EXPERIENCES
IN THE
DESIGN & MANUFACTURE
OF
SHOTGUNS & RIFLES

REMINGTON

DUPONT

Bridgeport, Connecticut, U.S.A.

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FOREWORD

The information compiled herein represents the contributions of many individuals of long service and varied experience in our organization. It comprises certain factual data based on analyses of our past experiences in the manufacture of shotguns and rifles and the performance of those weapons in the hands of our customers.

We believe that our employees are just as anxious as Management for maintenance of the quality, usefulness and economic value of our products. To develop and hold high quality standards we all recognize that we must practice constantly the habit of accuracy and thoroughness. Loose inspections and inattention to details are bound to lead to a minimum of good quality which in turn reduces our sales and affects the economic stability of the organization. The quality of our products must exceed that of our competitors at all times as our ultimate customers not only determine if our product is acceptable, but; of more importance, whether or not we stay in business. Therefore, in the manufacture and assembly of component parts for our shotguns and rifles we must maintain a quality consciousness which will ensure the contribution of good workmanship on the part of all members of the organization as they perform their daily tasks.

The recording of good accomplishments along with the focusing of attention upon existing weaknesses should serve as a guide or reference for those who assume the factory tasks as replacements in production during future years.

Now that war work is discontinued, if we can visualize our customers in place of Government inspectors awaiting our products for test and acceptance, we will go a long way toward building up an army of satisfied users of Remington Sporting Arms with attendant benefits toward our economic security.

Therefore, we are confident that all will unite in efforts to bring about new developments and improved designs combined with accurate fabrication and proper assembly so that Remington Quality may be maintained at a level unsurpassed in the industry.

W. L. Clay
Manager of Quality

COMMERCIAL ASPECTS OF DEFICIENCIES IN DESIGN

As a prelude to the discussions herein, we want to emphasize the decided effect on sales when firearms are placed on the market and develop deficiencies in functioning in the hands of the customer.

A few striking examples are listed herewith:

MODEL 14:

Just prior to 1912 Remington was selling the Model 8 which had been introduced in 1906 as the first American Autoloading Sporting Rifle and furnished in .25 Remington, .30 Remington, .32 Remington and .35 Remington calibers. A rifle of low cost was needed to meet the serious competition of competitors' lever action rifles which far out-sold the Remington Model 8. With this objective in mind, development was undertaken on a slide action centerfire rifle to be known as the Model 14. Considerable time was taken in its development and tooling; which during that period was an expensive undertaking. In 1912, the Model 14 Pump Action Hammerless Repeating Rifle was introduced in .25 Remington, .30 Remington, .32 Remington and .35 Remington calibers. It was enthusiastically received. During the first two years sales probably came up to expectations. However, a defect in the fire control mechanism was uncovered in the hands of customers with some unfortunate results. The rifle promptly got a "black eye" and failed to register customer acceptance. Sales dropped off seriously and the fire control mechanism had to be re-designed in order to overcome the defect. While sales were maintained at a moderate level for a few years, afterwards they dropped to a very unsatisfactory level and even after the gun was partially redesigned in the form of the present Model 141, the volume of sales was far below the level which had been expected with the result that competitors' lever action rifles continued to dominate the field. At the present time, over thirty years after the initial introduction of the rifle, it still lacks customer acceptance in certain sections of the country in spite of the fact that the principal faults in the mechanism were corrected many years ago.

This lack of customer acceptance is so serious that it is quite difficult to sell this rifle in certain sections of Canada and the Rocky Mountain territory in the United States and the unfavorable reputation of this one model reflects adversely on the sale of other Remington centerfire rifles and other Remington firearms in general in those markets and elsewhere where such reputation still persists.

This is an outstanding example of a heavy expenditure in the development and tooling of a new rifle which proved to be

a liability to the company rather than an asset and resulted in the company's failure to attain a satisfactory competitive position in this field over a period of approximately thirty years.

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Another example is set forth herewith:

MODEL 31:

The company's competitive position in the sale of slide action shotguns has never been satisfactory. A competitor's model commanded a very large portion of the market. In an effort to improve the company's position, the Model 29 was introduced in 1929 to replace the improved Model 10. Results were only mediocre. In 1931 the Model 29 was discontinued and replaced by the Model 31. Results again were quite mediocre and even in the early years of sale at which time any new model normally enjoys a large volume, the sales were very small and began to go downward.

A careful analysis of the situation a few years after the introduction of the Model 31 disclosed the fact that the weapon was developing an unfavorable reputation particularly among trap and skeet shooters who stated that the gun was slow in firing, thus causing flinching to an extent that many shooters refused to use it because they said it gave them bad shooting habits.

A check of the gun disclosed that the time required for the hammer to strike the firing pin was approximately .012 of a second which was longer in time than most of the similar types of this gun on the market. A redesign of the fire control mechanism corrected this difficulty and made the timing shorter than the majority of guns of this class on the market. However, the gun had received a "black eye" and sales did not improve appreciably. Other changes in the design were required, notably the repositioning of the trigger and strengthening of the action bar. Still the sales did not improve appreciably even though it was felt that the gun was probably the finest available for sale.

During the war the improved Model 31 has proven conclusively through its excellent services at training centers of the Army and Navy that it is an excellent gun and will probably now take its proper place in the competitive field so that the unfavorable reputation previously established may be overcome. However, if it had not been for the war, it is quite possible that the customer resistance to the gun might have continued and it would never have attained the reputation and position in its competitive class which it has now established.

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Another example of a fault which reduces customer acceptance and in turn lowers the sales volume is the following:

MODEL 720 (Model 30):

Misfires attributable to gun design have appeared in this model. The original Model 30 was practically free of this fault. As the 720 was developed by remodeling the Remington Enfield Military Rifle, the firing mechanism was completely copied. It employed the full length of the cocking stroke of the bolt handle uplift plus the final closing resistance when the cocking piece met the sear. This resistance was objectionable to many customers and the bolt mechanism was redesigned along the lines of the Springfield Rifle having the cocking fully accomplished by the rotation of the bolt.

A faster lock time was desired by all shooters. Accordingly, the firing pin travel was shortened which resulted in less energy being delivered by the blow on the primer and misfires resulted. When a stronger main spring was used the arm was hard to cock. The firing pin which had a long heavy body was lightened by milling grooves lengthwise in it at the same time the strength of the main spring was reduced. The main spring tension, the firing pin weight and the length of the cocking stroke were all on a very narrow margin of balance and some misfires were still liable to occur. Here again, our sales have suffered in the centerfire rifle line through a reputation for misfires built up by this particular change in design.

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Sometimes an arm may develop weaknesses or deficiencies through very heavy and constant use far beyond that normally expected in the hands of the customer. For example, we quote herewith certain experiences with our autoloading centerfire rifle:

MODEL 81:

As stated previously under the Model 141, the Model 8 was introduced in 1906 as the first American autoloading sporting rifle. The Model 81, an improved model containing changes in the stock and the addition of a semi-beaver tail fore-end, was produced in 1937. The Model 81 was also furnished for the .300 Savage Cartridge in 1940. This gun enjoys an excellent reputation in the field and is outstanding in its class. However, a review of the files of the Products Committee discloses that the one-piece firing pin with which this arm was originally supplied was given to excessive breakage. Prior to January 15, 1942, a survey was made which indicated that over a five-year period average sales for replacements of the firing pin were 957 pieces per year. This situation prompted the development and adoption of a two-piece firing pin. This two-piece firing pin when subjected to heavy duty and constant usage has not

proven satisfactory. It was possible by incorrect assembly after the weapon left the factory to fire the gun before the action was securely locked in place. Combined with these deficiencies of the two-piece firing pin were reports from the F.B.I. that complete separations were obtained in firing .30 Remington ammunition in the Model 81 as supplied. As a consequence, a comprehensive check had to be made not only pertaining to the functioning of the gun but also with respect to the processing of the ammunition. As a result, a newly developed one-piece firing pin has been supplied which has given satisfactory service to date while changes in the processing of the .30 Remington cartridge case has eliminated the cut-offs which previously developed.

In the main, however, the Model 81 is probably the leading autoloading centerfire rifle on the market and should give excellent performance when utilized under normal conditions. This case is set forth to illustrate not only the great care which must be taken in changing functioning parts of a gun but also the necessity for the proper functioning of all cartridges in any weapon designed to accomodate the same.

MOST PREVALENT MALFUNCTIONS

The things that can be wrong with a gun at the assembly operation and during testing are numerous. For instance, the breech may assembly loosely, shells fed from the magazine may "stem" on the chamber, that is the end of the shell or cartridge does not enter the chamber cavity but strikes on the edge of the barrel. Sometimes the safety mechanism will be finished so that the trigger can be pulled oven though the safety is in the "safe" position. At other times, the safety will stay "on" or jar "on" so the gun cannot be fired when expected to fire. The mechanism occasionally will not unlock after the gun is fired. The ejecting mechanism may fail and the fired shell will not eject. Repeating or autoloading guns sometimes will drop a loaded shell or cartridge instead of feeding it into the chamber. Guns will sometimes fire on closing. They will occasionally "double" or "repeat", that is both barrels of a double barreled shotgun will fire simultaneously or two or more shells from an autoloading gun will fire when the trigger is pulled but once. Sometimes shells will catch in the feeding mechanism. The block may lock open with a shell on the carrier. The gun may not stay locked with a shell in the chamber caused by the breech block rebounding out of position. Misfires caused by a weak blow or other defect may be prevalent in a new arm from the assembly line. A new gun with all parts intact will occasionally "jar off" if it is struck a sharp blow or dropped a short distance and allowed to strike on the butt plate. The magazine follower may be stuck so that it does not release shells from the magazine to the feeding mechanism. Magazines may be too wide and allow wedging of the cartridges. The trigger pull may be too light so it is dangerous or too heavy and thus objectionable to the

shooter. The parts being new may not move as freely as they should, so the gun loads hard and functions stiffly. The firing pin may bind or may stick in any one of several positions and not retract. These defects and more must be the constant concern of operating personnel in an arms factory.

Some special defects inherent within arms of various kinds deserve special comment.

BREECH MECHANISM FAILURES:

All modern guns are the so-called breech loading type and they are all equipped with some kind of mechanism to hold the barrel and its breeching unit together. One of the most common designs makes use of a bolt or breech block for this purpose. The bolt or breech block may be locked in position by a barrel extension or held in place by a recoil shoulder in the receiver. Any failure in these parts during firing is serious. The breeching mechanism will be blown rearward violently while the shell or cartridge is at or near its maximum pressure. The projectile will leave the muzzle of the gun at approximately the same time the fired shell or cartridge case is blown out at the breech. Residual pressure usually ruptures the cartridge case releasing a considerable volume of hot gas and scattering burning grains of powder. The effect on the shooter is startling. In the case of a right-handed shooter it seldom causes a personal injury as the guns are designed with ejection ports on the right-hand side. Some left-handed shooters have been the victims of personal injury from this type of accident. Damage to the arm usually consists of a swollen receiver and broken feeding parts. It can be minimized in manufacture by using steels of appropriate structure and parts of correct design. There is no cure for the effect of this kind of accident upon the shooter.

SAFETY DEVICES:

Some mechanical safeties previously employed were so designed that the user of the gun would occasionally pull the trigger while attempting to "put on" or "take off" the safety. This was a former weakness in the Model 11 Shotgun, also in the Model 29 (Model 10). In both guns the former safety was located just in front of the trigger. It was a sliding unit which was pulled to the rear to lock the action or put the gun on safety, and was pushed forward to the firing position. Occasionally a shooter in attempting to put the safety "on" would allow his finger to slip off of the safety and strike the trigger, thus discharging the gun accidentally. It was also possible accidentally to discharge the gun while pushing the safety from "safe" to the firing position. Men with large fingers or wearing gloves could strike the trigger just to the rear of the safety with sufficient force to fire the arm. The effect of the accidental discharge of a high powered rifle or a shotgun is dangerous and annoying. It is sometimes accompanied by personal injury either to the shooter or

to adjacent bystanders. The shooter, of course, will invariably blame the arm.

In several instances this deficiency was overcome by changing the design of the safety to a cross bolt at the rear of the trigger guard.

ACCIDENTAL FIRING BY CLOSING THE ACTION:

Gun designs have been such that breakage or dirt could contribute to the accidental firing when the action is closed with no pressure of any kind placed on the trigger. This can happen if a firing pin breaks or if the firing pin becomes sufficiently fouled with dirt so that it is held in the forward position. Accidents of this type have occurred. In general, they have been caused partly by the use of carbon steel which was too brittle in quality and partly by the design of the firing pin. In the Model 11 Shotgun the former firing pin was a fairly heavy mass of steel at the rear end with a long slender forward portion. This design resulted in more or less frequent breakage, leaving the forward portion of the firing pin stuck fast in the breech block and protruding from the face sufficiently so that when the breech block was closed rapidly upon a loaded shell a premature firing could take place. The firing usually occurred before the breech was securely locked and resulted in a burst head on the shell, a considerable amount of noise at the chamber end of the barrel and a startled shooter. The damage of prematures was minimized by changing the design of the firing pin, using a tougher steel and adding a retractor spring.

FIRING BY "JAR OFF":

We have often noticed soldiers executing the command of "Order Arms". During such performance the butt plate strikes the ground at their feet and the barrel extends upward adjacent to the body. Hunters in the field frequently will rest a gun on the butt plate with the barrel pointed in any direction. Strangely enough the design of some guns has been such that this jar on the butt plate was sufficient to fire them. One model developed this defect. It was caused by the sear being out of balance to the point where an external jolt on the butt plate would cause it to slip out of the full cock notch. The difficulty was eliminated by changing the design of the parts and adding safety hooks to the firing pin and trigger which prevented the fall of the firing pin when the trigger has not been pulled. This type of accident gives the shooter a scare even though it is not accompanied by personal injury.

There have been enough gun accidents in the past to acquaint the American public with the constant danger accompanying the use of firearms. The more a shooter knows about arms and ammunition the greater is his pleasure in their use and his respect for their potential dangers. A gun which will fire by "jar off" will check the confidence of any shooter from the hardened and experienced lifetime hunter to the farmer boy who is out on his first hunting trip.

DEVELOPMENT AND MANUFACTURE OF A MODERN RIFLE OR SHOTGUN

With the foregoing difficulties in mind, what can we do to improve our products and avoid similar defects in new designs?

The preparation of a new model rifle or shotgun should be divided into the following stages: designing, preparing model, testing and perfecting model, production of samples for field tests, correcting designs as result of field tests, tooling up, and getting into quantity production.

Before starting the design work, a decision must be reached as to the cartridge the gun is to handle. A cartridge of new design and consequently of small distribution, adversely affects the sales volume of the gun. The greater the popularity of the cartridge, the better chance the gun has in a highly competitive field.

With this point settled, the general type of the gun is taken up, whether it is to be bolt action, slide operated, lever operated or autoloading. This is governed by a study of the competitive field unless an idea has been worked out which has enough original and novel features to make this unnecessary, or unless there is a definite need for a certain gun in our line. An example of this last was the development of the Model 31 Shotgun as we had only the Model 29 gun to compete with the Winchester Model 12.

In selecting the type of action we have several from which to choose:

THE BOLT ACTION:

This type is too well standardized to permit of much originality in design. It is one of the oldest actions made and is known for its strength, dependability, and accuracy when properly produced. Some trouble has been experienced when using rim shells due to a condition known as "rim lock" where the head of the shell sticks in the bolt recess. The Enfield, as made by Remington during World War I, is probably the best of the bolt actions, and with alterations has been used in bolt action sporting rifles. One of its outstanding features is the convenience of the safety and there is also a camming action of the bolt lugs in seating the shell.

THE SLIDE ACTION:

One of the earliest types of slide action was the Colt Lightning Rifle brought out in 1885. It met with considerable success, about 90,000 being made. Practically all the earlier slide actions were made for rimfire ammunition, Remington being the first to make a successful high power rifle of this type.

One of the points to be considered in designing a slide action gun is the danger of shells exploding in the magazine (tubular). There is little danger of this in shotguns but it is present in high power rifles particularly with pointed bullets. Remington overcame this by rolling spiral grooves in the magazine, throwing the nose of the bullet out of line with the primer in the cartridge ahead. In the rimfire rifles this condition can be caused by a jam in the action bar or the transferring mechanism.

Another danger is a hangfire condition. If the shooter is pulling rearwardly on the bore-end at the time the trigger is pulled, the action will open and the cartridge may explode just outside the ejection port endangering the shooter's eyes or hands.

All slide actions should have a means of preventing the gun from firing if the trigger is pulled back at the time the action is being closed. Remington guns all have a means to prevent such firing.

Rattle from loose fore-ends should be held to a minimum. It is objectionable from a sales angle but the fore-end must be loose enough to work freely. It is well to remember that in damp weather the fore-end, if fitted closely, will swell enough sometimes to bind the action.

AUTOLOADING ACTION:

Remington, in Caliber .22, uses the straight "blow back" type of action only. This has proven successful with us and is employed in the Model 241 and the Model 550. It was also used in the Model 16 now obsolete.

This action utilizes a fixed or stationary barrel, a rearwardly moving breech block operated by the recoil of the cartridge which ejects the fired shell, cocks the firing mechanism, compresses the action spring and, on its forward motion, takes the loaded shell from the magazine and feeds it into the chamber.

In designing an action of this type care must be exercised to have the breech block or bolt of sufficient weight so that the inertia will prevent a rearward movement of the fired cartridge in the chamber until the pressure has dropped to a point where it will not produce bulged or blown out rims. A cartridge case head blowout is dangerous to the shooter or bystander and bulged rims make extraction and ejection difficult, as the best possible extraction and ejection are mandatory in autoloading guns.

The trigger mechanism must be such that the rifle cannot be fired until the breech block or bolt is in its fully locked position. This is to prevent firing in case the breech block or bolt has rebounded or failed to close fully.

The firing pin blow is important as a weak blow may give hangfires or imperfect ignition often resulting in the bolt being started back and full pressure not developing until the shell is partly out of the chamber.

The balance between springs and pressure is very important as an autoloading .22 Caliber rifle is called upon to handle a number of different kinds and makes of ammunition with widely differing pressures.

Proper heat treatment of the bolt face and breech end of the barrel is important as the continued impact of the bolt against the barrel requires a good depth of case hardening plus a stiff core to prevent deformation.

THE RECOILING BARREL TYPE OF AUTOLOADING GUN:

This is, so far, the most successful type of sporting "high power" autoloading arm and is the type used by Remington. It was developed by John Browning. In this gun the barrel and breech block recoil or move rearwardly as a locked unit in the meantime compressing a heavy recoil spring and the action spring. During this time and before the action becomes unlocked, the pressure of the gas has spent itself in propelling the charge; When the locking block is disengaged from the barrel extension, which is attached to the barrel, the recoil spring forces the barrel forward, extracting and ejecting the fired shell. Here, we must be sure that the ejected shells are not thrown backward so as to strike the face of the shooter or burn him in any way. When the barrel has reached its forward position; the breech block moves forward under pressure of the action spring, removes a shell from the magazine to the carrier and places it in the chamber and locks itself to the barrel extension. The gun is then ready to fire. While the preceding principle is the one on which a gun of this type works, the description is necessarily sketchy.

In the shotgun there are a number of movements which must take place in their proper sequence and all within a small fraction of a second or the weapon may fail or jam. In other words, proper timing is paramount in this type of gun.

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With the type of action decided upon, layouts are made to determine the shape and size of the components required for the functioning of the mechanism. Special attention should be given to the weight of the completed arm and the outline or its finished appearance.

The weight is more or less established by convention. For instance, it is generally conceded that a 12 gauge shotgun using 3-3/4 dram loads should weigh around 7-1/2 pounds. In a gun much lighter than this, the recoil is objectionable. This is an instance where a good selling point should be weighed against satisfied users.

As appearance, lines, balance, weight, all affect the sale of the gun, a great deal of attention should be given them by the designer. The customer buys the gun if in his opinion it looks and feels better to him than a gun of the same class and price range made by one of our competitors. He takes for granted, if the gun is made by Remington or other reputable producers, that the parts inside will be properly made, that the gun will function and will shoot straight. One exception to this, of course, is the boy whose father and perhaps grandfather shoots a certain make of gun so that "What is good enough for his father and grandfather is good enough for him".

Proper attention having been given to the appearance, etc. of the new gun; careful consideration must be given to reliability of functioning, shape of the component parts in regard to strength and cost of machining, etc.

With the design completed, the manufacturing or processing engineers should come into the picture for their opinion on the practicability of the limits established, and for their advice as to the cost of the component operations. The Metallurgical Department should then establish steel specifications and heat treatments for the various components.

The model is then started and when completed it is given a thorough try-out and corrections or alterations made where necessary. The model is then given thorough shooting tests and when these are completed it is disassembled, all parts examined for evidence of undue wear or lack of endurance and corrections made where necessary. If it can be arranged, it is best to prepare about twenty of the new weapons so that comprehensive field tests can be made by different personnel. These tests often bring out deficiencies not uncovered in checking the model and give greater assurance that all deficiencies have been eliminated before the new design goes into production. It is always good practice to have thorough tests made on the new weapon by personnel other than the one or ones directly responsible for the design and development. Machinery layouts, operating sequences, and material specifications are then prepared.

At this point an estimate of the cost of manufacture is made and submitted to Management and if satisfactory, tooling is then started and when completed a "pilot" lot (perhaps 500) is started through the Plant. When the component parts reach the Assembly Department special attention is given to the assembly of parts with a minimum of hand fitting and also the difficulties or deficiencies encountered at the various inspection points and finally the appraisal of the shooting test. The purpose of putting through this pilot production lot is to discover any "bugs" missed in the model and to check for an accumulation of limits in any one direction causing an interference and also to find out whether our machining limits are too loose or too tight. When satisfied that

everything is all right, the actual commercial production may be started.

RULES APPLYING TO ALL TYPES OF ARMS

GENERAL RULES:

The gun must be safe. It must withstand a free fall of about 6", striking on the butt. A new model must be tested for "jar off" in various ways as sometimes a slight blow on top of the receiver or butt stock will cause the notches to separate resulting in a jar off. There have been cases where closing a slide action gun too hard would give the same result.

A careful study of the distribution of the weight of the hammer, sear and trigger, the angle of the notches, distance from pivot points, etc. should be made to forestall this condition. Retraction should be insisted on, that is, if the trigger is partially pulled and then released, the notches should return to full engagement.

The shape of the firing pin should be studied to provide against breakage which frequently is caused by metal fatigue aggravated by vibration. This generally is the result of "dry" firing (no shell in chamber).

The strength of the firing pin blow should be established by the depth of the impression made in a standard copper crusher. In the past there have been too many cases where this has been ignored in order to obtain easier functioning. The result has been complaints of misfires with ammunition having primers less sensitive than our own, yet possibly within the accepted range. This is a source of constant annoyance and expense.

The extractor should be of such design that it does not depend on a high degree of sharpness of hook for positive extraction. A sharp edge quickly becomes dull with use especially with steel shells.

Particular thought should be given to the best means of attaching the butt stock to the receiver. This is important as a slight deviation from the correct angle of attachment will result in split or chipped stocks at that point. The earlier issue of the Model 31 is an example.

Simplicity of design should be constantly kept in mind, and any design involving complicated machining operations should be avoided. In the development of a new weapon, components should be studied with a view of maximum interchangeability with parts of weapons already approved for manufacture. Also, the effect of heat treatments should be given attention as corrective measures made necessary by warping during heat treatment are often very expensive.

SPECIFIC RULES:

Control of Feeding.

Desirable way - A carrier having a transverse, horizontal pivot located in its rear portion and passing through the receiver (as in Model 31 having trunion pivots in each side wall of receiver) as far rearward as possible in the receiver; to allow for passage of the breech block between the carrier side arms. This arrangement provides a long easy slope for the cartridge moving rearward from the magazine, then when the carrier is lifted by cam action of breech block, the cartridge is presented in the rear of the barrel chamber in a nearly horizontal plane for easy entrance.

Undesirable way - Where the cartridge is lifted by a very short carrier to move the cartridge vertically through a T-slot in the action bar and into a similar T-slot in the face of the breech block. In this case the guidance and control of alignment of the cartridge depends upon the accuracy of fitting of the cartridge head within the T-slot. Too much freedom allows side sway of the front end of the cartridge which may not enter the barrel chamber properly and cause a jam in feeding.

Stationary Magazine for Tubular Magazine Guns.

Desirable way - Magazine tube screwed rigidly into the receiver, thereby furnishing a firm support for the action bar and detachable barrel.

Undesirable way - Magazine tube moveably mounted in the receiver to slide longitudinally in the receiver, the tube screwed rigidly into the action so as to move with the action bar. This motion of the tube causes the cartridges contained therein to shuttle back and forth, having a tendency to deform the soft points of the bullets.

Ease in Loading (Single Cartridge into Chamber).

Desirable way - Easy access through the side ejection port in receiver as in Models 11 and 31.

Undesirable way - Wherein a single cartridge must be carefully passed through a deep slot in the bottom of the receiver during which motion the cartridge is liable to tilt out of proper alignment and become jammed.

Safety of Fire Mechanism.

Desirable way - A simple arrangement of hammer, trigger and safety sear as in the Model 11 where the trigger holds the hammer at full cocked position until the breech block is fully closed and locked after which the trigger may then be pulled to

fire the gun. Also, as in the Model 31 where the trigger is prevented from being pulled by a trigger lock until after the breech block is fully closed and locked by the action bar lock.

Undesirable way - The hammer or the firing pin which has been brought to the fully cocked position by opening motion may be released by pulling the trigger during the closing motion and before the breech block is fully locked. Also, in weapons wherein it is necessary to release the trigger during the closing motion of the breech block. This requires very accurate workmanship to adjust the sear lock to prevent pulling the trigger before the breech block is fully closed and locked.

Mechanical Safety.

Desirable way - A device which will securely lock the trigger and the breech block in closed position. Also, a device which will securely lock the trigger or sear when breech block is fully closed and locked as in Model 11 and Model 31.

Undesirable way - A device which will lock the trigger but not lock the sear against "jar off".

Use of Springs.

Desirable way - Coiled springs are almost universally made of music wire which provides a most convenient source of material used in so many diversified products and is of a reliable quality. It can be fabricated conveniently at lowest cost without heating and tempering. It is also most reliable and durable and less liable to change or break during use.

Undesirable way - Flat or leaf springs are still used in some models simply because they were included in the original design of these models and a change by redesign to use of coiled wire springs would entail a great expense in equipment. Greater care is required in the manufacture of flat springs than in coiled springs because of proper shape and finish plus proper hardening and tempering. Also, the flat spring is more liable to weaken or break during use.

Another point of great importance and value is the greater convenience of coiled springs in designing the mechanism.

Breech Locking of High Power Rifles.

Desirable way - As in a military bolt action rifle where the bolt locking lugs are arranged as closely as possible behind the cartridge head and are of equally balanced strength to prevent tilting or swaying of the cartridge. It has been proven by accurate tests of rifles having locking lugs of uneven or unbalanced strength that bending or whipping of the barrel throughout its length may

result and cause inaccurate shooting. This type of front end of bolt locking is embodied in Models 81 and 720. Another model of this type having only one locking lug is not considered equal to the Models 81 or 720 for the reasons above mentioned.

Interchangeability of Design Changes.

Desirable way - Changes in design from the original plan as first produced, usually to obtain lower cost or to improve functioning of the mechanism. Such changes in design should make possible a substitution of the newly designed parts in place of the original parts without any alteration of the other existing parts of the gun. This is illustrated by single and double triggers - Model 32 and firing pin Model 32.

Undesirable way - Changes in design which require alterations in the other parts of the mechanism to make possible the inserting of the newly designed parts.

Fixed Trigger Pull.

Desirable way - A design employing a rotating hammer with a direct connected trigger having no intermediate part such as a sear. This is illustrated in Models 11, 31, 81 and 121.

Undesirable way - A design employing a rotating hammer, an intermediate sear and a trigger and/or a design having a firing pin with main spring attached, an intermediate sear and trigger. The objection to this is that when a sear is arranged intermediately between the hammer or firing pin and the trigger, the accumulated tolerances of manufacture cause too much lost motion or back lash when the trigger is pulled, thus resulting in a long drag or creepy pull. These conditions generally develop in manufacture and do not show up in the pilot model.

Trigger and/or Sear Movement and Lock Time.

Desirable way - A design of fire control which has the simplest and most direct correlation between hammer and trigger is considered the most desirable and least liable to change after proper assembly due to influence of wear and the accumulation of corrosive powder residue. Some devices are designed to adjust themselves automatically for accumulated looseness or back lash due to manufacturing tolerances. These usually consist of a simple spring arranged to take up looseness such as difference in diameters of a hole; and a pivot pin as illustrated in the Model 513T trigger and sear, wherein the trigger spring urges the sear into full cock notch and a take-up spring moves the sear pivot, fixed stationary in the sear, to contact the pulling side of the hole in the trigger, thus eliminating all back lash and ensuring a crisp trigger pull.

Lock time is a term used to indicate the interval of time between release of the trigger or sear until the firing pin strikes the primer. Tests have proven that a slow heavy blow may have enough force or momentum to indent the primer, but due to slow speed will not fire the primer; but if a lighter weight firing pin is driven forward at a much higher speed, the primer will fire. Beyond the point of attaining enough speed surely to fire the primer, excess speed is preferred by only "Bug Target Shooters".

Undesirable way - A design of fire control which has more complication, using more parts and causing more points of connection which build up an accumulation of manufacturing tolerances causing more back lash resulting in a long drag in trigger pull which is more liable to change during use. Another point, is the fact that when the trigger is pressed during the closing motion of the breech block, the tail end of the sear is brought into contact with the trigger. This pressure on the trigger must be released before the breech block will fully close. This is very objectionable because the exact difference between sufficient release of the trigger and the final pull off is very close and may at times cause premature firing.

INSPECTION OF SHOTGUNS AND RIFLES

Inspection procedures should be examined carefully to insure that they include a check for each of the following:

Is the gun safe?
Do any of the parts show undue wear in firing?
Is the extractor properly made and does it function correctly?
Is the butt stock correctly attached to the receiver?
Is the breech tight?
Do shells or cartridges stem the chamber?
Can you pull the trigger with the safety "on"?
Will the safety "jar on"?
Does the gun unlock after the hammer falls?
Do fired shells eject properly?
Will the action drop a loaded shell?
Will the gun fire on closing?
If a double barreled gun, will it double?
If automatic, will it "repeat"?
Do shells catch in the feeding mechanism?
Does the bolt lock open with a shell on the carrier?
Does the breech block rebound?
Will the gun misfire?
Can it be made to "jar off"?
Do shells release properly from the magazine?
Do shells wedge in the magazine?
Is the trigger pull too light?
Is the trigger pull too heavy?
Does the gun load hard?
Does the gun function stiffly?
Does the firing pin bind or stick in any position?

In addition to the checks which may be prescribed by present inspection procedures, it is important that we take cognizance of complaints received during the past to insure that weapons leave the factory in a satisfactory condition.

SHOTGUNS

MODEL 11 AND SPORTSMAN - 12, 16 AND 20 GAUGE:

Is the guide ring loose?
Is the stock checked?
Is the fore-end checked?
Is the carrier latch out of adjustment?
Is the cartridge stop out of adjustment?
Does the carrier dog hold?
Does the extractor hold shells?
Are the receiver cushion and rivet loose?
Does the gun fail to lock back?
Does it fail to feed?
Are the guide grooves in receiver too thin?
Is the compensator out of line?
Are the carrier screw threads stripped?
Is the barrel properly aligned?
Is the carrier bent?
Is the sear out of adjustment?
Is the barrel extension loose?
Does the gun fail to eject?
Do the shells stem the chamber?
Does the tang screw hold?
Is the front sight base off center?
Is the magazine stop screw too long?
Is the sear too short?
Does the gun load hard?
Can you get doubles with the gun?
Does the block bind?
Are the cuts in safe out of position?
Does the barrel bind?
Is the compensator bushing loose?
Is the locking block latch too long?

MODEL 31 - 12, 16 AND 20 GAUGE:

Is the trigger lock out of adjustment?
Does the gun misfire?
Is the cartridge stop properly adjusted?
Is the main spring follower out of the housing?
Does the gun drop shells?
Does the action bar lock hold?
Is the barrel loose?
Is the barrel locking stud broken?
Is the trigger pull too heavy?
Is the barrel adjusting bushing loose?

Does the barrel adjusting bushing lock hold?
Does the hammer link jump out?
Is the nib loose on the action bar?
Is the extractor pin hole out of position?
Is the magazine loose?
Is the carrier out of adjustment?

MODEL 32 - OVER-UNDER:

Is the single trigger out of adjustment?
Does the gun fail to eject?
Does it cock properly?
Does the gun double?
Is there too much play on the safety?
Does the gun fire on closing?
Does the top lever plunger slip out?

PARKER:

Does the gun "jar off"?
Is the single trigger out of adjustment?
Does the action open hard?
Is the selector properly adjusted?
Does the gun fail to eject?
Does the safety hold properly?
Does the gun double?
Is the extension rib loose?
Do the fore-end and stock match?
Is the recoil pad properly fitted?

CENTERFIRE RIFLES

MODEL 81:

Does the indicator jump on?
Does the magazine retainer stay in adjustment?
Does the action lock back?
Does the barrel extension work loose?
Is the safety out of adjustment?
Is the front sight base out of line?
Does the action jam?
Does it fail to extract?
Does it fail to feed?
Is there a loose fit between barrel nut and jacket bushing?
Does the firing pin bind?
Does the bolt close hard?
Is the magazine side pin missing?
Is the front sight slot crooked?
Is the barrel lock spring broken?
Can the gun be fired without the action being locked?
Is the bolt carrier latch broken?

MODEL 141:

Is the magazine ring loose?
Is the guard loose in the receiver?
Does the gun fail to feed?
Are the sights out of line?
Are the cartridge stops out of adjustment?
Does the gun load hard?
Does the gun fail to eject or extract?
Does the sear lock hold?
Is the magazine tube pulled loose?
Does the gun "jar off"?

MODEL 720:

Does the gun misfire with any brand of ammunition?
Does the gun fire when the safety moves off?
Is the action properly bedded?
Is the front sight ramp machined properly?
Does the bolt strike the follower?
Does the gun fail to eject?

RIMFIRE RIFLES

MODEL 510:

Does the firing pin follow down?
Is the firing pin and sear adjustment functioning properly?
Does the gun fail to eject?
Is the bolt handle loose?
Is the rear sight set too low?
Is the barrel pulled away at receiver?
Does the gun pull off on safe?
Is the front sight loose?
Is the firing pin too long?
Does the gun fail to extract?
Does the bolt pull out?

MODEL 511:

Does the chamber permit shells to swell?
Does the gun fail to eject?
Does the bolt pull out?
Is the sear pivot screw loose?
Does the trigger pull properly (poor sear notch)?
Does the gun fail to extract?
Does the firing pin follow down?

MODEL 512:

Does the gun fail to feed properly?
Does the bolt pull out?

Does the gun "jar off"?
Does the gun fail to eject?
Does the firing pin follow down?
Does the barrel pull out of the receiver?
Do the shells jump the cartridge stop?
Does the gun fail to extract?
Are the rear sight holes out of position?
Does the gun pull off on safety?
Do the shells jump past the retainer?

MODELS 513 S and T:

Is the ejector properly adjusted?
Does the bolt pull out?
Do the shells stem the chamber?
Is the bolt handle loose?
Does the firing pin follow down?
Is the trigger pull properly adjusted?

MODEL 550:

Does the gun fail to eject?
Does the magazine unlock?
Does the gun "jar off"?
Does the action jam?
Does the gun fail to feed?
Do the shells catch in the insert?
Does the extractor hold the shells?
Does the bolt fail to close?
Does the extractor bind?
Does the gun fail to cock?
Does the trigger bind?
Is the recoil chamber chamfered too much?
Does the firing pin strike side of chamber?
Is the rear sight out of line?
Is the carrier out of adjustment?
Is the rear sight loose?
Are the trigger and sear out of adjustment?
Is the magazine ring loose?

MODEL 37:

Is the trigger out of adjustment?
Is there too much play in the windage yoke?
Is the trigger pull too light?
Does the receiver sight work loose?

MODEL 121:

Does the gun feed properly?
Is the carrier dog spring broken?
Are the sights in line?

Is the guard cracked at the trigger bushing hole?
Does the gun fail to eject?
Is there a poor fit between guard and receiver?
Do the cartridges stem the chamber?
Does the gun misfire?
Does the action fail to lock?
Are the cartridge ways in block too wide?
Does the take-down screw pull out?
Is the guard loose in receiver?
Does the gun cock hard?
Is the sear lock out of adjustment?

MODEL 241:

Has the proper firing pin been assembled in the gun?
Is the guard loose (shells jump out)?
Does the gun fail to feed?
Does the gun fail to extract?
Does the gun fail to eject?
Are the trigger, disconnector and scar adjusted properly?
Is the front sight slot out of position?
Is the sear pin loose?

APPENDIX

HISTORICAL BACKGROUND

RIFLES AND SHOTGUNS

GENERAL:

When the first breech loading guns were made, both shotguns and rifles, they were the result of inherent craftsmanship on the part of the maker. Little was known about metallurgy and precision equipment was almost non-existent. Parts were made and fitted by hand to any design which pleased that particular gun maker. Regardless of these shortcomings, many of the old arms were extremely accurate and showed fine workmanship. Too many of these old guns were handed down from father to son and used until they broke down. Fortunately for the shooting public, when these guns failed, only rarely were serious personal injuries involved.

In more recent years, the public demand for greater power, more speed and longer range resulted in the development of progressive burning smokeless powders. These powders do not necessarily develop higher maximum pressures than the first smokeless powders, but the pressure is sustained over a longer period of time and any combination of powder and projectile which imparts a greater energy to the projectile must of necessity place a greater strain upon the arm. Hence, if we increase the muzzle energy of our projectiles, the strength of the arm must be sufficient to hold the forces which do the propelling. Even with modern methods and metallurgical knowledge, the fabrication of a smooth functioning gun is a manufacturing problem of considerable magnitude. Typical gun mechanisms are not as simple as casual observation would lead us to believe. A parts list for the Model 510A - Single Shot Rifle - shows something over 50 separate items. The Model 11 Autoloading Shotgun and the Model 31 Repeating Shotgun each have something over 80 individual parts. The Model 37 Target Rifle equipped with a magazine but with no sights of any kind, is composed of more than 90 individual parts. None of the parts in any of the guns is superfluous; each has a function to perform. Some of them are moving parts and while this movement may be small in extent, it is important. It is no wonder with this multiplicity of parts and their irregular shapes that an occasional gun will be produced which does not function smoothly when first assembled.

REMINGTON ACCOMPLISHMENTS

SHOTGUNS:

Prior to 1890 most breech loading double barrel shotguns were of a type known as hammer guns. A lever to open the gun was located forward of the trigger guard. Other means of opening were by a top lever lift or top lever of present design. The gun was

locked securely in the frame and in some designs an added locking was made by a rib extending rearward into the breech and locked by a horizontal cross bolt operated by the top lever.

In 1894 Remington built its first hammerless double weapon. In 1902 or thereabouts, Remington designed and built the #9 single barrel shotgun, unique in design and termed "semi-hammerless", with a cocking lever located on the left side of the frame and operated by the thumb of the right hand. The short top lever functioned to "break" the gun. Very few changes in design have been made in present-day single and double guns except improvement in materials and in minor substitutions of coil type for flat springs in top lever and main springs. Automatic ejectors and single trigger developments followed in 1910.

Well-known double guns of this period were Remington, Baker, Smith, LeFever, Ithaca, Colt and Parker. The foreign guns of top quality were Daly, Greener, Scott, Purdie, Wesley Richards, Francotte and Bone Hill. Many cheap foreign double guns were imported and sold up to 1908. Most of them went off the market with the general use of smokeless powder loads.

BROWNING TYPE - 12 GAUGE.

In 1905 Remington acquired the American rights to manufacture the Browning patented Autoloading gun and placed this first autoloader on the American market under the name "Model 11". Its design was identical with the Belgian product which was introduced later with the following minor changes: No magazine cut-off; slight increase in weight to withstand American heavy loads; barrel guide and guide ring of two-pieces brazed to the barrel instead of integral with it; safety device within the trigger guard forward of the trigger instead of in the rearward end of the trigger guard.

The safety device was changed in 1922 to a cross bolt type located at the rear of the trigger guard. Subsequent changes improved functioning and durability of the arm. Redesign of the firing pin, a retractor spring adoption, and improvement of metal and heat treating have eliminated broken firing pins and the tendency to "fire on closing". The substitution of coil springs for flat springs in the cartridge stop and the carrier latch, the addition of check screws to carrier pivot screws, trigger plate pin and tang screw, were found to be much needed improvements. Stock and fore-end design and improved finish were made to enhance appearance and handling.

Barrels were furnished with solid and ventilated ribs made integral therewith. This feature increased sales volume. Checkering of the fore-end and grip was added to provide better handling and appearance.

MODEL 11.

The Model 11 was furnished in 20 gauge in 1930 and in 16 gauge in 1931. In anticipation of the law limiting the magazine capacity to 2-shots for the killing of migratory birds, the Model 11, after conversion to the "SPORTSMAN", was produced with a magazine capacity of two shells, a shortened magazine and fore-end, from which an improvement in appearance and balance was obtained.

The Model 11 and "SPORTSMAN" are now furnished in 12, 16 and 20 gauge and in a variety of finishes to suit the duck hunter and the field or skeet shooter. While the arm has limited acceptance by the trap shooter, it has been enthusiastically received by skeet shooters.

MODEL 10 AND MODEL 29.

In 1907 Remington produced the Model 10, a 6-shot slide action repeating shotgun under the Pederson patents. It was the first and only hammerless pump gun produced. Later competitive models were styled hammerless, however, all of them possessed hammers enclosed within the receiver.

The Model 10 was a bottom ejection pump gun, the first gun of this type. The firing mechanism was enclosed within the breech block and consisted of firing pin, firing pin spring, cocking head, sear and action bar. The firing mechanism is similar to the bolt action type used in rifles. Improvements and refinements were completed from time to time in appearance and functioning. Changes in design of extractors and elimination of the flat ejector spring were completed and as a result, the improved Model 10 became the Model 29 in 1929.

BROWNING PUMP GUNS.

In 1919 Remington procured manufacturing rights from John Browning to produce a 20 gauge pump gun (Model 17). This arm had a streamlined solid receiver with bottom ejection. It differed in takedown from the conventional pump gun as receiver, magazine, fore-end and operating slide were assembled as a unit. This was accomplished by a simple method of locking the barrel in the receiver and to the magazine by means of a locking magazine cap. This design permitted the sale of an extra barrel at less cost, as other type pump guns required the purchase of fore-end and magazine assembly mounted on the barrel. The breech block, carrier and other components were designed to permit the loaded shell to be fed into the chamber directly from the carrier, and the rim was held securely by the extractors so that "straight line feed" was accomplished. This feature was an improvement as it permitted ease of operation and overcame malfunctions that occurred after shell crimps became deformed. The prong type carrier functioned both as a carrier and ejector. The safety was the cross bolt type located at the rear of the trigger guard. This model was discontinued in 1937.

MODEL 31.

The Model 31 Shotgun was introduced in 1931 in 12 gauge only; 16 gauge and 20 gauge models were furnished in 1933. The basic design of the Model 31 is almost identical with the Model 17 with the exception that it is a side ejection type. Changes were made in the original design to accomplish this feature as follows: Changed extractor from a vertical position to a horizontal position and added an extractor on left side to aid in feeding and positioning for ejection; a tie bar was placed on the carrier at its forward end and a conventional ejector was placed in the receiver; some minor improvements were made in the firing mechanism such as a lighter main spring and a shortened hammer travel. These changes improved the trigger pull and the ease of operation.

Because of its ease of operation, balance and stability, the Model 31 holds a splendid reputation with all classes of shooters. A recent change in design and heat treating of the operating slide to overcome breakages has corrected its main weakness.

A most recent change of moving the trigger guard and trigger, rearward, has improved its handling and balance and will permit a better stock and grip design. The outstanding features are:

Ease of operation
Cross bolt safety
Side ejection "straight line feed"
Fast firing -- "speed lock"
Interchangeability of barrels at a minimum cost.

OVER-UNDER SHOTGUN - MODEL 32.

In 1931 Remington procured patent rights to the Peiper Over-Under Shotgun. This arm was produced in 1931 and was known as the Model 32. The first model was a plain barrel, two-trigger gun. Other changes were incorporated to produce solid and ventilated rib barrels and an excellent single trigger was added. Some minor changes were made, such as changing the position of the sear springs to insure positive cocking. Trap and Skeet Models were produced.

The Model 32 is a rugged, well-designed shotgun and the best American Over-Under on the market. It compares favorably in design, balance and shooting performance with foreigh-made Over-Under guns that sell at three times the price.

PARKER GUNS.

In 1934 Remington acquired the gun assets, designs and use of "Parker" name from the Parker owners located at Meriden, Conn. Remington continued manufacture at Meriden until 1938, when part of the Parker personnel and most of the machinery were moved to Ilion.

The Parker is a custom-built line of guns. Better Parker guns have been produced at Ilion because of more rigid inspection standards. The Parker gun is accepted as the finest double gun made in America.

CENTERFIRE RIFLES:

The Model 2 of 1888 was one of the first models supplied in .22, .25/20 Winchester, .32/20 Winchester, .38/40 Winchester and .44/40 Winchester calibers. It was discontinued in 1913.

Remington also supplied, in 1903, a Model 3 Rifle (Hepburn Patent) of .40/60, .40/65, .40/65 Remington Straight, .40/82, .45/70 and .45/90 calibers. It was fitted with a vertically sliding block action with a side lever for operating the breech block. This rifle was supplied in both sporting and target grades. It was later furnished for use of the high powered smokeless loads of this era, namely, .30/30, .30/06 Springfield, .32 Winchester Special, .32/40 High Power, .38/55 High Power and .38/72.

The #5 or Military Single Shot Rifle, a rolling block action, was produced in 1898 and discontinued in 1911. This rifle was sold to many foreign countries and was furnished in .303 British, .32/40, .32/20 Winchester, .38/55, .30/30, 7 m/m Mauser and .30/40 Krag calibers.

The Model 98, an improved Model 5, was produced from 1898 to 1912.

The Model 99 was produced from 1898 to 1921 and was furnished in World War #1 for the 8 m/m cartridge.

In 1898 Remington produced the Remington-Lee Bolt Action Box Magazine Military and Sporting Rifle, used by the United States, Great Britain, China and other countries. It was furnished in 30" barrels and in 20" barrel in Carbine. It was supplied in a variety of calibers - 6 m/m (.236 Navy), .30/30, .30/40 Krag, 7 m/m, 7.65 m/m, .32 Winchester Special, .35 Remington, .32/40, .38/55, .303 British, .38/72, .44/77, .43 Spanish, .45/70, .45/90, .45/85 and .45/84 Express. This model was discontinued in 1909.

MODEL 81.

The Model 8 (Browning Patent) produced in 1906, was the first American Autoloading Sporting Rifle in .25 Remington, .30 Remington, .32 Remington and .35 Remington calibers.

The Model 81, an improved model, containing changes in the stock and the addition of a semi-beaver tail fore-end was produced in 1937. The Model 81 was furnished for the .300 Savage cartridge in 1940.

MODEL 141.

In 1912 the Model 14 (covered by Pederson patent) Pump Action Hammerless Repeating Rifle was produced in .25 Remington, .30 Remington, .32 Remington and .35 Remington calibers. It was the first hammerless type sporting rifle offered the American sportsman. This model was obsoleted by the Model 141 in 1937. The Model 141 with redesigned shotgun stock and butt plate and large fore-end, was furnished in .30 Remington, .32 Remington and .35 Remington calibers.

MODEL 14½.

A Model 14½ in .38/40 Winchester and .44/40 Winchester was produced in 1913 and discontinued in 1931. The sales volume of this model did not warrant its continuation.

MODEL 30.

From components of the original British Enfield (Caliber .303) and later the U.S. Model 1917, the 30A was produced in 1920 in a sporting model. A change in cocking action was incorporated. It was furnished in .30/06 Springfield, .25 Remington, .30 Remington, .32 Remington, .35 Remington and 7 m/m. In 1930 the Model 30S was produced, an improved sporter in .30/06 Springfield, .257 Roberts, 7 m/m and .25 Remington calibers.

MODEL 720.

Both of these models (30A and 30S) were replaced in 1940 with the Model 720 in .30/06 Springfield, .270 Winchester and .257 Roberts calibers. The Model 720 was improved in appearance and trigger pull. Also, it had a short bolt travel and a modified bolt stop to improve streamlining.

MODEL 25.

In 1922 Remington produced the Model 25 slide action gun (Pederson patent) similar in design to the Models 12 and 14 in .25/20 Winchester and .32/20 Winchester calibers. It was discontinued in 1937.

RIMFIRE RIFLES:

Remington built the #4 Rolling Block Action Single Shot Rifle in 1890 and discontinued its manufacture in 1935. It was supplied in .22, .25/10 and .32 Rimfire calibers. The #4 was a duplicate of the original #5 Military Rifle but built smaller and lighter for Rimfire cartridges. It was a hammer type using flat main and trigger springs. Few changes were ever made with the exception of minor ones that reduced manufacturing costs.

Remington built the #6 Single Shot Rifle in 1901 and its manufacture was discontinued in 1933. It was furnished in .22 and .32 calibers. The model was similar in design to the Model 4 built with a shorter barrel, lighter in weight and cheaper to construct. It was supplied with a tang peep sight of simple design and low cost. This feature contributed to its large volume of sales.

Remington built the Model 7 in 1903 and discontinued its manufacture in 1911. It was supplied in .22 and .25/10 calibers. This rifle was Remington's first small bore target rifle and was built using the Navy Single Shot Pistol Frame fitted with 24", 26" or 28" half octagon barrel. Standard sight equipment consisted of a combination front sight and a "Lyman" Combination Peep Rear Sight. The weight was 5 to 6-1/2 pounds.

Remington also supplied, at about this period in 1903, a Model 3 Rimfire Rifle.

In 1933 Remington designed and produced its first .22 caliber Single Shot Bolt Action Rifle. The Model 33 was a low-cost rifle of simple design.

In 1934 the Model 34 - a tubular magazine, bolt action, .22 caliber Repeating Rifle - was produced which was similar in appearance to the Model 33. The Model 341 - a tubular magazine, repeating, .22 caliber - was produced in 1936. The Model 41 - a .22 caliber Bolt Action Rifle - that cocked on the upthrow of the bolt replaced the Model 33. A Model 411 - similar to the Model 41 in construction - was produced for the .22 C.B. "Special" and supplied to the Steel Materials Corporation for "Bang-A-Deer" short range gallery.

MODEL 121.

Remington, in 1909, introduced a Model 12 - .22 caliber Side-ejection, Hammerless, Pump Action Repeating Rifle. It was built under the Pederson patents. It was the first Repeating Hammerless Rifle and the first Repeating Rifle with cross bolt safety. Also, it was the first Repeating Rifle that would handle .22 Short, .22 Long and .22 Long Rifle cartridges interchangeably without adjustment. It was supplied in 12A-22" Round Barrel Straight Grip, 12B-24" Octagon Barrel Pistol Grip for .22 Shorts only, and the 12C for Shorts, Longs and Long Rifles; also the 12CS was furnished in the .22 Remington Special (.22 W.R.F.) caliber. The Model 12 was replaced in 1936 by the present Model 121.

The 121 is furnished in only one model with a 24" Round Barrel, Beaver-tail Fore-end, Pistol Grip, increased capacity magazine, and shotgun butt. Its weight is 6 pounds. The firing and breech block mechanism is simple in design. The breech bolt contains the extractor and firing pin. The hammer is operated by a coil spring and few changes in design have been made in this model.

AUTOLOADING MODELS.

In 1914 Remington produced the Model 16 Autoloading .22 Caliber (Remington Auto) Rifle. This rifle was designed by C.H. Barnes. The rifle was similar in appearance to an autoloading shotgun, excellent in balance and weight. It was made to compete with

Winchester's 1903 - .22 Caliber Autoloading Rifle. It had a tendency to burn out the breech which was due to the use of the .22 Auto Cartridge which is inside lubricated. This rifle was discontinued in 1934.

In 1924 Remington acquired the patent rights to produce the Model 24, .22 Caliber Autoloading Rifle, from John Browning. Minor changes were made in the original Browning consisting of a longer barrel, a wider and deeper receiver and a change in the loading port from within the grip to the middle of the stock. This rifle was the conventional "blow back" type with a cross bolt safety, tubular magazine located in the butt stock and was built originally for the .22 Short. It was later supplied for .22 Long Rifle.

MODEL 241.

In 1935 the present Model 241 replaced the Model 24. The newer model has improvements such as larger fore-end and stock and a 24" barrel.

MODEL 37.

The Model 37 DeLuxe Match Rifle was produced in 1934. It is the last word in a match rifle and Remington's first modern .22 Caliber of the match type.

MODEL 500 SERIES.

In 1939 the production of the 500 Series of Bolt Action .22 Caliber Rifles was inaugurated. First, the Model 510, a Single Shot; the Model 511, a Clip Magazine Repeater; the Model 512, a Tubular Magazine Repeater, followed by the Models 513S and the 513T, Clip Magazine, medium priced, "Sporter" and "Match Rifles".

In 1940 the Model 550, a .22 Rimfire Autoloading, Tubular Magazine Gun of unique design was adapted to .22 Short, .22 Long and .22 Long Rifle with complete interchangeability.

PISTOLS AND REVOLVERS:

Remington produced Cap and Ball Revolvers near the close of the Civil War: The Remington Model 95, better known as the Remington Derringer, an over-under two-barreled Pistol of .41 Rimfire Caliber was first produced in 1867 and discontinued in 1937.

In 1903 Remington produced the Model 7, a Single Shot Pistol in .22 Caliber, .25 Rimfire and .44 S & W Russian Centerfire. This pistol was built on the Navy Single Shot Pistol Rolling Block frame with 10" barrel. It was discontinued in 1907.

The Model 51, supplied in .32 and .380 Automatic Pistol calibers, was designed and produced in 1918 but discontinued in 1927.

AIR RIFLE:

The Model 26 Air Rifle first produced in 1926, was discontinued in 1934.

W. L. Clay
Manager of Quality

WLC:VPD
10/1/45

December 3, 1946

TO: P. B. Rutherford

FROM: M. H. Walker

SUBJECT: THEORETICAL UNSAFE CONDITION OF M/721 SAFETY

Straight calculation of the amount the Safety lifts the Sear off the Trigger gives a max. lift of .0147" and a min. lift of minus .0024". However, fourteen (14) different dimensions are used in the calculation. The actual amount of lift by statistical analysis would be a max. of .009" and a min. of .0032".

Objections have been raised to the above theoretical unsafe condition. According to L. T. Murphy, the necessary dimension changes on the Sear to eliminate this condition can be made without changes to tooling or gaging. With a minimum lap of .026" between Sear and Firing Pin head the change can be made by changing the depth of grind on the Sear notch.

This change will be incorporated in the drawing as soon as tool procurement is completed.

M. H. Walker,
Design Section,
Arms Technical Division

MHW:LJ