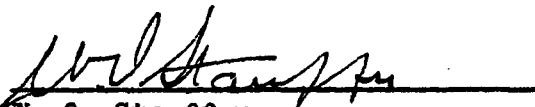


QUARTERLY RESEARCH REPORT

FOURTH QUARTER, 1943

This report is a compilation of brief reviews prepared by Research Section staff members covering their activity on research projects and assistance to plants during the Fourth Quarter of 1943.

Approved by:


W. O. Stauffer
Manager
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PRIMER GROUP - BRIDGEPORT

PHILIP H. BURDETT

NON-MERCURIC, NON-CORROSIVE
CENTER FIRE PRIMING MIXTURES: E. H. Johnson, E. J. Lemanski

A mixture has been developed which appears to give satisfactory performance in caliber .30 ML carbine cartridges and which has a greatly reduced tendency to mass detonate. It is a modification of one of the mixtures developed previously and contains PETN as a breech flash and mass detonation inhibitor. Tests in laboratory batches and on two plant batches have shown that it gives satisfactory cold barrel times, pressure, velocity, muzzle flash and breech flash when it is used in caliber .30 ML carbine cartridges. It is a little more sensitive and a little more stable to humidified storage than 1348. The use of pretreated calcium silicide and of TNR in the mixture has solved the problem of the stability of the mixture on wet storage. It has been coded J-232.

A request has been made to Ordnance for permission to charge J-232 into caliber .30 ML carbine primers on a limited scale in the Bridgeport plant for further evaluation.

The mixture is at present being evaluated for use in .38 S & W special cartridges. If it proves satisfactory it will be tested in these cartridges on a plant scale.

A few of the disc type anvils similar to those used by C.I.L. have been made. After this preliminary trial the tools were changed slightly. They are now ready for a larger run as

soon as an anvil forming press can be obtained.

O.S.R.D. Contract: T. B. Johnson

After a considerable period of inactivity we have been requested to resume work on this project. Interest at the moment centers on development of a priming mixture to give a longer flame than that obtained with TI-15. For the intended use it is important that the violence be as low as possible. A mixture has been developed which appears to give a significant improvement over TI-15 and sample primers have been submitted to General Electric Company.

.22 CALIBER FLAME THROWER CARTRIDGE: T. B. Johnson

Sample 2 of the .22 caliber flame thrower cartridge submitted to the Standard Oil Development Company in July is now reported to be completely successful. An additional 1,000 cartridges of this type have therefore been submitted.

COMMERCIAL CENTER FIRE CARTRIDGES: T. B. Johnson, E. H. Johnson,
E. J. Lemanski

It is felt that Remington will of necessity furnish center fire cartridges containing non-mercuric, non-corrosive priming mixtures after the war. A project has therefore been taken out to accomplish preliminary work on the adaptation of existing priming mixtures to the various primers used in the commercial center fire line. The cartridges to be investigated were chosen in consideration of the problems involved and of their availability. Those chosen for immediate attention include .30-'06 Springfield, .32 Winchester, .38 S & W, .38-40 Winchester, .44-40 Winchester, .45 A.C.P. and .22 Hornet.

FUSE LIGHTER PRIMERS: T. B. Johnson

At the request of the Engineer Board various primers were submitted for use in a device to light blasting fuses in the field. It was found that #57 primers charged with TI-15 priming mixture were satisfactory for this job. Tentative specifications were therefore prepared and submitted to the Engineer Board along with a quotation on the larger number of primers. This development is now considered complete and any further work will be carried on by the plant.

EASTMAN PROPELLANT UNITS: T. B. Johnson

Additional units have been charged but no experimental work has been involved.

CALORIMETER TESTS: T. B. Johnson, E. H. Johnson

Rather extensive tests have been made to determine whether the available heat energy of various priming mixtures was affected by the firing pin blow. Results to date indicate that if there is a dependence, the effect of variations in firing pin blow is very slight.

NEW PRIMING EXPLOSIVES: L. Summers

An investigation of various salts of methazonic acid has continued. The lead salt continues to appear interesting but it has thus far not been possible to prepare successive batches of satisfactory material. Work on this project has been curtailed by the pressure of more urgent work.

ELECTRICAL IGNITION: L. Summers, P. H. Burdett

At the request of the Artillery Division of the Office

of the Chief of Ordnance we have attempted to develop a satisfactory electric primer for use in the 20 MM cartridge. The first contract required the preparation of 2,000 primers and following a certain amount of experimental work samples of three types of primers were submitted to the Ordnance Department. Type F represented an essential duplication of a primer produced during the last war. Types E and G represented simplification of this design chiefly by the abandoning of a black powder booster. The resulting primers were of substantially the same size as the percussion primer now being used.

Following successful firing of the samples submitted to Ordnance of the E, F, and G types, completion of the order was undertaken using the G-2 type primer. Simultaneously negotiations were undertaken for the redesign of the primer to allow mass production and for the submission of fifty or one hundred thousand additional primers. Although negotiations on the supplement have not been completed, work has continued with the Chemical and Metallurgical Group redesigning the primer and the Mechanical Experimental Section developing an assembly machine and an electric inspection machine.

It has been found that the required volume of primer mixture can be attained within smaller outside dimensions than those used on the G-2 type and attempts are therefore being made to reduce the diameter of the primer to the place where it can be used in the pocket of the present case designed for percussion primers.

PLANT ASSISTANCE ON EXPLOSIVES (BRIDGEPORT): M. W. Maughan

Priming Mixtures Containing Wetting Agents: A. E. Watkins,
G. J. Behling

The addition of Triton NE to #125 mixture for 20 MM and 1341-F for rim fire priming has been recommended. It has been found that the addition of Triton NE does not alter the drying rate or moisture regain of priming mixtures.

Caliber .50 Primer Sensitivity: P. D. Jost

A study of the effect of conditioning and humidification shows that primers decreased in sensitivity during 48 hours at 92% R.H., but more than 48 hours at 64% R.H. was required before the sensitivity was reduced.

#57 Shot Shell Primers: P. D. Jost, A. E. Watkins

Sensitivity of these primers as measured by drop test was found to be greatly reduced by off-center firing pin blows with both two and four ounce weights. This study will be continued with larger weights.

157-R Priming Mixture for Rim Fire Shells: P. H. Burdett, G. J. Behling, A. E. Watkins

This mixture has been found to be superior to 1341-F from sensitivity, steel corrosion, stability and safety standpoints. Authorization has been requested from the Explosives Committee for limited production.

Sensitivity of .22 Caliber Steel Cases: G. J. Behling, A. E. Watkins

The sensitivity of steel shells of the "dog eared" type prepared by the Chemical and Metallurgical Group has proved to be excellent, particularly when primed with 157-R.

Ground Antimony Sulfide: A. E. Watkins, N. T. Hildreth

Results of sensitivity and ignition tests indicate that Class A antimony sulfide is as satisfactory as the more expensive Class C granulation for caliber .50 primers.

Caliber .30 M1 Carbine Tracer: P. D. Deans, G. J. Behling

A satisfactory igniter mixture I-7 was developed for this cartridge, recommended for use by the plant and has been generally successful on a production basis. An additional igniter mixture has been developed in order to dim the igniter flash near the muzzle of the rifle. Indications have been obtained that the increase in ballistic pressure observed on cartridges after high temperature, high humidity storage is related to excessive bullet pull.

Caliber .38 Tracer: P. D. Deans, G. J. Behling

The performance of Bullseye powder with I-3 igniter mixture has been investigated and approved for plant use. The use of I-7 igniter mixture with Bullseye powder has also been found to be satisfactory for this cartridge.

Shot Shell Tracer: P. D. Deans, G. J. Behling

No correlation was found between trace performance and either ballistic pressure or primer bridge thickness. The trace performance with I-7 mixture was found to be inferior to that obtained with the #92 mixture currently used for shot shell tracer.

Process Records: G. J. Behling, A. E. Watkins, P. D. Deans

Information for the formulation of standard procedures and process records has been compiled for 1341-F, 1316, 5054, 5021 priming mixtures and I-7 tracer mixture.

Evans Potassium Chlorate in TX-2 and #125
Priming Mixture:

A. E. Watkins

The Evans material has been used satisfactorily by decreasing the amount of water in the gum solution.

Caliber .50 Incendiary: R. A. Sahlin, H. H. Peterson

Experimental results of laboratory tests and samples prepared on plant equipment indicate that the compression can be greatly reduced or entirely eliminated on the first charging station without adversely affecting sensitivity.

Safety: M. W. Maughan

It has been recommended that:

1. The necessary electrical controls be provided to prevent the temperature of the wiping pad on the .22 caliber bullet lubricating equipment from exceeding that of the final dip tank.
2. Humidification be provided for primed .22 caliber cases to prevent excessive drying prior to loading.
3. A means of humidifying Building 808 be provided which will not cause drafts on personnel working in the primer inspection booths.
4. Equipment be provided to transport priming mixture scrap from dry charging booths to the sink in Building 725.

PLANT ASSISTANCE (MILITARY):

Utah: F. B. Clay, L. R. Feinauer

Caliber .50 Priming Mixture: It was found that the sensitivity of FA90A priming mixture could be increased by reducing the percentage of potassium chlorate and increasing the percentage of all other ingredients proportionately. It was felt that a worthwhile improvement in sensitivity could be accomplished by reducing the chlorate content from 53% to 43%. The tests did not

indicate that there was any difficulty in powder ignition.

Tracer Bullet Accuracy: Following suggestions made by the Chemical and Metallurgical Group (Bridgeport) alterations were made in the method of drawing caliber .30 steel tracer bullet jackets. Sufficient reduction in mean radius was attained to allow the meeting of the specification.

Manufacture of Incendiary Mixture: A device for manufacture of incendiary mixture directly on the charging machine was completed and given a trial run. Results were satisfactory but mechanical construction of the equipment was not satisfactory for production use. Operations were discontinued before another unit could be developed.

Caliber .30 Primer Inversion: At the time of closing of the plant the conversion to hand operation was partially completed.

Smokeless Powder Handling: A special truck for handling cases of caliber .50 powder in the loading mezzanines was developed and placed in operation. Although minor changes were necessary, the operation was essentially successful.

Priming Mixture Scrap Reduction: A curved back board for the charging table reduced the amount of mixture which was scrapped by dropping into the moat.

Magnesium Screening: A simplified screening device has been developed which consists essentially of an adapter for fastening two magnesium drums together end to end with a screen between which is free to be vibrated.

Denver: D. W. Gay

Primer Anvil Dimensions: It was found that a shorter anvil tended to give higher standard deviations in the drop test. However, hyper sensitivity required a reduction in anvil weight from the range .082 - .0855 to the range .080 - .083.

Potassium Chlorate: Satisfactory procedures for the use of Evans potassium chlorate have been developed. A blend of 2/3 Evans and 1/3 Trojan was used for some time but more recently it has been found that the use of 1/2 Evans and 1/2 Trojan with the normal gum content gives satisfactory mixture.

Relative Humidity vs. Primer Sensitivity: Records of humidity and primer sensitivity for a considerable period of time show no correlation. This might be expected at Denver since the relative humidity is usually low.

Primer Drying: The procedure for determining the number of primers passing through the dry houses has been changed recently and every tenth tray is now weighed. The new procedure is apparently adequate and is safer and quicker.

Effect of Pellet Weight on Sensitivity: An extensive experiment has been conducted which confirms previous findings that sensitivity decreases as pellet weight increases. Although the regression line has not been fitted there is an indication of an effect previously noted by Dr. Churchman of Frankford Arsenal, namely, that the relation between average height of fire and pellet weight is represented by a straight line in the lower ranges of pellet weight and by another straight line having a higher standard deviation in the high pellet weight ranges.

The limit below which the tendency toward hangfire is marked was found to be .30 grains.

For all practical purposes velocity seemed to be independent of pellet weights.

Lowell: M. J. Rasmussen

Potassium Chlorate: A method was developed for the use of Evans potassium chlorate and all operations were on the basis of this material for approximately two months.

Primer Drop Testing: A standard lot of primers was tested each day for a three week period along with daily control samples. Analysis of the results shows that the testing procedure was reproducible and furthermore that the daily average did not show a variation greater than the variation in the testing technique.

Lake City: F. C. Johnson, F. B. Clay, C. T. Williams, T. W. Mullen, E. F. Nauman

Dim Igniter for Caliber .50 Tracer: Considerable work was done to adapt the I-194 dim igniter to plant operation. A slight reformulation has been made and the use of a sub-igniter has been introduced.

Tracer Mixture: In line with results obtained previously at other plants, it has been found that fine calcium resinate is desirable for satisfactory functioning of tracer mixture.

Muzzle Bursts in Incendiary: An epidemic of muzzle bursts was obtained with a fast burning smokeless powder. The trouble disappeared when a return was made to a slower powder.

Caliber .50 Hangfires: A number of hangfires have been obtained by Ordnance. A study has been made to determine possible sources of contamination by oil.

A.P.—Incendiary: Improved incendiary functioning has been obtained with a mixture containing an increased percentage of oxidizing agent. This has not been used in production since it has not been approved by the Ordnance Department.

Primer Drop Testing: Control lots of primers are now used in setting up the drop test machines and this has resulted in a considerable decrease in the number of retests necessary.

Kings Mills: C.J.W. Wiegand

Carbine Primers: Considerable use has been made of statistical methods for determining the effect of different manufacturing variables on primer sensitivity. It has been found, for example, that the skewness factor on primers from one shift is generally greater than that from other shifts. An improvement has since been made on the shift which was producing primers of questionable quality.

Effect of Pellet Weight on Sensitivity: It was found that sensitivity decreased as pellet weight (bridge thickness) increased. However, contrary to expectations no critical point was found above which the sensitivity decreased more rapidly with increases in pellet weight. (See report from Denver)

Primer Anvils: A primer anvil has been developed having a very pointed profile and this apparently is not as sensitive to changes in bridge thickness as the conventional anvil.

Shot Shell Primers: Due to the fact that shot shells

are conditioned after heading, experiments have been conducted on the possibility of wet anvilling and inserting at the heading operation. This would allow the primers and shells to condition at the same time. This would not only reduce overall manufacturing time but would improve safety. Results up to the present time are quite satisfactory.

CHEMICAL AND METALLURGICAL GROUP - BRIDGEPORT

W. L. FINLAY

STEEL AMMUNITION:

Corrosion Resistance—Caliber .50 Steel Case: D. R. Adessa, G. E. Hutchinson, A. A. Schilling, J. H. Zimmerman

Additional firing tests of oiled finishes were made. These included both dust tests and shooting in a heavy barrel at -70°F with maximum head space. The results indicated that:

1. An oiled finish will reduce the number of stretches to about 1/10, and partial and complete ruptures to about 1/20 the usual occurrence.
2. An excess of oil tends to cause gun stoppages and rim shears in the dust test.
3. A peculiar casualty, that of a rim shear on extraction of the case from the link, occurs only with oiled cases and may possibly be associated with the oiled surface becoming gummy at -70°F.

These results suggested that perhaps a graphited surface would have the low friction coefficient advantage of oil without its tacky disadvantage. This proved to be the case but failure to eliminate ruptures completely caused this possibility to be tabled.

Interesting results have been obtained on duplex copper-lead electroplates. The following tabulation gives the under plate first and the top plate second:

.0001" Copper; .0003" Lead—Good corrosion resistance. A number of cases so plated were subjected to regular Lowell handling and were then salt sprayed for 96 hours. The amount of corrosion was quite low and this finish therefore appears quite promising.

.0001" Copper; .0003" Lead; .0001" Copper— This gave very poor corrosion resistance even without Lowell handling.

.0003" Lead; .0001" Copper—This gave poor corrosion resistance even without Lowell handling.

A further evaluation of copper-lead duplex plate is planned on the basis of the foregoing. Facilities for lead plating on a larger than glassware scale are being obtained.

.22 Caliber Government Steel Case Process: R. T. Catlin, H. C. Moss

Satisfactory results were obtained on a repeat test of the modified present process. The modification consists of the elimination of the first draw anneal and quench cooling from the cup anneal.

Cups concentric within .0005" were secured from the blanking and cupping die set. Approximately 3/4 million cups have been made and it appears that the die set is entirely satisfactory.

Caliber .50 Steel Case Process: J. P. Catlin, R. T. Catlin, G. R. Eckstein, C. W. Greenhalgh, J. H. Zimmerman

Blank-Cup-and-Draw Process: "Better than brass" is the comment which has been made regarding the December production of the Lowell Ordnance Plant. This production consisted of thick, uniform wall cases, quench-hardened before tapering. Justification

for this comment is given by the Ordnance Department Grade A acceptance tests at Lowell in which, out of 15,000 rounds fired, total casualties consisted of three neck splits and one leaky primer. Even better than this performance were the results of the severe testing of 10,000 rounds at Frankford Arsenal in which no casualties of any sort were suffered. Re-inspection of the fired cases at Frankford with the aid of a magnifying glass uncovered evidence of eight leaky primers.

Hot-Extruded Draw Piece: Work on the dial feed for the draw press is complete.

Two draw pieces designated as HE-10 and HE-11 have been designed and requested from Chevrolet. The object of the new designs is to secure enough metal in the wall so as to employ the thick, uniform wall feature found desirable on blank-cup-and-draw cases.

Supplement 5 to the caliber .50 steel case development contract was approved.* The supplement calls for the development of a hot-extruded draw piece and process, and the manufacture by that process of 500,000 cases made up into loaded rounds.

The first formal monthly report (the October report) to Frankford Arsenal on the hot extrusion development was submitted.

SHOT SHELLS:

Piston Plus Wadding: G. G. Garrison, G. E. Hutchinson

Part II of the project was approved. Work is expected to resume shortly.

*Notice of termination of this contract has since been received from the Ordnance Dept., effective January 14, 1944.

Molded Wads: G. G. Garrison, G. E. Hutchinson

13K (Asplund-Kraft): Because of the availability of starch and the press of production, drainage water trials were again postponed. A project will be submitted to evaluate two possibilities which would eliminate the need for recirculation by replacing the starch with a binder which would not be lost as is starch in the drainage water. These two possibilities are:

1. A special urea-formaldehyde resin designed for dispersion in the beater.
2. The use of lignin present in the Asplund fiber for binding.

A second check of 16 gauge 13K wads was made. Manufacture of the wads was quite successful and ballistic evaluation is now under way.

In an effort to increase the capacity of existing Molded Wad equipment, the RPM of one unit has been increased from 6.0 to 6.5. After two weeks' running at the increased rate no trouble of any sort has developed. Hence, the RPM has been increased to 7.0 for another trial run.

Starch: Firing tests of wads bonded with Lojel were satisfactory and the Purchasing Department was advised that in the case of a starch shortage Lojel could be used for Molded Wads. Lojel is a deglutinized cereal flour.

100% Asplund Wads: Press of production has prevented the running of the two 100% Asplund lots.

Steel Shot Shell Heads: J. J. Buczynski

A high-spot investigation was started to determine

if a brief (of the order of 1/2 hour) nitriding treatment can enhance either or both the corrosion resistant or mechanical properties of a low carbon steel such as is used in steel shot shell heads. Some quite high physical properties were thereby obtained. The corrosion resistance of a nitrided surface in the salt spray was not very significantly better than the un-nitrided control.

New Crimp Closure: D. R. Adessa, G. E. Hutchinson

Because of unavailability and also because of indications of chamber buildup with the standard plasticized ethyl cellulose binder, a project was authorized to evaluate both thermoplastic and thermosetting binders which might be more satisfactory. Two test procedures were set up and several of the experimental binders were found to give promising performance with the new tests.

Test Procedures: The following procedures were developed:

Metal Adhesion—Essentially, this test consists of a set of plungers which can be pressed together in the Riehle tensile testing machine. The plungers are surrounded by a small electric furnace with close temperature control. The New Crimp binder tape to be tested is placed between the plungers and held at a given temperature and pressure for an indefinite time, e.g. five minutes. The pressure is then relieved and it is determined whether the binder stuck to the metal. A curve involving pressure and temperature for metal adhesion may thereby be determined for each binder. It has been found that the standard plasticized ethyl cellulose binder has a curve starting at 85°C and zero pressure which drops to 55°C at 3,000 pounds per square inch pressure and remains at 55°C to 25,000 pounds. A number of other possibly satisfactory New Crimp binders have been evaluated in the same manner. One of these, a Vinylite, has a curve starting at 140°C and zero pressure which drops to 125°C and 115°C at 3,000 pounds and 25,000 pounds respectively.

Chamber Buildup— This test comprises the following conditions:

Chamber Temperature—105°C. This is equivalent to the temperature arrived at by firing 300 or more (the temperature curve flattens out) shot shells at 2½-second intervals. It is attained in the test by an electric heater on top of the barrel in the chamber region.

Number of Shots—25 shots fired at 30-second intervals, the fired shell not being ejected until the 30-second interval has transpired.

Condition of Binder—No paper is interposed between the binder and the chamber wall. When, as is of course usual with the New Crimp binder, the binder is separated from the chamber by paper, very little buildup occurs.

The chamber buildup test is thus seen to be quite severe:

Experimental Binders: Using the foregoing test procedures the following results were obtained:

Thermoplastic—Using the chamber buildup test, 12 thermoplastic binders, including the standard plasticized ethyl cellulose, have been evaluated. Seven of the 12, including plasticized ethyl cellulose, exhibited very severe chamber buildup. Further tests are planned on the five which gave no buildup.

Thermosetting—The optimum catalyst, as well as the optimum time and temperature of affixing for the urea-formaldehyde thermosetting binder were established. It was found necessary to employ a wetting agent with the catalyst to insure uniform wetting of the binder. An extensive search developed two suitable wetting agents. The combination of wetting agent, catalyst and urea-formaldehyde binder was tested by means of a plant affixing run of 5,000 shot shells. Preliminary firing results on these shells are encouraging. When subjected to the standard chamber buildup test, this binder exhibited no chamber buildup whatever.

Caliber .45 Shot Cartridge: G. G. Garrison, G. R. Eckstein,
G. E. Hutchinson

The Ordnance Department reported the results of

their testing of the first lot of 10,000 paper capsule cartridges sent to Aberdeen. As compared to the 55% average patterns obtained at Bridgeport, in an old barrel, the Ordnance Department secured only 37% average patterns in a new barrel. The Ordnance Department therefore requested additional development work to eliminate the low patterns and to raise the average pattern. Extensive testing of the paper capsule principle indicated that it was unsatisfactory, the basic defect being that the capsule cannot be removed from the path of the pellets on every shot. Attempts to incorporate a paper body in the existing caliber .45 case resulted in cutting off of the paper body at the mouth of the case. Hence an entirely new case was made with the following characteristics:

1. Longer length than the standard .45 case;
2. All-metal, one-piece construction;
3. Outside taper but straight inside wall obtained by a special draw layout followed by taper.

A comparison of the pattern performance of the old paper capsule cartridge and the new, all-metal, straight inside cartridge shows the improvement which was obtained:

Cartridge	Pattern in 30" Circle at 40'	
	Ave.	Min.
Paper capsule	45	10
All-metal	65	35

A tentative process was given to the plant.

Experimental Shot Shell Powder: G. G. Garrison

The loading characteristics of two samples of experimental powder from Burnside Laboratory were compared with standard M3X powder. One of the samples gave excessive powder charge variation but the second appeared satisfactory.

RIM FIRE:

Bullet Lubricants: A. A. Schilling

The new Government lubricant #9A has continued to give satisfactory performance in plant scale tests and has entirely replaced #31A as the standard Government lubricant. Because of its domestic availability and its advantages of long life in the lubricating tank, light color and low viscosity, it appears that #9A will be the standard Government lubricant in the present and post-war periods. It will also be available as a commercial grease lubricant replacing #9 which "runs" at a considerably lower temperature. It is, however, definitely more tacky than #65; hence, unlike the latter, it cannot qualify as a universal, i.e., as both a wax and a grease, lubricant for .22 rim fire.

Improved High Velocity .22 Caliber Rim Fire: D. R. Adessa, J. P. Catlin, R. T. Catlin, G. R. Eckstein, R. M. Treco

Non-Ferrous: The need for quite concentric case walls for adequate accuracy, especially in high velocity cartridges, prompted the design of a "one-shot" case layout. By one-shot is meant that blank-cup-and-finish draw is done in one stroke of a special, double-action press. Interest in the one-shot layout arises from the belief that better wall concentricity can

be obtained the fewer times a cupping or draw punch is removed from the component with subsequent insertion of a smaller punch. A press is being altered in accordance with this design to evaluate the principle.

Ferrous: Continued evaluation of the "dog ear" head shape has given very encouraging results. Sensitivity is much better than with the conventional head shape and permits steel case sensitivity to equal that of brass cases. There is also some indication that the "dog ear" head shape is less subject to casualties than the conventional head shape. This is unquestionably true of extractions, presumably because of the improved grip the extractor claw can secure on the new head shape. The "dog ear" head shape has been discussed with the Remington Patent Attorney who has expressed the opinion that the new "dog ear" may support several claims.

Further work on the one-draw layout has given promising results. It appears that no anneal in this process is either necessary or desirable. With this layout, some SAE-1015 steel .0165" thick was fabricated and loaded to 30,000 pounds pressure and a velocity of 1500 f/s. In the Springfield rifle and the Colt Ace pistol no casualties were suffered with the steel samples whereas 6% head casualties (cracked rims and burst heads) occurred in the regular brass.

Testing Techniques: The impact hydraulic bursting tester has not yet been calibrated. A microhardness tester has been secured and adapted to a Bausch and Lomb microscope.

Storage Tests of .22 Caliber Match Ammunition: A. A. Schilling

The final report has been issued on this investigation thus completing it.

Improved .22 High Velocity Appearance: D. R. Adessa

A project to improve the appearance of the high velocity rim fire cartridge was approved. It covered the following items:

1. Survey various .22 case and bullet finish possibilities;
2. Determine Products Committee preferences;
3. Estimate equipment and operation costs to apply the preferred finish.

Work has been started on this and it is hoped to have a complete display board by the middle of January.

Study of Lead Bullet Lubrication: A. A. Schilling

Under match firing conditions (slow rate of fire) and using the standard 98½-1½ bullet alloy, no significant difference in accuracy (ten 10-shot groups for each sample) was obtained between the following samples:

1. Regular bullets unlubricated;
2. Regular bullets lubricated with #9 (regular match lubrication);
3. Carbon-tetrachloride-cleaned bullets, unlubricated;
4. Carbon-tetrachloride-cleaned bullets with #9.

It would appear from these results that lubrication is not a controlling factor in accuracy under the conditions tested. A significant difference was found, however, in the amount of leading obtained with lubricated and unlubricated

bullets: unlubricated bullets gave possibly five times as much leading as lubricated bullets. Whether or not the bullets had been cleaned with carbon tetrachloride appeared unimportant.

A retest was made using #65 lubricant instead of #9. Substantially identical results were obtained.

Included with the retest was a sample with a regular bullet dip-lacquered with a nitrocellulose lacquer. Leading and accuracy with this lacquered sample were of the same order of magnitude as with lubricated regular bullets. In view of the possibility of greatly improved severe storage stability by over-the-mouth lacquering of rim fire cartridges, this possibility was evaluated further with the remaining funds in the "Study of Lead Bullet Lubrication" project. This possibility is particularly interesting in connection with steel rim fire cases where an overall lacquer coat would serve the triple function of bullet lubrication, hermetic sealing and case corrosion resistance. Using accuracy after one week's humidified storage as the criterion, it was found that one lacquer sample gave as good protection against humidified storage (90% R.H., 120°F) as non-running, over-the-mouth grease. Unlubricated control samples stored in a humidifier and lubricated before firing gave very poor accuracy. Leading under rapid firing conditions is next on the program.

ARMS:

Muzzle Devices: G. E. Hutchinson

Rotary Variable Choke: A final Progress Report has been prepared and this project has been closed out.

Longitudinal Variable Choke: A final Progress Report is being prepared and this project has been closed out.

Constriction Length Choke: The "Variable Angle Choke" project recently determined the optimum choke angle for full choke patterns. This optimum choke angle will now be employed to investigate the possibilities of pattern control by varying constriction length.

Non-Expanded Compensator: A project was approved to investigate the possibility of securing recoil reduction and variable pattern control by means of a non-expanded compensator section, i.e., by machining vent holes in the barrel near the muzzle. This procedure is disclosed by an 1899 U.S. patent. It appears that by this means, patterns are not appreciably affected and good recoil reduction can be attained.

Plastic Gun Stock:

An order has been placed with the molder for plastic gun stocks in 12 different colors. These will be for display only since the mold can only handle very free-flowing cellulose acetate but would not be strong enough for functioning tests.

MISCELLANEOUS:

Steel Head Shot Shells: G. E. Hutchinson

A characterization of component characteristics and salt spray resistance of competitors' (Western, Winchester and Federal) steel-headed shot shells was made for the Development Section. No new practices on competitors' brands were discovered. They are employing either a phosphate coating on steel or zinc

electroplate on steel for corrosion resistance and are securing the same order of magnitude of corrosion protection as Remington's copper plate.

Salt Spray Testing: J. H. Zimmerman

Salt spray corrosion tests were run on four 03-A3 rifle barrel-receiver assemblies submitted by Ilion.

AXS 674 Packing Oil: A. A. Schilling

An investigation was made to determine whether the corrosion resistance of the packing oil in current use at Ilion was affected by prior treatment of the steel surface with Remington Oil. It had been the practice to use Remington Oil to coat Springfield barrels after targetting. Subsequently this oil was wiped out and an oil meeting Federal specification AXS 674 was applied. The Ilion Ordnance representative had questioned this practice. The tests showed that the corrosion resistance of the specification oil (Tellus #31) is reduced somewhat by the prior coating of the steel with Remington Oil when the panels are tested at 120°F and 90% R.H. When similar tests are made at 120°F and 80% R.H. this difference is not found since at this lower humidity none of the oil-treated samples rusted. It is probable that condensation occurs at 90% R.H. and does not occur at 80% R.H. so that the former condition is much more severe than would be indicated by the mere difference of 10%

PHYSICS AND BALLISTICS GROUP - BRIDGEPORT

P. F. DARBY

IMPROVED HIGH VELOCITY RIM FIRE: J. J. O'Connor, L. G. Stier

Bomb tests were made on 4753, 1301, EX-4954, and

EX-4945 powders to compare their burning characteristics. There was no significant difference between the two EX powders. Also 4753 and 1301 were very similar in behavior except in the initial portion of the burning curve. The EX powders are roughly 20% slower than the other two powders.

Ammunition was loaded with various charge weights of these powders, and pressure-velocity curves were constructed from the results of the firings. In the meantime two new powders, EX-4953 and EX-4992 were received from Burnside and these were included in the test. The results of the bomb tests were reflected in a favorable pressure-velocity relationship for EX-4954 and EX-4945 powder as compared with 1301 or 4753. The EX-4953 and EX-4992 powders were both faster than the other powders in the velocity range in which we were interested.

All the EX powders are double-base coated powders having the same basic grain size and 15% nitroglycerine but differing in the percentage of coating. The powder with the heaviest coating (EX-4954) and hence with the most favorable pressure-velocity relationship also showed the greatest variability in pressure and velocity. $\frac{dp}{dt}$ vs. p oscillograph curves were taken in the gun in order to investigate with a more sensitive technique the initial portion of the pressure time curve. These results served to show that the EX-4954 was slow to ignite.

Accuracy tests showed the fast powders to be superior to the slow powders, the best targets being obtained with 1050B which is regularly loaded in low velocity cartridges but was included in these tests in order to broaden the range of test

powders. The relationship between accuracy and powder characteristics is being investigated by the $\frac{dp}{dt}$ vs. p technique mentioned above.

A new bullet has been developed which can be made on regular production equipment using different tools. The regular 98½ lead 1½ antimony alloy has been found to be satisfactory. Tests have indicated that further refinement in high velocity accuracy depends to a large extent upon the powder used and on the amount of powder.

Under laboratory conditions the combination of the new bullet, regular brass case, and 1050B powder gives a muzzle velocity of approximately 1350 f.s. and accuracy considerably excelling that with Remington, Western, or Winchester match cartridges. Time firing experiments (10 targets) have shown no significant effect upon accuracy.

ELECTRICAL STRAIN SENSITIVE GAUGES: L. G. Stier

A dynamic calibration was made of an Ess gauge wound on the breech of a Springfield rifle. A draft of the Progress Report on this project has been completed.

NEW POWDERS FOR BRIDGEPORT: R. M. Blunt

In continuation of the work reported on DuPont EX-4924 in the last report, investigation of the moisture resistance of the following powders has been made with the cooperation of Department DTC: 4898, EX-4991, 4753, 1301; further testing of EX-4991, 1301 and two new powders is still in progress. EX-4991 shows the best moisture resistance of any DuPont powder tested

to date; its performance in velocity, pressure and accuracy tests was satisfactory save for an excessive 73 ft/sec. velocity drop upon humidified storage of loaded rounds. The cause of this drop is now being investigated. The improved moisture resistance of EX-4991 is due to the substitution of K_2SO_4 for KNO_3 , the former salt being less hygroscopic under similar conditions.

As a result of the recent change in the patent situation the use of double-base coated powders in center fire ammunition is now possible, and the suitability of some of these powders is being investigated.

REVOLVER BALLISTICS—CALIBER .38 SPECIAL FMC: R. M. Blunt

The internal ballistics of revolvers is now being studied by means of a special weapon, constructed to permit varying the critical dimensions. The performance of .38 Special 158 gr. FMC cartridge as loaded with 4898 powder has been acceptable, hence the urgency of this particular phase of the revolver study has been decreased.

ARMS DESIGN GROUP - ILION

P. B. RUTHERFORD

HIGH POWER SLIDE ACTION RIFLE:

Model 1X-760: J. D. Howell

Firing tests, including approximately 3,000 rounds of caliber .30-06 ammunition, indicated revisions to be desirable in the breech locking and action bar mechanisms. This test

firing, however, was completed with no apparent adverse effect upon the aluminum receiver or the aluminum trigger guard.

In line with these tests further design work is being carried on to revise the breech locking and action bar mechanisms and to improve the fore-end mechanism, as requested by the Sales Department. It has become necessary to request an additional appropriation to carry on further development work.

Model 2X-760: G. H. Hart

A preliminary design of an alternate construction for high power slide action rifle has been completed and a model is being tested. The firing of approximately 1,000 rounds of caliber .30-06 ammunition indicates that this alternate construction can be made to operate satisfactorily. The testing, however, has indicated certain revisions to be desirable to improve function and increase strength at certain points. A further appropriation will also be required to continue this work.

HIGH POWER AUTOLOADING RIFLE:

Model 1X-740: H. W. Young, J. D. Howell

Preliminary testing of the autoloading means on the Model 1X-760 confirmed the necessity for revising the breech locking and action bar mechanisms. Further test work on this model awaits a revision in the design of these components. The alternate revision of bolt rotating means which was at one time thought to have possibilities for use in the autoloading action has proved to be unsatisfactory.

Model 2X-740: G. H. Hart

The preliminary design of an autoloading means to be added to the Model 2X-760 action is approximately 90% complete and sample parts for one model are approximately 70% complete.

SINGLE BARREL SHOTGUN:

A Part II project has been approved to resume development work on the low cost single barrel shotgun. However, due to the greater urgency of other items, design work has not yet been started. An outside designing company has been contacted relative to the possibility of assisting in the development of this arm. This possibility appears to hold promise and is being investigated further.

AUTOLOADING SHOTGUN:

Model 2X-850: C. C. Orloff, O. H. Loomis, L. A. Rix

A simplified design of breech locking and shell feeding mechanism has been incorporated in a sample model. Tests, including the firing of approximately 2,000 rounds of ammunition, indicate that the revised mechanism can be made to operate satisfactorily. It has been necessary to revise the angle of the locking shoulders in this mechanism and upon completion of these revisions tests will be continued to determine whether or not, with the new cartridge feeding mechanism which has eliminated the cartridge stop and carrier latch cuts in the receiver, a die-cast aluminum receiver will be sufficiently strong.

Further development work is being done on the basis

of furnishing three basic sizes for the 12, 16, 20, 28, and .410 gauges. This program will allow for a greatly reduced tooling cost and should simplify manufacturing problems.

LOW COST HIGH POWER BOLT ACTION RIFLE:

Model 1X-721: M. H. Walker

Work on the Model 1X-721 High Power Bolt Action Rifle has been temporarily held up due to the higher urgency of other items on the development program.

LOWEST COST SINGLE SHOT .22 CALIBER BOLT ACTION RIFLE:

Model 1X-500: D. R. Luster

Based on the appearance and cost the Model 1X-500 having the steel topped receiver has been determined to be better than that utilizing the wood covering over the action mechanism. Further design work on this model is necessary to offer improved functioning and improved appearance.

Model 2X-500: G. H. Sanders

An alternate design of a low cost single shot .22 caliber rifle has been made utilizing a more conventional locked breech mechanism. The preliminary model of this construction indicates that satisfactory operation can be obtained with very low production cost. Further design work is necessary to refine the arm from a functioning and appearance standpoint.

.22 CALIBER AUTOLOADING RIFLES:

Model 550—Improvement to Function: C. C. Loomis, R. P. Kelly

Based upon the testing of approximately 175 rifles with revised components, it is indicated that with the revisions

now contemplated the Model 550 rifle can be made to function satisfactorily. A review is being made of the model drawings of the parts affected by the changes so as to incorporate in these drawings the changes required for this improvement. A project has been submitted by the plant to cover the revision of tools necessary to manufacture the revised components.

Model 2X-550: G. H. Sanders, L. A. Rix

Preliminary design work on a lower cost construction for an autoloading rifle has been completed and manufacture of the first model is approximately 50% complete.

A most interesting development has been made in this connection. It has been found that, through the use of the straight tapered chamber previously developed for the Model 1X-500 single shot rifle by D. R. Luster and with a lighter weight bolt and action spring, it is possible to make up a rifle which will satisfactorily operate over the entire range of .22 caliber cartridges, from the .22 Short Spatterless to the .22 Long Rifle High Speed cartridges, without the use of a recoiling chamber. Additional work is being carried on to determine the causes for this ability to operate over the wide range of cartridges and, if possible, to set up definitive dimensional limits for patent purposes. It is evident that the cost of the rifle can be very materially reduced if it is possible to eliminate the recoiling chamber.

Model 1X-541: D. R. Luster

Design work on the autoloading version of the rotating block action employed in the Model 1X-500 has been held up pending revisions in the design of the Model 1X-500 action itself.

Model 2X-541: G. H. Sanders, L. A. Rix

A preliminary design has been worked out for a low cost autoloading rifle to utilize the Model 510 or Model 2X-550 components where possible. Recent development of an action which will operate satisfactorily with any of the present .22 caliber cartridges without the use of the recoiling chamber has made it desirable to hold up on this design.

.22 CALIBER SLIDE ACTION RIFLE:

No further development has been made on this rifle due to the higher urgency of other work.

MODEL 610 ACCURACY STUDY: C. C. Loomis, M. H. Walker

Under authorization of Project TM-3349, ten Model 610 rifles were made up with revisions planned to improve the accuracy of the .267 caliber gun-cartridge combination. These revisions included (1) strengthening of the receiver by leaving a solid bridge across the bolt lug recess; (2) heat treating the receiver throughout; (3) increasing the bolt lug area; and, (4) brazing the barrel and receiver joint. With these changes and with closely controlled shooting conditions a very material improvement in accuracy was obtained. However, it was determined that the tendency of the present lead bullet to lead the bore of the barrel is so prevalent as to exclude any extended accurate firing. It is indicated that in order to improve this condition a re-evaluation of the cartridge must be made. A Progress Report is being prepared.

ADAPTATION OF MODEL 610 TO .22 HORNET: C. C. Loomis

Work on preparation of ten models of Model 610 rifles adapted to the .22 Hornet cartridge is approximately 50% complete.

CEMENT GUN: C. C. Loomis

The new style Cement Gun utilizing a falling block instead of a reciprocating bolt has been tested extensively in the field under the direction of Mr. Dewey Godfrey. Reports from these tests indicate that the new construction operates very satisfactorily and would be received quite favorably by the trade if it were placed on the market.

A project is being prepared by the plant to cover the purchase of forty of these new style guns.

RITE-FLITE TRAP: D. R. Luster

Following further testing of the skeet and trap models of the Rite-Flite Trap at the Findlay plant, patterns are being made up for the casting of parts on a pilot production basis. Further tests will be made on these production models.

RITE-FLITE TRAP RELEASE: D. R. Luster

The design of a release to be used in the Rite-Flite Traps is complete and the first models have been made. Pending actual tests on the traps themselves, these releases appear to be satisfactory.

ACTION ON FIELD COMPLAINTS:

Model 81 Firing Pin: C. C. Loomis

It has been found that with the new two-piece firing

pin for the Model 81 rifle, it may be possible to fire the shell before the breech is completely locked. One gun has been returned from the field which indicates that this must have happened. A review of the design has been made which indicates that, by revising the firing pin sleeve so that it will engage with the cam pins, it will be possible to prevent the firing pin from protruding through the face of the bolt until the action has been locked up. A Change of Manufacture request has been started to cover this revision.

Model 513-T Magazine Lock: C. C. Loomis

A sample model has been made up of a revised magazine lock which indicates distinct advantages, both in appearance, function, and in the prevention of breakage, over the present lock. The new style lock, however, does present certain problems in the Assembly Department, the extent and difficulty of which cannot yet be forecasted. To determine the extent of this difficulty a batch of 200 of the new style parts is being made up and will be assembled in rifles.

Model 11: C. C. Loomis

A project has been approved to cover the manufacture of approximately twenty Model 11 shotguns incorporating several revisions which have been developed for the purpose of improving the action, durability, or production cost of the gun. These twenty guns are to be submitted to the Sales Service Group for

extensive testing in the gunnery training schools.

CHEMICAL AND METALLURGICAL GROUP - ILION

SHADBURN MARSHALL

MODEL 850 DIE CAST RECEIVER TEST: S. Marshall

The firing of approximately 2,000 rounds in the Model 2X-850 experimental gun, using a die-cast receiver, has failed to indicate any serious failures.

The shell feeding mechanism of this action has been revised so as to eliminate the cartridge stop and carrier latch cuts in the receiver. These cuts previously caused weak points which failed in the die-cast receiver test.

WALNUT BLANK PROCESSING: R. F. Shaffer

A very material difference in scrap losses was found to occur between the first (low scrap) run and the subsequent (high scrap) runs of Springfield rifle stock blanks urea treated prior to the kiln drying. It is indicated that this difference probably was due to differences in the condition of the wood itself prior to the treatment. It will be necessary to conduct further tests to determine more accurately the factors affecting the scrap losses.

APPLICATION OF BROWNING SOLUTION: R. F. Shaffer

The process of applying the acid for browning by spraying instead of with natural sponges has proved to be satisfactory. The method was used on approximately 50% of one week's production for Model 11 and Model 513 components. A Progress Report is now being written.

INDUCTION BRAZING:

A project has been approved and the order placed for induction heating equipment to be used in further, more extensive testing of the use of induction heating for brazing firearms components. Numerous brazed joints have been tried on model guns and found to be satisfactory. On the basis of these tests many of the design features of the new items in the development program are being based on the use of induction brazing. As yet, a non-destructive method of testing brazed joints has not been found.

ARMS PROCESS GROUP - ILION

E. M. WILSON

BARREL PROCESSING: E. M. Wilson and Industrial Engineering Division

Process schedules for the production of high power rifle and shotgun barrels at costs approximating the .22 caliber rifle barrel costs have been drawn up and groups of barrels have been made up according to these schedules. To date it is indicated that very material reductions in costs can be obtained with no reduction in the quality of the finished product.

DRAW RIFLING: M. H. Walker

A pilot production lot of approximately 4,000 barrels has been rifled by the new process. Tests have indicated that the accuracy of barrels so rifled is equal to that of barrels rifled by the conventional method. Arrangements are now being

made with the Ordnance Department to allow the use of the draw rifling process for any or all of the Springfield rifle barrels.

PRECISION CASTING: E. M. Wilson, E. G. Drumm

A project having been approved to cover further development of the precision casting process, E. M. Wilson and E. G. Drumm have spent approximately one week at the plant of the General Electric Company, at Schenectady, learning the details of the precision casting process as used at that plant. Equipment has been ordered, or is being fabricated, for use of the process in the Ilion laboratory.

WOOD FINISHING: E. M. Wilson, R. F. Shaffer

Having obtained quite promising results from preliminary tests, a cylindrical mold has been completed and submitted to an outside company to conduct further experiments with the proposed method of finishing wood stocks by impregnating the surface with thermosetting resins and subsequently curing it under heat and pressure. It is now indicated that it may be possible to impress the checkering in the stocks or fore-ends by this process.

PLYWOOD: R. F. Shaffer

A die has been made up for use in forming a plywood fore-end for the Model 2X-760 rifle. Preliminary results from parts made with this mold, together with samples of plywood barrel guards for the Springfield and Garand rifles which have

been supplied by outside companies, indicate that the use of plywood for fore-ends is possible and holds definite promise for post-war use.

INTELLIGENCE GROUP - BRIDGEPORT

J. F. HUTCHINSON

PATENTS:

Assistance has been rendered to Patent Attorneys in several patent cases.

Opinions have been obtained of the value of certain selected patents and copies of these patents, together with the opinions, have been circulated among various members of the Remington organization in accordance with Manufacturing Department Instruction No. 77.

Translations have been made of German patents cited by the Patent Office against our patent applications.

Copies of various patents have been ordered from the Patent Office for interested parties.

The Official Gazette of the U.S. Patent Office has been reviewed each week and patents of interest to members of the Technical Staff have been ordered from it.

Checks have been made on the status of a number of patent cases.

Copies of the Western-Winchester ammunition patents have been obtained and opinions have been obtained from the Technical Staff as to Remington interest.

LIBRARY:

Book lists, advertisements and reviews have been examined and those books appearing to be of interest have been ordered for the library.

Loose copies of magazines have been bound and books requiring it have been rebound.

The monthly list of U.S. Government publications has been reviewed and those of interest ordered for the library.

Photostats of articles from journals we do not have in our library have been obtained from other libraries for members of the Technical Staff.

Items have been located in the library for various individuals...

JOURNAL ARTICLES, TRANSLATIONS, ETC:

Journal articles or abstracts of them have been called to the attention of different members of the Technical Staff.

Minutes have been taken of the proceedings of several meetings.

Notebooks have been witnessed for various members of the Research Staff.

Changes in the shipping regulations of the Interstate Commerce Commission have been reviewed and those of interest have been communicated to the proper parties.

Changes in process at the Bridgeport and Kings Mills plants have been reviewed for the Technical Committee.

Assistance has been rendered in various explosives
and safety matters.

WOS:MDB
2/2/44

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