LABORATORY NOTEBOOK

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CONFIDENTIAL 83

Notebook No.: 3013

Assigned to: JAMES W. RONKAINEN

Date: 7/10/97

INSTRUCTIONS FOR KEEPING RESEARCH RECORDS

In addition to providing a complete record of your laboratory work which can be understood and repeated by yourself and others, this notebook has been designed to afford maximum patent right protection. Several practices must be followed to give the notebook value as a legal document in possible patent litigation:

1. Enter all data directly into this book; it is permanently bound with numbered pages so that pages can not be substituted or deleted. Insert a piece of carbon paper between each original and duplicate page in turn such that a copy of all dates, data and signatures are made as work progresses. These copies should be removed from the book and given to your group leader. Do not record data elsewhere for transfer into the book. Write in ink. Never make erasures. Thus, the integrity of the record will not be in question.

2. Record sufficient information. All procedures, reagents, apparatus, sketches, conditions, references, etc., should be entered into the book as the work is done. The purpose and significance of the experiment as well as observations, results, and conclusions should be made clear. What may seem trivial at the time may later prove of critical importance. Your entries should be clear and complete enough for someone else who is "skilled in the art" to read and comprehend what has been accomplished.
   Avoid sweeping negative statements, e.g.: "This procedure is worthless," which could later limit the scope of your claims.

3. Not only is the conception of an invention important, but so is the diligence shown in making a working model or demonstrating that the idea works—"reducing to practice." These two elements of an invention, conception and reduction to practice, must be corroborated by a witness. The records of the inventor(s) are not enough. Thus, each page of the notebook should be read, witnessed, and dated (daily if possible) by someone who is competent to understand it, but who does not claim to be a co-inventor. Charts, tables, etc., should be complete, and lines should be drawn through any blank spaces prior to witnessing. It may be wise to perform key experiments in front of one or more witnesses. Spectra, charts, etc., should be signed, dated, witnessed, and if they can not be permanently attached to the notebook, they should be referred to with an entry in the book and kept on file. Dates and witnesses can establish your priority of invention.

4. To delete an entry, draw a line through it so that it is still legible. Corrections should be made adjacent to the deleted entry, and they should be initialed and dated by you and the corroborating witness. Changes made after the page has been witnessed should also be initialed and dated by you and the witness. Always use the current date.

5. The notebook and its contents are to be considered confidential and of great value. Exercise every care in preserving them. Report the loss or theft of a research notebook to your group leader immediately.

6. Index the contents and return each book as completed (or when not in use) for filing.

7. New ideas must be recorded and witnessed as they occur to establish priority of invention. Even ideas which do not pertain to the project at hand should be documented in the book.

Keep your research records as if each project were to be patented. Even though the work contained in the book may not result in a patent application, observance of these practices will provide a clear record for reports, publication, or future reference.

Instructions Read and Understood by James W. VanDamme

Dated 7/10/97

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10 BOLT ACTION RIFLE

HE M/710 RIFLE IS INTENDED TO BE A LOW (MANUFACTURED) COST, MARGIN BOLT ACTION RIFLE. THE INTENT OF THE PROGRAM IS EVELOP A BOLT ACTION RIFLE DESIGN THAT:

- HAS SHORT, LONG, AND MAGNUM CALIBERS, INCLUDING SMALL CASE HEAD SHORT ACTION CALIBERS (.223 REM FAMILY)
- STANDARD BARREL LENGTHS (22", 24")
- SYNTHETIC & WOOD STOCK VERSIONS
- NON-BLIND MAGAZINE (FLOORPLATE OR MAG BOX)
- REASONABLE BOLT ACTION GRADE TRIGGER
- ACCEPTS SCOPE BASES
- OPTIONAL ADJUSTABLE SIGHTS
- MATTE METAL FINISH

HE INITIAL MANUFACTURED COST GOAL WAS $113.00 ON 2/11/97. AS OMPARISON, THE M/700 ADL SYNTHETIC MANUFACTURED COST JWR 7/10/97 IS APPROXIMATELY $139.00.

VE HEARD SEVERAL MANUFACTURED COST FIGURES RECENTLY FOR NEW GUN THAT ARE IN THE $60-$70 RANGE, BUT I HAVENT N ANYTHING OFFICIAL. OUR GOAL IS TO PRODUCE THE GUN THE MINIMUM COST POSSIBLE WHILE MAINTAINING

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PROJECT M/710 BOLT ACTION RIFLE - OVERVIEW Notebook No. _____

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THE SAFETY AND PERFORMANCE OF THE PRODUCT. THE MINIMUM "SYS
COST APPROACH IS NOVEL IN THAT IT DOESN'T ATTEMPT TO MINIMIZE
COST OF ANY SINGLE COMPONENT, BUT DOES ATTEMPT TO MINIMIZE
COST OF THE ASSEMBLED FIREARM.

THIS PROJECT WILL ALSO UTILIZE ANY NEW TECHNOLOGIES AVAIL
TO PRODUCE "NEAR NET SHAPE" PARTS WHEREVER POSSIBLE, PROVIDED
(THE COMPONENTS) CAN BE APPLIED TOWARD THE GOAL OF MINIMIZED S
COST. TO THIS END, WE ARE GOING TO HIRE A MANUFACTURING CON
TO GIVE US AN OVERVIEW OF TECHNOLOGY AND PROCESSES THAT ARE NEW
THAT WE MAY BE UNFAMILIAR WITH. AGAIN, EMPHASIS WILL BE PLA
ON PROCESSES THAT YIELD LOWEST NET MANUFACTURED COST FOR
SYSTEM.

THE LAST ITEM (FOR TODAY) IS THE ISSUE OF DESIGNING THIS
TO BE A "BUILD TO ORDER" RATHER THAN A "BUILD TO STOCK"
I BELIEVE THE FINANCIAL ADVANTAGES TO THE BUSINESS IN REDUC
WIP (WORK IN PROCESS) COSTS AND REDUCED FINISHED GOODS INVENTORY
CARRYING COSTS MAKE THIS AN ITEM TO CONSIDER. ACCOMPLISHING
GOAL WILL REQUIRE AGILE MANUFACTURING AND A NEW PRODUCTION MIND
THE CONSULTANT & ILION MFG ARE BOTH EXPECTED TO HELP TOWARD THIS GOAL.

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James M. McDermon — Signed — 7/10/97 Date

Signed — 7/14/9 Date

PROGRAM OBJECTIVES

BUILD TO ORDER ⇒ AGILE MANUFACTURING
LOW COST

JWR 7/11/97 WITHIN A GIVEN MODEL

WHAT FACTORS DIFFERENTIATE BOLT ACTION RIFLES FROM EACH OTHER?

- CALIBER
- EXPECTED END USE (VARMINT, TARGET, PACK RIFLE, ETC.)
- RIGHT OR LEFT HANDED ACTION
- MATERIALS (RELATED TO END USE)
- MAGAZINE STYLE (BLIND, FLOOR PLATE, DETACHABLE BOX MAGAZINE)
- AESTHETICS

JWR 7/11/97 FROM THE ABOVE LIST

I BELIEVE THE MOST CONSTRAINING DIFFERENTIATING FACTOR IS THE CALIBER. ALMOST ALL OTHER ASPECTS OF THE PRODUCT CAN BE FIXED BY SPECIFYING THEIR ATTRIBUTES IN A PRODUCT SPECIFICATION, BUT IN ALL LIKELIHOOD, THAT GUN WILL NEED TO BE MANUFACTURED IN MULTIPLE CALIBERS. THEREFORE, THE ABILITY TO RAPIDLY CONFIGURE A GUN FOR DIFFERENT JWR 7/11/97 OF CALIBERS IS A DESIGN NECESSITY IF A BUILD TO ORDER SYSTEM IS TO BE IMPLEMENTED FOR PRODUCTION. THE DESIGN OF THE GUN TO ALLOW THIS JWR 7/11/97 (RAPID CALIBER CONFIGURA JUST UTILIZE AGILE MANUFACTURING TO AVOID STOCKPILES OF THE VARIOUS COMPONENTS THAT SET A GUN'S CALIBER. IN THE M/700 TODAY, THE PARTS THAT SET A GUN'S CALIBER ARE THE BARREL (CHAMBER, BORE DIAMETER, GROOVE DIAMETER, RIFLING TWIST RATE), BOLT (SHELL HEAD DIAMETER), ~~AND~~ A MAGAZINE (IF THE GUN IS SO EQUIPPED), AND THE RECEIVER (LENGTH, FEED LIPS).

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PROJECT M/710 PROGRAM OBJECTIVES

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OTHER PARTS OF THE FIREARM ARE AFFECTED BY THE CHANGES TO FOUR PARTS LISTED ON p.3, BUT FOR THE MOST PART, THESE CHANGES A MINOR. IN ORDER OF IMPORTANCE TO SETTING A GUN'S CALIBER, PARTS SHOULD BE RANKED ① BARREL, ② BOLT, ③ RECEIVER, ④ MAGA (THE RECEIVER AND MAGAZINE COULD HAVE THEIR RANKS REVERSED). IF RECEIVER IS SIZED LARGE ENOUGH, A SINGLE RECEIVER COULD ACCOMO ALL CALIBERS. THE RECEIVER CAN BE MADE EVEN MORE GENERIC THE FEEDLIPS TO CONTROL SHELL FEEDING ARE PUT IN THE MAGAZ FIVE MAGAZINES COULD COVER THE COMPLETE SPECTRUM OF CALIBE THAT WOULD POTENTIALLY BE OFFERED (223 FAMILY, SHORT ACTION, LONG ACT SHORT ACTION MAGNUMS, AND LONG ACTION MAGNUMS). IF THE MAGAZINE DESIGN IS APPROACHED PROPERLY, ONE, OR POSSIBLY TWO, MAGAZINES SIMPLE INSERTS COULD ACCOMODATE THE COMPLETE RANGE OF EXPECTED OFFERINGS.

DEPENDING UPON THE BOLT DESIGN SELECTED FOR THE NEW GUN, SINGLE BOLT COULD COVER ALL POTENTIAL CALIBERS (MAUSER DESIGN) WITH A CHANGE TO THE EXTRACTOR. I PREFER THE SAFETY BREECH DES OF THE M/700 FOR ITS OUTSTANDING STRENGTH IN AN OVER PRESSU

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James M Ronberman
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SITUATION. A BOLT UTILIZING THE SAFETY BREECH DESIGN (AND ITS THREE RINGS OF STEEL) WOULD REQUIRE 3 DIFFERENT COUNTERBORE AMETERS (.223 FAMILY, .308/.30-06 FAMILY, MAGNUMS) AS WELL AS 3 EXTRACTORS. LL BOLTS WOULD BE THE SAME LENGTH, WITH BOLT STROKE CONTROLLED BY THE BOLT STOP.

THE ABILITY TO DRILL, RIFLE, AND CHAMBER ANY CALIBER BARREL IDLY AND ACCURATELY IN SMALL QUANTITIES IS ESSENTIAL TO MAKING A "BUILD TO ORDER" SYSTEM ORK. INNOVATIVE DESIGN AND/OR PROCESSING OF THE BARREL WILL E A NECESSITY TO MAKE THIS WORK.

I HAVE STARTED WORK TO LOCATE A MANUFACTURING CONSULTANT TO GIVE US AN "OUT OF THE BOX" LOOK AT MANUFACTURING PROCESSES THAT YIELD LOW COST PARTS. MY INITIAL CONTACT WAS WITH PHILIP QUIRE, CHAIRMAN OF THE LOUISVILLE SME CHAPTER. PHILIP DIRECTED ME TO DAVE GODDARD OF THE MANUFACTURING TECHNOLOGY RANSFER CENTER. DAVE IS OUT ON VACATION. DICK GILBERT, HIS ARTNER, DIRECTED ME TO CONTACT JOHN PFEIFFER OF THE INSTITUTE F ADVANCED MANUFACTURING SCIENCES (IAMS) AT (513) 948-2112. DICK ALSO UGGESTED I CONTACT THE OAK RIDGE NATIONAL LAB CENTER FOR MFG. TECHNOLOGY AT (423) 241-3111. EBBIE SUMNER IS THE CONTACT.

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James [illegible] 7/11/97 — Signed / Date

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PROJECT LOCKTIME IMPROVEMENT

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IMPROVEMENT OF THE MODEL 700 LOCKTIME HAS BEEN AN ON A OFF AGAIN PROJECT FOR THE LAST SEVERAL YEARS. THE M/700's LO TIME IS AMONG THE BEST IN THE INDUSTRY - 2.8 TO 3.0 MS. MOS ATTEMPTS TO IMPROVE ON THIS PERFORMANCE HAVE BEEN IN TH AREA OF FIRING PIN MASS REDUCTION AND INCREASING THE LOAD (FORCE) SUPPLIED BY THE MAINSPRING. WHILE ~~THE~~ CHANGES TO T TWO PARAMETERS HAVE YIELDED MARGINALLY FASTER LOCKTIMES, TH FASTER LOCK TIMES HAVE BEEN AT THE EXPENSE OF REDUCED PR INDENTS.

IF WE MAKE THE ASSUMPTION THAT THE FIRING PIN SYSTEM BE MODELED AS:

$$m\ddot{x} + c\dot{x} + Kx = 0$$

WHERE $\ddot{x}$ = acceleration
$\dot{x}$ = velocity
x = displacement
m = mass
c = damping coef
K = spring rate

WE HAVE CONCENTRATED ON THE FIRST AND LAST TERMS OF THIS EQU WITH LITTLE SUCCESS IN IMPROVING LOCK TIME WITHOUT ADVERSEL AFFECTING PRIMER INDENT. IF WE INSTEAD CONCENTRATE ON THE "DAMPING" TERM (ESSENTIALLY THE FRICTIONAL LOSSES

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James M. Dunbaugh
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SF THE SYSTEM) AND WAYS TO REDUCE ITS AFFECT ON THE SYSTEMS BEHAVIOR, I BELIEVE WE WILL HAVE A POSITIVE EFFECT ON REDUCING LOCK TIME WHILE MAINTAINING ACCEPTABLE PRIMER DENTING.

KNOWING THAT THE DAMPING ACTS TO OPPOSE MOTION, THE EQUATION CAN BE RESTATED CONCEPTUALLY AS:

MAIN SPRING FORCE - FRICTIONAL LOSSES = ACCELERATION OF FIRING PIN

WHAT ARE THE SOURCES OF FRICTIONAL LOSSES IN THE SYSTEM? THEY CLUDE:

- FRICTION BETWEEN THE FIRING PIN HEAD & SEAR AT THEIR INTERFACE
- FRICTION BETWEEN THE FIRING PIN & BOLT PLUG
- FRICTION BETWEEN THE MAINSPRING & I.D. OF THE BOLT DUE TO SPRING BUCKLING.
- FRICTION BETWEEN THE FIRING PIN TIP & FIRING PIN HOLE IN THE BOLT HEAD
- FRICTION BETWEEN THE FIRING PIN SHOULDER AND BOLT I.D.

EDUCING FRICTIONAL LOSSES IN THESE AREAS THROUGH THE USE OF COATINGS OW FRICTION) AND; PART GEOMETRY TO CONTROL FITS, AND NEW COMPONENTS g. LINEAR BEARINGS) SHOULD YIELD FASTER LOCKTIMES WITH ACCEPTABLE INDENT REPEATABILITY

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James H. VanDamme 10/13/97 Signed Date

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