

REMINGTON ARMS COMPANY, INC.

RESEARCH AND DEVELOPMENT - FIREARMS

FOURTH QUARTER PROGRESS REPORT - 1980

December 31, 1980

HIGHLIGHTS

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<u>New Product Development</u>	
• Production of M/4/7400 and M/6/7600 Centerfire Rifles has been authorized and announced. A task force of Plant and Research personnel has been established to solve continuing problems due to feeding malfunctions.	3
• In tests of XSG prototype components, a long square-wire action spring, located forward around the magazine tube, has taken a 1.5 inch set and continues to function well after over 5,000 baby magnum rounds.	3
• The revised Model 870 Competition Trap Shotgun has been successfully tested and drawings transmitted to the Plant. Trial and Pilot testing and warehousing is scheduled for after the first of the year.	4
• Forty Model 979 Seismic Guns required to satisfy the first two orders have been shipped and plans are being implemented to produce at least 100 more guns in 1981.	4
• A list of options for reducing weight of the Bolt Action Carbine has been supplied to Marketing for review.	5
• New format Owner's Instruction Book for the Model 700 Left Hand has been completed and released to Production.	5

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<u>Current Product Development</u>	
• Design and testing has been completed on a new safety system for the Model 788 Bolt Action Rifle to decrease the potential for inadvertent movement of the safety button from the "safe-on" to the "fire" position.	6
• New designs featuring separate bolt lock and fire control safety's for the Model 700 have been completed and tests are scheduled for January.	6
• Testing is complete, Marketing has approved artwork, and drawings and parts lists have been transmitted to Production for the first year Ducks Unlimited Shotguns.	7
• Based on favorable test results and cost estimates, electroless nickel plating has been recommended for Pistons and Piston Seals for all Model 1100 Shotguns to reduce the potential for malfunctions due to corrosion of those components.	7
• Redesign of Model 1100 links is being evaluated in an effort to reduce the frequency of fatigue related link failures.	8
• Rivetless extractors have been designed and tested for all centerfire rifles. Implementation of the designs should be complete by the fourth quarter of 1981.	8
<u>Process Development</u>	
• The entire Auto-Drill Line System is operating in the fully automatic mode and Plant personnel are being trained to operate the line. Total project cost is estimated to be slightly less than the authorized amount.	9
• The Schaevitz LVDT positioning system for the ASEA manipulator has been delivered and is being installed. Prove out is scheduled for January 1981 and Trial and Pilot for February 1981.	9
• Final attachments for the Four Slide Machine will be completed by January 1981 and the machine will be shipped to Whipcity for tooling. Delivery to Remington is scheduled for March 1981.	10
• Two laser welded XSG slide block to action bar assemblies have been received from ETL for endurance testing.	10

STATUS - NEW PRODUCT DEVELOPMENT

Model 7400 Autoloading and Model 7600 Slide Action Centerfire Rifles

These rifles have been developed as replacements for the current Model 742 and Model 760 rifles. Production has been authorized and the new line of firearms was announced at the December Gun Writer's Seminar.

The Plant continues to experience excessive gallery rejects due to feeding malfunctions and a task force of Plant and Research personnel has been formed to identify causes of the problems and implement solutions. These malfunctions are due in part to variations in the magazine box which is a carry-over design from the M/742/760's. However, analysis of the gallery reject guns indicates that the rejects are due to a cumulative effect from a variety of different sources. The task force is currently conducting a carefully monitored test program to identify the causes of malfunctions to establish actions required to decrease reject rates to an acceptable value (less than 5%). That test program is scheduled for completion by early February.

Plant and Research personnel have visited the magazine box vendor (H & P Die Stamping) to discuss problems with fabrication of the box. Efforts have centered on establishing acceptable gages for documenting critical dimensions on the box and providing the vendor and the Plant with an identical set of gages. Tests with 100 boxes from the most recent production lot indicate continuing problems due to variations in the spring and follower. Tests are continuing on a new box design featuring revised spring and follower geometries.

Preliminary drawings of the Limited Edition Model Four have been provided to Production for cost estimates. Marketing has approved use of a rosewood tip on the fore-end and is currently evaluating two receivers from Aurum Etching which feature revised artwork. Approval of receiver artwork and tests to demonstrate durability of the rosewood tip are the only items which remain to be completed.

XSG/XPG Shotguns

New autoloading (XSG) and slide action (XPG) Shotguns are being developed as potential replacements for the M/1100's and M/870's, respectively. Objectives of the program include decreased weight, increased reliability, and increased use of common parts for reduced manufacturing costs. New designs are in progress on the gas system, action spring, feeding system, and locking system. Completion of the preliminary design is scheduled for July 1981.

Weight reduction is being accomplished by redesign of the barrel and by movement of the action spring to a forward position around the magazine tube. A new gas system and action spring design are required to provide a system which will function with regular and magnum rounds with no manual adjustment. Work on a gas system metering and cut-off to control bolt velocity is continuing. And, in tests with a long square-wire action spring in a standard M/1100 gas system, the spring has taken a 1.5 inch set and continues to function well after over 5,000 baby magnum rounds.

Tests are in progress on two locking systems; one a new rear lock design and the other a new front lock design. A prototype rear lock system exhibited a premature failure due to the locking block cam that picks up on the slide block. This design is being modified to pick up on the breech bolt. Tests begun on a prototype of the new front lock design with successful function after 100 - 2-3/4" magnum rounds in combination with a long square-wire forward action spring.

Model 870 Competition Trap Shotgun

The Competition Trap Shotgun is a special single shot version of the present Model 870. It has a unique gas operated recoil reduction system. The gun was previewed at the Grand American Trap Shoot in August 1979 and announced in December 1979. During initial Trial and Pilot testing, problems were encountered with vent ribs and magazine caps becoming loose during test. Design revisions were required.

Revisions were made by adding a buffer to the piston and a barrel support to retain the barrel. Dry cycle testing was successful. These design changes were then successfully tested to 25,000 rounds each thru two guns. Drawings have been transmitted to Process Engineering. Updated costs show no significant changes.

Trial and Pilot is now scheduled for December 1980, with warehousing after the first of the year. Research is working with Production on long leadtime items. Presently we are drilling barrel support and gas cylinder positioning holes in barrels and increasing the size of the magazine tube hole in the barrel support.

Model 979 Seismic Gun

Forty (40) guns required for the first two Seismic Gun orders have been delivered and plans are being implemented to produce at least 100 more guns in 1981 based on the Dessa design. Initial orders have been placed with

outside vendors for many of the smaller components required for the next 25 guns. These components will serve as a check on quality and dependability of those vendors for future orders.

During exploration work at Wellsville, N.Y., SSC experienced freezing of the firing pin mechanism in cold weather conditions. However, in two days of testing at Ilion, in below freezing temperatures, the firing pin mechanism of a clean breech block did not freeze up. When modifications were made to the 3 guns at Wellsville, N.Y., all were found to have firing pin mechanisms that had not been cleaned in a large number of rounds and it is presently assumed that this was the major cause of the freezing problem.

Cold weather kits incorporating a manual firing pin retract option have been developed which will enable a gun with a dirty firing pin mechanism to be shot in cold weather. The SSC guns at Wellsville were retrofitted with these kits and Mapco has ordered 12 additional kits.

Twenty-five (25) percussion breech blocks will be shipped to Mapco as soon as an instruction sheet for installation and adjustment of the fire-on-closing mechanism has been completed.

Bolt Action Carbine

The Carbine is a short barreled, bolt action, centerfire rifle that is being developed as a replacement for the Model 600. Prototype models were field tested and well accepted except for the overall weight. Marketing has requested the weight be reduced to at least 6 $\frac{1}{4}$ pounds.

A list of options for reducing the weight has been supplied to Marketing. They include changes to barrel and stock contour, sights, floor plate assembly, and bolt handle. The barrel option will produce an approximate 12 ounce weight reduction.

New Owner's Instruction Book Format

Our present Owner's Manuals are written using words that are often technically slanted, making it difficult for the average person to read and understand. The new manuals are being written using a controlled language with the key principle being one word-one meaning.

Instruction book for the Model 700 Left Hand has been completed and released to Production.

A draft of the Model 870 Competition Trap Instruction Book has been completed and forwarded to Marketing and Legal for review. Mechanical illustrations are being prepared for proof printing. The instruction book is scheduled to be completed and released to Production in February 1981.

Work is proceeding to complete the new format Owner Manuals for our remaining product line. It is anticipated that the majority of the instruction books will be completed by December 1981.

STATUS - CURRENT PRODUCT DEVELOPMENT

Model 788 Safety

The present Model 788 rifle has been in the line for several years. A continuing effort is made to improve operation of the current firearms line in conjunction with reports from Production, Process and the field.

Experience indicated that the safety button could be contacted by the first web space of the hand when holding the gun by the grip of the stock and resting the gun on the shoulder. This could possibly cause the safety to be moved to the off safe position.

The safety system has been redesigned to decrease the size of the safety button and to reposition it to decrease the potential for inadvertent movement to the "fire" position. We have also modified the plunger geometry and redesigned the spring to provide a more positive safety action and to increase the "safe-off" force from $1\frac{1}{4}$ lb. on the current design to 4 lb. on the new design. "Safe-on" force has not been changed. In dry cycle testing, there were no component failures and no changes in "safe-on" and "safe-off" forces after 10,000 cycles. The test program included three (3) tests each of the following combinations: a.) New plunger geometry only, b.) New spring and plunger design, and c.) New spring, plunger and button designs for a total of nine (9) tests. Each test was conducted to 10,000 cycles.

The above test results indicate that the new design will provide reliable operation over the life of the gun and that the potential for inadvertent movement to the "fire" position should be significantly reduced. Model drawings are ready to be transmitted to Production.

Model 700 Bolt Lock and Fire Control

New bolt lock and fire control designs for the 700 Bolt Action Centerfire Rifle have been developed as part of an ongoing program to improve the functional

characteristics of our current firearms line.

The objective of the bolt lock program is to give the shooter the ability to open and unload his firearm with the safety in the ON position. To do this, the bolt lock and safety on the M/700 rifle have been designed to operate independently of each other. A spring actuated safety lever that is aesthetically acceptable combined with a reshaped bolt plug has been designed. Tests of the new safety lever combined with a new fire control featuring blocked trigger and sear will be initiated in January.

Model 1100 Ducks Unlimited

Marketing has developed a four year program with the option for a fifth year, to build special model shotguns for the Ducks Unlimited Organization. This program will consist of adding special features to our present shotguns. The Ducks Unlimited Organization will purchase a limited amount of these special shotguns which they plan to auction off at their fall dinner meetings. A different Trade Model in unlimited quantities is sold thru normal trade channels and Remington contributes an amount to the Ducks Unlimited Organization for each one sold.

The programs will include three special production model shotguns each year. The first year there will be 2400 Commemorative Model 12 Ga. Magnum shotguns, 2400 Ducks Unlimited Special Model LT-20 shotguns, and approximately 8000 special Trade Model 1100 - 12 Ga. Magnum shotguns.

Models have been furnished to Marketing. Artwork for first year requirements for all three models has been agreed upon. Testing of an emblem fastened to the side of the Commemorative Model has been successfully completed.

Drawings and parts lists have been transmitted to Production. Receiver artwork for the Trade Model will be finished by the end of December. Warehousing is scheduled to begin in July for the Dinner shotguns, and October for the Trade shotguns.

Model 1100 Piston and Piston Seal Rusting

Over the years there have been a number of customer complaints concerning the failure of their guns to operate after a period of time in storage. The majority of the complaints come from coastal and high humidity areas. These complaints centered around parts of the gas system, pistons and piston seals, which become rusted while in the gas cylinder and/or on the magazine tube. These parts do

not have a protective surface treatment or finish. During firing of the shotgun, they become covered with a burned powder residue. Subsequent exposure to moisture will cause rusting and over a period of time the parts can become inoperable. If the shotgun is disassembled after use and the parts are dried, there is very little chance of this happening.

Several methods have been investigated to circumvent this problem; including material changes and various surface treatments and finishes of the parts involved. The latest method has involved electroless nickel plating of the Piston and Piston Seal. Test results from in plant functional firing, environmental salt spray, and field testing have been positive. Use of electroless nickel plating has been recommended for the Pistons and Piston Seals of all Model 1100 shotguns.

Model 1100 Link Breakage

During a competitive shotgun evaluation this past year, a number of links were broken. Furthermore, returned parts that were replaced at the Grand American Trap Shoot this past summer included approximately 70 broken links. Plant records indicate that last year approximately 5000 links were sold as spare parts.

Fracture surface analysis on 10 of the Grand American parts by duPont ETL personnel indicate crack initiation by fatigue (cyclic) loading. Redesign of the links to decrease operating stresses and possible use of shotpeening are being investigated. A number of the present parts are being shotpeened in our Plant facilities.

A redesign of the link at the point of maximum breakage has been completed by adding approximately 17% more material. The vendor that presently makes this part has been requested to quote on making prototype parts to this latest design. He will also quote on making the present design from high carbon and alloy steels.

Rivetless Extractor

These new centerfire extractors in small, regular and magnum sizes will replace the troublesome riveted types. Part cost will be reduced, a number of bolt head operations eliminated, and gun reliability and ease of replacement will be improved.

All three extractor sizes have been extensively tested and approved for introduction in all centerfire rifles.

Drawings of extractors and bolt head modifications have been transmitted to Production.

Regular and magnum extractors require an anti-rotation projection in their respective bolt heads to prevent them from rotating out of position during unlocking of the bolt. Tooling to coin the projections in all centerfire bolt heads in both right and left hand configuration has been designed and built and trials should be completed by January. Some of the tooling is already in Production.

STATUS - PROCESS DEVELOPMENT

Auto-Drill Line

The present method of preparing shotgun barrel blanks for the swaging machines is difficult to control and requires an unacceptably high degree of technical and engineering support. A drilling process has been developed utilizing proven machining methods and completely automatic part handling to replace the current process.

The entire Auto-Drill system is running in the fully automatic mode and Plant personnel are being trained to operate the line. Current production rates are approximately 800 - 1000 barrel blanks per day with a single shift operation. Total project cost is estimated to be less than that authorized on Part II and within the 10% limit. There are currently no major problems with the system. However, we are continuing to work with Plant personnel on a variety of minor problems and adjustments.

ASEA Manipulator

Rifle and shotgun receivers are rough and finish polished by a labor intensive hand process. ASEA Inc., an Industrial Manipulator Manufacturer, demonstrated the technical capability of automatic polishing M/742 and M/760 receivers utilizing their industrial robot.

The economics on this project indicate a potential savings of \$61K per year and a 23% ROI for completely polishing M/7400 and M/7600 receivers. Adequate finish has been demonstrated on M/7400 radii. Side panel tolerance problems will be overcome with the Schaevitz LVDT System now being installed.

System development completion and LVDT System prove out is scheduled for January 1981 and trial and pilot for February 1981.

Investigation of shotgun receiver polishing will be conducted by Research. Improved panel sizing and polish are being investigated by E.S.D.

The system will be available for limited production on a manual load basis for M/7400 - M/7600 receivers in the first half of 1981.

Four Slide Machine

This automatic manufacturing system for in-house production of precision formed stampings will enable Remington to develop an expertise in stamping manufacture in order to eliminate our total dependence on costly outside suppliers. Additional benefits will be improved quality and reduced new product leadtimes.

Support equipment will include a wire electrical discharge machine (EDM) which will be used to manufacture four-slide tooling and prototype gun parts.

Additional attachments, for producing M/7400 - 7600 long magazine followers, are being installed on the Four-Slide Machine. Completion is expected in January 1981 and the Machine will be shipped to the tooling vendor when tooling is complete and ready for tryout. Delivery to Remington is scheduled for March 1981. Wire EDM glass bead blaster and material stock reel have been delivered.

A change to the M/7400 - 7600 long magazine follower drawing was necessary to match the new thick walled magazine box. Marked prints have been provided to the tooling vendor.

Laser Welding

Model 1100 and Model 870 shotgun slide blocks are currently being brazed to action bars or slide plates. The brazed points are inherently unreliable and difficult to inspect without destructive testing. Scrap rates run as high as 20% in subsequent operations. A laser welding process was proposed to replace the troublesome brazing operation. The estimated gross savings are \$30M per year at a 38% ROI.

ETL has laser welded a quantity of M/1100 slide block to action bar assemblies. These were sent to Ilion for heat treatment and subsequently returned to ETL for strength tests.

Two XSG laser welded assemblies were received and are in the Model Shop for subsequent machining operations. These will be endurance tested in guns when complete. ETL has requested additional XSG parts.