product is untested to date.

- TLX Priming Mixture — 14

  TLX mixture for shotshell mixtures is nearing feasibility as cellulose appears to be a viable alternative to nitrocellulose.

HIGHLIGHTS

Ammunition Research - Cont'd — Page No.

- Center Fire Cartridge Basics — 15

  The Center Fire Cartridge Basics analysis of the 308 Win. was completed and a presentation made to management. It was shown that significant changes have been made in the case since production was relocated from Bridgeport to Lonoke.

FIREARMS RESEARCH

Model 1100 Special Field Shotgun

Research has completed testing for the LT-20 Specials and has accepted Production's trial and pilot. Eleven trial and pilot guns were endurance tested. Seven fore-ends were tested to 5,000 rounds. Three were taken to 20,000 rounds. One fore-end cracked at 3,250 rounds at the 10 o'clock position.

Research efforts to prevent cracking in the 12 ga. Model 1100 Special fore-ends has been concentrated on two designs. Both utilize a new detent system retained in the magazine tube. Plastic molds for this system have been ordered. The prototype molds can be used to support Production through the end of this year.

The first design is a buffered fore-end having an elastomer sleeve retained in the fore-end. Sample molded parts are expected by July 3.

The second design utilizes an extension on the magazine cap which separates the fore-end from the inertial loads caused by the barrel. Parts for this system are in hand.

Model 111 Autoloading Shotgun

New autoloading and slide action shotguns are being developed as potential replacements for the Model 1100's and Model 870's, respectively. Objectives include decreased weight, and increased reliability, and reduced manufacturing costs.

The design currently being developed involves the use of a new, patently novel locking system, (rocker arm), improved barrel contour, threaded in stainless steel magazine tube, orifice selector/choke tubes, and improved carrier latch system. Two samples are in test and have been shot 15,000 rounds total. Nine styling samples have been completed which depict options for stock and fore-end design, checkering pattern, and receiver/vent rib contours.

A design alternative being considered includes the use of an aluminum receiver which would provide further weight reduction by approximately one pound compared to the current steel receiver design. Prototypes with aluminum receivers have performed satisfactorily for up to 10,000 Magnum rounds with no significant damage to the receiver.

Parker Double Barrel Shotgun

Reintroduction of the classic Parker side-by-side double barrel shotgun is being considered. Arrangements are proceeding to complete one VH Grade 12 Gauge Parker by August 1983.

A partial set of drawings from Jesse Briley on a 20 Gauge Parker has been received. These drawings are undergoing engineering evaluation. Once the remaining drawings of the package have been received, they will be sent out for cost estimating.

Model 870 Police Shotgun

By intentionally tripping the feed latch on the Model 870 shotgun, a jam condition can be created which is difficult to clear without removal of the fire control. Proposed modifications include changes to the slide and carrier assemblies.

Two Model 870 12 ga. Riot shotguns have been endurance tested to 7,500 rounds and one endurance tested to 5,500 rounds using 3 inch Magnums and 2-3/4 inch high base ammunition. At the end of each 1,000 rounds, 25 rounds are fired testing the jam condition.

There has been no apparent problems with the anti-jam design feature components and the guns will be continued to 20,000 rounds per gun endurance level. Estimated test completion date is August 1, 1983.

Engineering drawings have been turned over to Production for estimating.

Bolt Action Rifle Development

The replacement rifle for the Model 700 Classic has been accepted by Research and Marketing. Parts list and drawings are being prepared to meet the transmittal date of August 1, 1983. Warehouse date of this rifle is planned for November 1984.

Work on the new generation rifle will continue on completion of the above program. Testing of the proposed extractor change is planned to start in September with the completion of the prototypes. Work on the rotary magazine components is continuing. A test schedule will be determined with the completion of the magazine assembly. The magazine rotor, spring retainers, and end plate have been completed.

Model 7400/7600 Center Fire Rifles

The Model 7400 .223 carbine was being developed as a sporting version of that popular cartridge to augment this product line. Due to the cancellation of this project, efforts are being concentrated on collecting all technical data and design specifications and recording this information. For future reference, various prototypes will be completed and assigned to the Research Gun Library. An AI Report will follow.

All preliminary 7mm-08 and .25-06 work (orifice, pressure data) has been completed. A number of rifles in both calibers have been built and test fired satisfactorily. Drawings only would have to be updated for transmittal if this is desired. We are still waiting for a priority to get preliminary measurements on ten (10) standard .308 rifles. This is necessary before work can commence on data confirmation for the carbine length barrel.

One .257 Roberts model has been built and orifice and pressure data is acceptable. This rifle has been field tested with very good results. Barrels are being readied so that additional models can be built to verify our results. Other calibers currently being considered for evaluation are the .250-3000 Savage, 7mm Mauser, and possibly the .35 Remington. Some barrels have been allotted for these calibers and efforts will be made to get orifice and pressure work done.

Model Seven Lighweight Rifle

A sensitivity analysis was performed on the floor plate assembly. Using the criteria established, twenty-five rifle were built in .308 caliber. The floor plate base, trigger guard plate, and the floor plate cover were made from heavier material. The present heat treated trigger guard was used. The latch was altered to allow for more engagement with the floor plate cover.

The floor plate pad was altered to allow for the heavier floor plate base. A new latch spring was made from heavier material to give minimum seven pound release force.

Stocks were altered to allow for the thicker floor plate assembly.

The twenty-five rifles were functioned tested for over 600 rounds. Ten of the rifles were then brought up to 1100 rounds. Five of these rifles were brought up to 2100 rounds.

Results of the test indicate satisfactory performance if all specifications identified in the sensitivity analysis were met. Because of the time and expense required to implement these revisions, the decision has been made to proceed with the aluminum casting alternative instead. Our goal is to submit drawings to the casting vendor by July 1 and confirm the design by the last week in July.

Cut Checkering Machine Development

Remington's present N/C cut checkering machines will be completely burdened by the end of 1983. Marketing has identified several new specifications to be cut checkered, requiring the purchase of additional machines. This machine development program will provide additional checkering capacity at an appreciable reduction in machine cost.

Runoff of a Bostomatic machine, for checkering pressed stocks, is now scheduled for July 18 at the vendors. A fixture for the Model Four stock is being built in the Model Shop, and will be complete prior to machine delivery.

A requisition has been signed and given to Purchasing for CO.RE.MA. Model ZZ-A-E checkering machine for sanded wood. Machine delivery is expected 20 weeks after issuance of the Purchase Order.

Four-Slide Process Development

Magazine followers for the Models 7400 and 7600 are being processed over the four-slide machine to satisfy third quarter Production requirements. A $10,120 cost savings has been claimed for using the four-slide versus purchasing from outside. While this cost is still significant, it is down from the originally estimated $35,000 due to volume reductions with these two models.

Economics have been requested from Industrial Engineering on eight additional components.

Synethetic Shotgun Piston Seal

High temperature plastic piston seals are being investigated for autoloading shotguns. Implementation into the Model 1100 will result in a significant cost advantage, and a reduction in gas system corrosion. Most recent testing has focused on Torlon, a product of Amoco Chemical. Results to date have been unsatisfactory.

Piston seals made from Du Pont's Vespel® and 3M's Fluorel have been turned over to the Test Lab for evaluation. Also under investigation are Du Pont's Kalrez,® Delrin ST,® and Delrin T.®

Injection Molding of Firearms Components

Molding of Model 700 magazine followers began on June 20. Preliminary Test Lab evaluation is underway. Assembly to production guns is schedule for August 15, when the Plant returns from vacation shutdown.

A mold for the common center fire rear sight slide is due for delivery on July 8.

Ceramic Development

An Appropriation Request has been approved to purchase and install a ceramic pilot line.

Several alumina feedstocks have been prepared, and tooth implant samples processed. These will be tested for compatibility with "bioglass".

A very detailed request for quote has been received from Sandia National Labs for processing PZT samples. Because of the many exceptions that must be taken, we will propose supplying parts at no cost.

FIREARMS MODERNIZATION

Receiver Flexible Manufacturing System

A Committee has been formed of EDL and Remington personnel to study and recommend additional automation options that should be included in the Receiver FMS software and scope. Options being evaluated including: automatic material handling and scheduling, MRP interfacing, production reporting, and process monitoring. In addition, the "transportability" of the receiver manufacturing system software to other proposed Firearms Modernization systems including Small Component Manufacturing is being studied

Development of an automatic inspection system is progressing. Remington and EDL engineers have recently attended equipment demonstrations at Bendix and Brown & Sharpe. The Bendix "Cordax" equipment measured M/870 receivers four times faster than the Brown & Sharpe equipment. Bendix is currently investigating the feasibility of mounting four probes on their existing system to match our manufacturing system.

GFM Automation

We have developed a robot system to automate the shotgun barrel GFM machines. The system will be capable of loading and unloading the GFM machines, stripping the finished barrel from the mandrel, reassembling the barrel blank and the mandrel, and loading and unloading the automated cutoff machine. The newly designed mandrel assembly/stripping machine will be regrouped with the GFM and cut-off machine such that all can be operated by the robot. The existing cut-off machine will be equipped with automatic clamping to accommodate robot loading.

The new mandrel assembly/stripping machine has been designed and fabricated. The Cincinnati Milacron T-3 robot has been ordered and is scheduled for delivery to Ilion in September. The modifications to the cut-off machine are scheduled to be complete in September. Software programming of the system controller is in progress and is scheduled for completion and simulation in August. Total system installation will begin in October with full production of one automated GFM scheduled by year end.

Wood Shop Flexible Manufacturing System

CNC Long Stock Inletting

The Heian machine has been purchased and installed to perform the secondary machining operations for all long stocks. Machine controllability studies indicate that the Heian is producing more accurate stocks than the existing production equipment and stocks have been processed thru assembly with no problems. Operator training is currently in progress and the Heian is running limited Model Seven production.

Wood Shop Flexible Manufacturing System - Cont'd

CNC Long Stock Inletting - Cont'd

The second fixture will be installed on the Heian machine in early July and the machine will then be ready for Production turnover.

Rotary Bell Atomizers

Two rotary bell atomizers were purchased and installed on the existing plant electrostatic spray line.

Initial start-up of the equipment was unsuccessful due to oil contamination of the atomizer air control lines.

An air dryer has been ordered for the main compressed air line for the electrostatic spray room with delivery expected in early July.

Stock Sourcing Study

With Purchasing we have reconfirmed that there are no stock manufacturing vendors currently operating in this country. Overton previously manufactured a portion of Winchester's stocks, but we have been unable to contact them in the past month.

A list of wood furniture manufacturers, (all previous Du Pont wood finishes customers) has been provided by F & F.P. We will establish contact and visit these plants to explore their interests in becoming stock vendors.

AMMUNITION

New Unibody Shotshell Process

The New Unibody Shotshell Process is being developed to provide a single process for all shotshell gauges. It has been designed to substantially increase process tolerances and yield, and simultaneously improve product quality.

"12 gauge" large volume bodies have been made in very limited quantities on the Production machine. Product assembled, headed and primed by the Plant passed all tests at +150°F, but developed some cracks in the base section at -20°F. The cause of the cracks was a tool change at heading to improve primer sealing at hot temperatures. It has been subsequently demonstrated in semiworks that the cracking can be eliminated if less localized work is done at heading. New heading tools are being fabricated and a minor modification will be made to a body former tool (prehead bunter), to permit less cold working at heading. Production is expected to resume on the 3" large volume shell by mid-July.

"20 gauge" product quality off the Production machine has been reconfirmed by hand assembly and loading since the machine has been reassembled. An alignment related prehead pin breakage problem is being corrected. Production assembly and loading is scheduled for later this month.

"28 gauge" bodies produced in semiworks were not successfully assembled on the Production equipment due to a tight fit of the body on heading pins and brass cap feeding problems. The heading pin diameters have been reduced and the profile changed to insure good integrity. Also, Plant Engineering is fabricating new cap feed rails.

Testing of hand headed products at extreme temperatures revealed no casualties. Production has tentatively scheduled another assemble, head and prime run in early July.

".410 bore" with a tapered body indicates that the shell may be capable of up to 10 reloads. Body buckling has been reduced by the addition of the deep skive. However, the internal volume appears marginal to accommodate the load. Development will resume when manpower is available after resolution of the 20 gauge prehead pin breakage problem.

"Premier" Shotshell

Production of the 12 gauge 3" 1-7/8 oz. and 1-5/8 oz. loads is dependent on the large volume body scheduled for production mid-July. An experimental run was completed in June with ballistics, load fit and pattern results within specification. Confirmation is planned in July. A handload for the 1-5/8 oz.

"Premier" Shotshell - Cont'd

Handloads for both the 20 gauge 1-1/8 oz. 2-11/16" and 1-1/4 oz. 2-7/8" have also been established. Confirmation of the former fabricated on Production equipment is scheduled for late June with the latter following.

Steel Shot Shotshell Loads

Steel shot is mandated in some waterfowl areas. Previous steel shot loads utilized a dry molded asbestos basewad. Asbestos use has been eliminated to avoid environmental contamination in the manufacturing operation. Development of loads in the new unibody is requiring both new wads and load development.

An experimental run of 1,000 wads for a 1-3/8 oz. 3" 12 gauge load was successfully completed on Production equipment. The core pin was identical to the 1-1/8 oz. except for longer petals to accommodate the increased payload. Handload development has been completed. A confirmation is planned pending resolution of the 12 gauge 3" LV problem.

Wads and bodies for a 1 oz. 3" 20 gauge steel shot load have been made in Research. Handloads will be developed with Research new unibodies.

1 oz. Target Load

Experimental products were loaded to the higher velocity (1200 ± 20 fps). Hercules Red Dot 20 propellant produces an acceptable product, giving reasonable chamber and port pressures, acceptable performance factors, low muzzle flash and unburned powder characteristics within Research specifications.

An experimental run of this 1 oz. product using Red Dot 20 was made in early June. Product evaluation and field testing at Bridgeport and Lonoke indicated satisfactory performance and superior gun function characteristics when compared with the Winchester 1 oz. control ammunition. Low temperature performance of the Remington load showed no significant problems with function and casualty and was superior to the Winchester control which had 60% off-sounds and severe wad casualties. Based on the positive laboratory and field tests by Research and Marketing, the Remington 1 oz. target load using Hercules Red Dot powder has been approved for production.

Shotshell Primer Basics

Development work on this program is essentially complete and test product has been shipped for evaluation at the Ohio and Michigan state shoots. Primers with both 1024 and fuelless mixture are being evaluated. The fuelless mixture (no aluminum or

nitrocellulose) produces no breech flash, improves perceived primer piercing resistance and solves the nitrocellulose procurement problem. All tests to date with this mixture have been excellent.

The domed primer cup which improves piercing resistance and gives good sensitivity requires few tooling changes. Anvils produced from quarter hard brass eliminates anvil annealing and results in a more uniform product. Primers produced with these components have consistently equalled or surpassed Federal in piercing resistance and been comparable in sensitivity. Lot-to-lot sensitivity variations in Federal product results in some test-to-test reversals as to which product is superior.

ABC Primer

A trial run was made on the ABC press with experimental 5th anvil draw punches with very encouraging results. Measurements made on battery cups produced in the experimentally tooled rows show no dimensional differences from battery cups produced by standard tooling, but the stress riser which appears at the 3rd anvil coning station using standard tools is absent in those rows using the experimental anvil draw punches. A set of five modified 5th anvil draw punches is being fabricated for a more extensive test run. The effect of the elimination of this stress riser on product performance has not been tested.

Part of the experimental tooling made for a four flash hole battery cup was sent back to the tool vendor. The first and second anvil pyramid dies were not made per drawing and the vendor is working on the returned tools.

TLX Priming Mixture

TLX is a priming mixture which will not explode when wet and will result in a safer manufacturing operation. Mixture processing difficulties at charging have been a persistent problem, particularly in Rim Fire. Emphasis is now being placed on Shotshell as this appears to be the easiest to implement

Fine nitrocellulose, which is not readily available, had been added to both Rim Fire and Shotshell mixtures to improve processability. In Shotshell, cellulose has proven to be an acceptable replacement although it has created some -20°F ballistic deficiencies. Increasing the lead styphnate content to 38% and adding 2% aluminum have given acceptable ballistics in target loads. The addition of aluminum at this low level did not produce breech flash. Evaluation in other Shotshell (and Center Fire) loads and efforts to improve sensitivity are under way. Mixture processability has been good.

TLX Priming Mixture - Cont'd

In Rim Fire, cellulose is an acceptable substitute for nitrocellulose. Ballistic performance has been comparable to 600S and misfire performance is improved. The mixture is characteristically difficult to charge which results in operator fatigue and lower productivity. A program is underway to improve this condition through evaluating alterations to the charging methods.

Center Fire Cartridge Basics

The Center Fire Cartridge Basics program objective was to evaluate and compare key case characteristics for Remington and competitive ammunition. The results show that case dimension and metallurgical structures do vary between Bridgeport, Lonoke and competitive products. It has been concluded that:

- Bridgeport produced 308 cases exhibited a higher degree of cold working and more metal in the head area than the current Lonoke product.
- Lonoke produced 308 cases when compared to competition exhibit smaller head and bridge thicknesses and lower head and sidewall (at .210" datum) cold working as indicated by differential scanning calorimetry (DSC) analysis.
- All data indicate Lonoke produced cases are manufactured to a tighter tolerance than competition.

Further programs have been proposed to determine whether and how this data correlates with case failure modes.

ETL has also developed and demonstrated the utility of two experimental methods:

- Weight measurement is an efficient and significant method to statistically sample center fire ammunition.
- DSC can be used to evaluate the brass microstructure to measure cold work and hence case strength.

Also pickling residue has been noted on both Lonoke and Bridgeport cases.

The above information was presented to Management on June 10 by J.C. Callahan, F.E. Schmidt (ETL), and F.T. Zimone (ETL).

RESEARCH PERSONNEL

REMINGTON ROLL

	Actual 5-31-83	Actual 6-30-83	Forecast 12-31-83
Exempt			
Ammunition Research	17	17	16
Firearms Research	39	39	40
Firearms Modernization	7	7	9
Other	1	1	1
Total Exempt	64	64	66
Nonexempt			
Ammunition Research	12	12	12
Firearms Research	12	12	11
Firearms Modernization	1	1	1
ER&DD	1	1	1
Other	1	1	1
Total Nonexempt	27	27	26
Wage Roll			
Firearms Research	19	19	19
Firearms Modernization	2	1	2
Total Wage Roll	21	20	21
Total Research Department	112	111	113

PATENTS & TRADEMARKS

Summary of Activity

June 1983

Patent Applications Filed

N O N E

Trademark Applications Filed

N O N E

Patents Received

FIRING PIN BLOCK FOR FIREARM WITH A ROTARY BREECH BOLT
Patent No. 4,389,919 issued 6/28/83 RA-0209-A USA
Patent No. 1,145,984 issued 5/10/83 RA-0209 Canada
(Kast/Eddy/Carter)
ABSTRACT: A major safety feature of Model 7400 and 7600 rifles. The bolt carrier forceably retracts the firing pin inside the bolt face prior to unlocking the action, and continues to block the firing pin in a retracted position until relocking is completed. Thus, the rifle cannot be discharged with the bolt unlocked, even if the firing pin spring is broken or missing, or the firing pin is bent and jammed.

Trademarks Received

U.S. Trademark No. 1,240,219 for "REMINGTON" (word) in Class 13 (U.S. Cls. 9 and 23) for Industrial Guns for use in kilns, mining and in seismic exploration T1-US10

Inventions Reports

Arkansas:

CENTERFIRE CARTRIDGE PACKING MACHINE MDB-174