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REMINGTON ARMS COMPANY, INC.

RESEARCH DEPARTMENT

FIRST QUARTER PROGRESS REPORT - 1981

MARCH 1981

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REMINGTON ARMS COMPANY, INC.
RESEARCH AND DEVELOPMENT DEPARTMENT
FIRST QUARTER PROGRESS REPORT - 1981

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● 117X Primer - Reduced anvil hardness in the improved target load primer has minimized piercing while maintaining sensitivity equal to or superior to competition.	5
● Integral Anvil Battery Cup - The Lachaussee press and die have produced 7.5 million cups. Tool costs are averaging \$.25 per thousand parts, which is encouraging for economic justification of this equipment, and weekly production rates are improving with experience.	7
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● "Scorpion" Rim Fire Cartridge - Several Hercules powders appear capable of achieving "Scorpion" goal ballistics. To maintain compatibility with rim fire loading equipment, powder blending may be required.	8

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- 21MM Seismic - Production of 21MM Seismic 1981 to date is 600,000 rounds versus the 795,000 first quarter schedule. Primers and shells are on hand to complete first quarter goals. The process is being transferred to the Production Department

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- Four 3" magnum models of the XSG autoloader shotgun will be completed by mid-April. These models feature the action spring forward design with a modified barrel contour for reduced weight and an improved locking system. Completion of the preliminary design is scheduled for July. 11
- Results of Warehouse Quality Audits on the M/7400 center fire rifles indicate that visually the new rifles are superior to comparable M/742's. However, malfunction rates are unacceptably high(4.6%), particularly for feeding malfunctions. Plant and Research personnel are working with the magazine box vendor to solve the problem. 12
- Trial and Pilot testing on the M/870 Competition Trap shotgun has been completed and guns approved for warehousing. 13
- MAPCO has placed an order for 100 additional Model 979 Seismic Guns for 1981. The first three guns have been shipped and a schedule has been established for completing the order. 14
- To reduce fatigue related failures on Model 1100 links, use of shot peened parts and a change to a higher strength steel are being evaluated. 14

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- Preliminary test results on machined Torlon Model 1100 piston seals were encouraging. Durability exceeded 14,000 rounds. Molded piston seals are scheduled for delivery and testing in June. 15
- The Auto-Drill Line is on a two shift operation and has produced approximately 50,000 blanks to date. Machining quality, production rates, and tool life have met or exceeded project goals. 15
- Automatic polishing of receiver top and bottom radii using an ASEA industrial robot has been successfully demonstrated. The system will be available for limited production use during the second quarter. 16
- The Four-Slide Machine has been delivered to the tooling vendor and is scheduled for delivery to Ilion by June 1, 1981. 17

REMINGTON ARMS COMPANY
RESEARCH AND DEVELOPMENT

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AMMUNITION

New Unibody Shotshell Process

An experimental run of 15,000 12 gauge 2-3/4" bodies was completed with a defect rate of only 2%. Longitudinal tensile strength was 22,000 psi. Body design has been altered slightly to maximize processability on current Bridgeport production equipment. Included is a tapered wall which allows heading with standard PTL heading pins, and an internal contour which allows for the use of RXP®, SP, R12L and RTL wads.

Increased strength and stiffness of wall material coupled with slightly increased mouth thickness has resulted in a difficult crimp operation. Normally trimmed and skived shells exhibit premature buckling under some reloading conditions. A deep skive has been demonstrated which corrects buckling but this solution has not been demonstrated on existing Duplex loading equipment. Experiments are continuing to reduce crimp closure forces and reduce mouth thickness.

Delivery of the prototype production body former to EDL, Wilmington is presently scheduled for April, 1981.

Body Performance Improvement

Bodies were formed on a Perkins press where wall thickness was increased from 0.31" to .036", and work ratios were varied from the normal 4.2 to 4.4 both with and without internal lubricant. Bodies produced at the 4.4 work ratio with an .036" wall gave the best performance in the body cutoff test but only 32% of the bodies produced were acceptable. The increased wall thickness of .036" with the normal 4.2 work ratio resulted in an improvement over standard product. Wad fit with the thicker wall is being studied.

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Body Performance Improvement - Cont'd

The new body forming process has produced bodies with a 4.8 work ratio with only a few percent body defects and a resultant tensile increase to 21,000 - 22,000 psi. This body, when internally heat treated with hot liquid, exhibited a significant improvement in cut off performance.

We are working with DuPont ER&DD (ETL & EDL) to define an internal heat treat process which would be compatible with Rotary Cam production equipment.

Asbestos Elimination

The objective of this program is to eliminate the dry molded asbestos basewad from Remington's shotshell products by conversion to a high density polyethylene component. At the Bridgeport Plant, all gauges with the exception of 8 and 10 have been converted and are in production.

A recent product design modification which added primer bore prongs to the inner cap has solved the 8 gauge shell integrity problem. Based on test firings of product assembled in the Research semiworks heading press the only problem is occasional and slight gas leaks past the basewad obturating skirt at -20°F. This leakage does not affect shell integrity or function and is not serious. Only after disassembly of the fired shells and careful inspection can the gas leaks be detected. Head pull tests of the fired experimental product average 130 lbs. versus 85 lbs. for the asbestos dry molded basewad control shells. Recently, a proof pressure test was performed on the experimental product. Pressures averaged 46,000 psi and no shell casualties were noted. After firing head pull tests were identical to standard tests--130 lbs., thus no indication of shell disassembly was noted at these severe pressures.

With modified tooling and experience gained on the Research extruder, 8 gauge rod can now be extruded with stable dimensions. To reduce cut slug skewness and length variability, PE&C has modified a standard "Versacutter" unit and plans to test it before the middle of April. If this test is successful, experimental run will be made in early May.

117X Primer

The objective of this program is to develop a target load primer with sensitivity equal or superior to that of the competition.

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117X Primer - Cont'd

To confirm both laboratory and limited field tests of the excellent sensitivity characteristics of the new 117X primer, Lonoke prepared a quantity of 117X primed 12 gauge target loads for further field evaluation at several trap shoots during January. Although there were no misfire complaints, pierced primers were observed during a Florida trap shoot at a frequency of about 19/4000--a rate considered unacceptable. Based on these findings, a program was initiated to determine the cause of the piercing, devise a solution, and develop primer piercing test techniques which are better representative of extreme conditions that are encountered in the field.

The piercing test was improved by increasing the impact energy of the pendulum gun. Testing in these higher energy level positions did verify that 117X primers were significantly more prone to piercing than either Federal or Winchester product. Analysis of the competitive primer components brought forth the following information:

- Competitive anvils were significantly softer than Remington by 10-20 Rockwell "B" points.
- Competitive primer cups were maintained at tighter grain size tolerances (.035-.040mm) than Remington (.035-.070 mm).

Tests performed with modified primer explosive content and/or powder burning rate showed no significant improvement in reducing pierced primers; however, a drastic reduction in casualties was achieved when annealed, reduced hardness anvils (60-80R_B) were tested in the #1 and #2 positions of the pendulum gun.

In addition, loaded round, angled off-center sensitivity results were superior to Federal #209 control at all energy and offset test positions.

Based on the above results, Research has ordered experimental quantities of ASTM standard half-hard R_B60-77 brass strip for anvils which will be used for confirming tests on "as received" material and additionally, has ordered ASTM standard .025-.050mm grain size primer cup brass for more comprehensive testing with this material.

Work has started on a more comprehensive program to correlate various modes of failure of primers in general with variables associated with primer design. A series of designed experiments is

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117X Primer - Cont'd

planned to evaluate dimensional, assembly, priming mixture and other variables that may be identified as possible causes of primer function and/or casualty problems.

Integral Anvil Battery Cup

The objective of this program is to develop an integral anvil battery cup to reduce primer manufacturing costs, improve consistency of primer quality, and provide greater opportunity for process automation.

Approximately 7.5 million parts have been produced on the die. Tool costs are averaging \$.25 per thousand acceptable parts. Training of shift supervisors, toolsetters and operators is being accomplished. Current plans are to run the press on two shifts, with Research covering days and Production covering evenings, in order to decrease the time required to make 25 million parts necessary for establishing tool usage data.

Economic justification for this project is sensitive to tool usage and material costs. The main concern has been the effect of operating with bare versus copper plated strip steel. Experience to date indicates the copper plated steel's primary advantage in this process is not reduced tool costs, as was expected, but is increased operating speed. The plated material can be run for extended periods at 180 strokes per minute without significantly heating the die coolant. Base steel can be comfortably run at 160 strokes per minute. Above that speed, the coolant heats up rapidly and misfeeds begin to occur. At this decreased operating speed, the equipment is now meeting 75% of the projected production rate goal. Larger coil sizes, spare tool modules and additional operating experience will significantly improve productivity.

Primer samples containing 1024 mix with open and covered flash holes were produced for pierced primer and mass detonation tests. This product is superior to Federal for resistance to piercing.

TLX Priming Mixture

The TLX mixture that was prepared and charged into center fire and shotshell primers at Lonoke during February proved difficult to handle presumably due to differences in the nitrocellulose used at Lonoke. Shotshell primers assembled with this mix were tested at Lonoke and the results indicated that sensitivity was not within specifications for shotshell primers. Later, at

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TLX Priming Mixture - Cont'd

Bridgeport, the primers were retested and the sensitivity results were marginal but within specifications. This marginal sensitivity has been attributed to pellet weights in excess of the nominal .98 grains needed for ignition of the target loads. A shotshell mixture containing the Lonoke nitrocellulose will be made at Bridgeport to verify it as the cause of the charging difficulties and an analysis of both lots of nitrocellulose (Bridgeport and Lonoke) is being made to determine composition differences.

The Ilion gallery test of 110M rounds of TLX primed 22 Long Rifle high velocity ammunition is almost complete and the misfire rate has been less than current product with standard mixture.

Rifled Slug Improvements

The objective of this program is to improve the terminal ballistics of rifled slugs in selected gauges. Heavier slugs for 12 and 20 gauge will provide more energy since velocity, pressure and accuracy specifications will be maintained. Experimental loads of 3/4 and 7/8 oz. 20 gauge and 1-1/8 oz. 12 gauge hollow point rifled slugs have been tested.

The 3/4 oz. slug met the Remington specifications and is projected to replace the 5/8 oz. 20 gauge slug. A quantity sufficient for a combined experimental and trial and pilot run has been requested from the Plant. Upon completion of product acceptance tests, product introduction should follow shortly.

The accuracy of the 7/8 oz. 20 gauge slug has been marginal. In an early test, accuracy was slightly out of specification, but a retest showed enough improvement to meet specifications. This slug, planned for a potential 20 gauge S MAG load, is being redesigned to improve accuracy.

The 1-1/8 oz. 12 gauge slug met all Remington standards; more slugs are on order from the Plant for an experimental run of the 12 gauge S MAG.

"Scorpion" Rim Fire Cartridge

The objective of this program is to develop a solid point, truncated cone, high performance rim fire cartridge.

Recently three new powder samples were received from Hercules and based on tests with handloads all three powders appear capable of obtaining "Scorpion" goal ballistic; however, due to higher charge weights required, they are incompatible with the high speed of production autoloaders. In order to meet

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"Scorpion" Rim Fire Cartridge - Cont'd

the autoloader requirements, a slightly "faster" burning powder is necessary. We plan to evaluate Hercules' suggestion that one of the candidate powders be blended with a standard (faster) rim fire powder.

21MM Seismic

To date in 1981, 600,000 rounds of the 795,000 rounds scheduled for the first quarter of 1981 have been loaded. More than enough primers and primed shells are on hand to complete the quarterly requirements which are expected to be loaded by April 10. AH&P scheduling, in combination with the slow manual resistance inspection, continue to limit the output. Several hundred thousand rounds are currently in the warehouse.

The technical data packages are nearing completion and will be transmitted to Production. Due to the delay in obtaining the automatic resistance inspection unit, the manual process will be transmitted to the Plant.

Progress is being made with component fabrication. HOB Industries delivered 470,000 primer cups and all have been converted to primers with excellent results. HOB is also currently active in developing the contact button and samples have been examined. The contour of one portion of the button is the main area to be corrected. Tooling for the support cup has been fabricated but remains untested.

The insulator forming unit, developed primarily by Research, is undergoing startup.

The second quarter production schedule is 495,000 rounds and over half of the primer components are on hand.

Squib loads, actually wads and slugs lodged in the barrel, were encountered in the field. The condition was duplicated by reducing pellet weight substantially from the normal 1.15 grains to .77 grains and firing at -20°F. No failures were encountered at normal temperatures with pellet weights as low as 0.5 grains. Testing of returned product is now underway.

7mm Bench Rest Remington Case

The experimental cases passed all tests at Lonoke, Bridgeport, and Ilion. There is an internal volume difference between the production case and handmade cases which does not affect

7mm Bench Rest Remington Case - Cont'd

either performance or safety of this proposed new product. All tools and gauges for manufacturing this case have been ordered by Production.

7mm Mauser 140 Grain PSP

Ballistic tests were conducted to resolve several pressure related concerns for this new cartridge. Production has since warehouse 350,000 cartridges for product introduction. The Technical Data Package has been accepted by Process and Release for Shipment papers have been authorized.

7mm 140 Grain PSP Bullet

Refinement of the tooling requirement for this product is in progress. After two experimental assembly runs, the need for a three-step forming progression has been identified. Forming dies and knock-out pins for improving the nose of this bullet were designed and ordered in January. Down range ballistics testing of bullets made without these nose-forming tools were conducted with unsatisfactory results. Development efforts will continue upon receipt of the new tools.

357 Rem Max 158 Grain SJHP

Four thousand rounds were loaded on the Duplex loader. This product performed satisfactorily in ballistic, function and casualty testing; however, excess pressures were found with cartridges stored at elevated temperatures. Additional tests confirmed these results. One thousand cartridges will be forwarded to Ruger for further evaluation.

Marketing has clarified their minimum acceptable vented test barrel velocity requirement as being 1700 fps. This appears achievable with existing propellants at acceptable pressures.

FIREARMS

PRODUCT DEVELOPMENT

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 reduced weight, increased reliability, and increased use of common parts for reduced manufacturing costs. New designs of the gas system, action spring, feeding system, and locking system are in progress. Completion of the preliminary design is scheduled for July 1981.

Four magnum models of the XSG autoloader will be completed by mid-April. These models will include a modified model A3 locking system, a square wire action-spring-forward around the magazine tube, and improvements to the fire control system (e.g. a one piece connector, improved trigger, and modified hammer configuration). Also included in the models will be a new barrel contour strengthened over the 4-1/2" chamber position and redesigned for weight reduction, wide vent rib for magnum models, integral ejector, wide extractor, receiver bolt buffer, reverse stock bolt attachment, modified model 1100 type gas system piston and seal, new magazine cap and detenting system, improved feed latch system, and simplified interceptor latch. Improvements to the action bar assembly in the feed cam, carrier dog notch and carrier tab cuts are included in assemblies for the four model guns. Cut checkered stocks and fore-ends will be available for these model guns.

The above features are the basis for the Preliminary Design to be transmitted in July. However, work is continuing on contingency designs for critical components as follows:

- Improvements to the modified A3 locking system which include further strengthening of cams on the slide block, reduction in overall cam-locking block movement, and strengthening of locking block web areas where cracking was experienced in earlier prototype testing.
- Redesign of an experimental sliding pivot locking system and modifications to the slide block - action bar assembly.

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XSG/XPG Shotguns - Cont'd

- Evaluation of a forward bleed-off gas system using wave and belvelle washers for a pre-load on the bleeder ring. Initial test results have been favorable. Bolt velocities for magnum loads have been reduced with no effect on light loads. A 2" downbore orifice position is also being evaluated for effect on bolt velocities and PT curves.
- Development of a simplified feed system to be utilized on both the XSG and XPG models.
- Design of a fire control system with simplified release and latching mechanisms and reduced number of parts compared to the M/1100 design. A one piece carrier latch has been fabricated and a new release has been developed to allow free carrier movement during loading of the magazine.

Shotgun computer modeling is being pursued by both Remington and Du Pont ETL personnel. The Remington program is nearly complete and now plots bolt velocities and gas system pressure. Some inadequacies still exist in the gas system equations. These are being improved with the help of Du Pont EDL personnel. A computer simulation of the dynamics of gun firing has been provided by Dr. Boger of EDL. This program will be instrumental in the HPX program to develop a steel shotshell. Work is being done now to adapt this program to run on the IBM M/370 computer.

Preliminary design of a new XSG safety is complete and a single prototype has been built. The new design features a blocked hammer with trigger disengagement from sear by means of a connector lift. The safety style and operation is similar to that of the military M-1 Garand, with a lever (not button) operating through the trigger guard in a front to back motion. The prototype is currently in the Test Lab for evaluation.

Model 7400 Autoloading and Model 7600 Slide Action Center Fire Rifles

The Model 7400/7600 rifles were developed as replacements for the Model 742/760 rifles and were introduced into the product line in 1981. Features of the new rifles include smoother action, improved locking system, and more attractive styling. Customer

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Model 7400 Autoloading and Model 7600 Slide Action Center Fire Rifles - Cont'd

acceptance of the new line has been good. However, the Plant has experienced a variety of production start up problems requiring continued support by Research personnel. In addition to the routine assistance provided by the design group, a special Task Force of Plant and Research personnel was formed to implement long-term solutions to the problems. Although gallery reject rates have not yet reached an acceptable level, progress is being made and reject rates should decrease to a more normal level as the Plant develops experience in production of the new models.

Task Force programs have been completed on analysis of gallery reject data, component measurements, interviews with Production personnel, a 100 gun correlation study, and a Warehouse Quality Audit to compare Model 7400's with comparable Model 742's. Data from these studies are being analyzed to prioritize problems and to identify causes and solutions to those problems. Results of the Warehouse Quality Audits indicate that visually the Model 7400's are superior to the Model 742's. However, field test results confirm that overall malfunction rates are unacceptably high on the new rifles. Feeding malfunctions in particular were high.

Results of test firing the correlation study rifles confirmed a high feeding malfunction rate. The magazine box design and fit relative to the receiver appears to be a major cause of feeding malfunctions. A new box design is in progress and prototypes are being fabricated. However, confirmation of the new design will require at least six months. In the meantime, work with the vendor is progressing on fabrication problems with the current box and new gages have been completed to assure that boxes conform to model drawings. Past test results indicate that, if properly fabricated, the current design can produce low (1.5%) malfunction rates.

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.

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Model 870 Competition Trap Shotgun - Cont'd

During Trial and Pilot testing in January, the Plant experienced a problem with alignment of the barrel and receiver assemblies. Drawings were checked and results indicated that, in the worst case, present tolerances could cause an interference. The gas cylinder diameter was reduced to alleviate the problem. Two shotguns with modified cylinders were tested with the following results:

- No appreciable change in piston velocities.
- No detectable change in gas leakage past gas cylinder
- Shoulder forces comparable to the initial design.

The gas cylinder drawing was changed and production is continuing. Trial and Pilot has been completed and guns are being warehoused.

Model 979 Seismic Gun

The Model 979 Seismic Gun is an adaptation of the Remington Kiln gun. Development of the gun, which is used in geological studies, has been a joint development by Firearms Research, Ammunition Research, and MAPCO. All guns produced to date have been converted Kiln guns, with Ilion replacing the conventional breech block with an electrically actuated design for simultaneous firing of several seismic guns.

MAPCO has placed an order for 100 guns to be shipped in 1981. The first three guns have been shipped, and a schedule agreed upon by Marketing and Research for shipment of the balance. The controlling factor in meeting these shipments will be receipt of the Hofmann guns for conversion (or delivery of components for assembly here, if this option is chosen). Building of the electric breech block assemblies will not be a problem.

Model 1100 Link Breakage

In a competitive shotgun evaluation, an excessive number of link failures were experienced. Approximately 70 links were replaced at the Grand American Trap Shoot last fall. Plant records indicated approximately 5,000 links were sold last year as spare parts.

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Model 1100 Link Breakage - Cont'd

Evaluation of the parts indicate failure due to fatigue loading. Methods being pursued to reduce breakage are shot peening, use of a higher strength material and redesign to decrease operating stresses. Tests of shotpeened parts are being scheduled in the Lab. High carbon steel parts with increased strength are scheduled for delivery from the vendor by mid-April.

Torlon® Piston Seal

A new stainless steel stamped piston and high temperature plastic piston seal are being investigated for auto-loading shotguns. Implementation of this design into the Model 1100 will result in an annual savings of \$100,000. In addition to this cost improvement, a reduction in gas system corrosion problems should result.

The high temperature plastic currently being tested has the trade name Torlon®, and is a product of Amoco Chemical. Torlon® is presently used by the Department of Defense for several military components. Alternative Du Pont materials are also being researched.

Preliminary testing, using machined Torlon® seals, endured 14,000 rounds prior to failure. Molded Torlon® seals are due the end of May, at which time testing will resume.

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 Auto-Drill Line has produced approximately 50,000 blanks to date and is on a two-shift operation. Machining quality has been excellent, production has exceeded predicted rates, and tool life is better than anticipated. While a detailed cost summary was not available, estimates indicate that total cost will be less than the Authorized Expenditures and will be within 10% of

Auto-Drill Line - Cont'd

of the Part II authorization. Major factors limiting sustained operation are problems with the Smoke Removal and Oil Filtration systems. Research personnel are working with the Plant to solve those problems and to establish routine Production operation of the system by mid-April. Electrical and hydraulic engineering drawings and a complete spare parts stock list will be provided by June. Closeout of the project is planned by July.

ASEA Manipulator

Rifle and shotguns receivers are rough and finish polished by a labor intensive hand process. Based on the demonstrated ability of an industrial robot to automatically polish M/742 and M/760 receivers, Project RXI-63 was authorized to purchase an ASEA programmable manipulator.

Experimental polishing of the top and bottom radii has been satisfactorily demonstrated. Experimental polishing of receiver side panels indicates that forces above the rated load of the manipulator may be required to obtain a suitable finish. Revisions to the gripper design, which may reduce the force level, are being investigated.

An ASEA representative was in Ilion in early March to review contouring problems with the manipulator. Corrections to the machine should be complete by April 3rd, after which development work will be resumed.

The system should be available for limited production on a manual load basis during the second quarter, 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 and eliminate our total dependence on costly outside suppliers. The main advantage of this type of machine over a punch press, on which most of our stampings are currently produced, is in the four forming slides positioned around a central mandrel, which is an ideal arrangement for forming the type of stampings used in Remington firearms.

Prior to expiration of Remington's contract with its principal stamping vendor, the four slide machine will be used to make prototype parts for Research.

Four Slide Machine - Cont'd

The four-slide machine has been delivered to the tooling vendor for assembly of the dies to form the Model 7400 magazine follower. However a delay in completion of special cams by Torin will result in a postponement of the machine. Projected delivery in Ilion is now June 1st.



Joseph P. Glas, Director
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RESEARCH PERSONNEL

Remington Roll

	<u>2-28-81</u>	<u>3-31-81</u>	<u>Forecast</u> <u>12-31-81</u>
Exempt	64	64	61
Nonexempt	22	22	22
Wage	<u>20</u>	<u>20</u>	<u>20</u>
Total	106	106	103

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