Tests and Developments of Semi-Automatic Shoulder Arms at the Springfield Armory, 1900-1914

[by Constance McLaughlin Greene]

Beginnings of the Investigation

The story of the Springfield Armory's connection with the development of semi-automatic shoulder arms begins in early 1900. Even before the Ordnance Department had issued requests or listed requirements for a semi-automatic suitable for military service, one S. M. McClean of Cleveland offered to submit for test not only an automatic gas-operated one pounder but a small arm model as well. Although nothing further was heard in Springfield of McClean's model for another nine years, and the Armory files reveal no record of any models ever being presented for formal test, the attention of the Ordnance Department nevertheless was thenceforward focused on the possibility of developing a military semi-automatic rifle.[1] In October 1900 Colonel Frank Phipps, Ordnance, then Commanding Officer at the Springfield Armory, wrote to the Chief of Ordnance urging the procuring of models of semi-automatics being developed in Europe:

> As the tendency abroad seems to be towards the introduction of an automatic shoulder arm, as well as revolver, it would seem to be advisable [sic] for the Department to be prepared to submit one, should there be any demand for such an arm in this country. (S.A. 109, O.O. 35271, 2nd Ind., Incl. 10, Oct. 11, 1900.)

In the course of 1901 two models were considered at Springfield Armory, one formally tested by a Board of Officers convened for that purpose. Test of the Bergmann combination automatic pistol and carbine, a recoil-operated weapon, resulted in November, 1901 in unconditional rejection of the model as being too heavy and too badly balanced to be suitable for the service.[2] Blueprints of the second weapon, a trooper's gas-operated automatic rifle submitted by the Buescher Manufacturing Company of Elkhart, Indiana, indicated that the design of their rifle was too complicated to merit formal test. In spite of the Company's assurance that the rifle could be used either as a full or semi-automatic arm, and that its parts were simple and not likely to get out of repair, Colonel

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[1] S.A./2, O.O. 22396 Incl. 21, 1st, 2nd, 3rd, 4th Ind., May 12, 15, July 14, 1900, May 7, 1901; S.A. 109/g, O.O. 38351-97, March 22, 1909.

[2] S.S. 109, Report, Nov. 4, 1901

Phipps reported it unsuitable because of the large number of small and weak parts, its likelihood of clogging with dirt, and the objectionable feature of a gravity cartridge feed.[3]

During the next two years considerable correspondence was carried on between Colonel Phipps, the Chief of Ordnance, and American military attaches in European capitals in an endeavor to obtain completed foreign models of semi-automatics.[4] But until midsummer of 1903 these efforts proved abortive.

Springfield Designs

Meanwhile, without waiting for models from abroad, the Springfield Armory staff was working on the problem. In June 1902 J.L. Murphy, the mechanical draftsman at the Armory, submitted a drawing of a gun which, it was hoped, might serve as a basis for development.[5] A year later a blueprint and description of a simpler recoil-operated model was forwarded to the Ordnance Office, a rifle designed with a telescopic bolt according to a plan of Captain John Thompson, then stationed at the Armory. Requests from the Ordnance Office for calculations to determine the action of the mechanism before any work be undertaken upon the construction of a model delayed the developmental work many months,[6] and authorization of the manufacture of a semi-automatic of this design was not granted until November 8, 1905.[7] Murphy himself died in December of that year. Lt. Wilford J. Hawkins, Ordnance Department, was then put in charge of the fabrication and one rifle was completed in October 1906.[8]

The test conducted in November, however, revealed insuperable weakness in the rifle. "…the friction developed between the cartridge case and chamber walls is so great as to retain all or part of the case in the chamber under any pressure obtained." This was deemed a fundamental fault which obliged the Board to label that type of gun impractical.[9]

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[3] S.A. 2, Nov. 21, 1901, 1st, 2nd Ind., Dec. 2, 1901, Dec. 20, 1901, 2 Incls.
[4] e.g. S.A. 109/a, O.O. 026791, Jan. 23, 29, Mar. 5, 1902, Jan. 31, 1903; S.A. 109/e, filed under 109/g, O.O. 37392-2, June 19, 1902
[5] S.A. 109, O.O. 37392-2, June 19, 1902
[6] Ibid., 3rd, 4th and 5th Ind.
[7] S.A. 109/e, O.O. 37392-2, 9th Ind.
[8] S.A. 109/e, O.O. 37392-2, 10th Ind.; S.A. 109/e Oct. 15, 1906 (Col. Phipps to the Board constituted by Paragraph IV, Post orders No. 53 of 1905)
[9] S.A. 109/e Report of the Board of Officers, convened in compliance with Post Orders No. 53, dated S.A., Mass., Sept. 25, 1905, Nov. 15, 1906, Par. VI.

This discouraging outcome of five years' work was a less severe blow to the Armory staff than might have been, because the Board was at the same time able to render a favorable verdict upon the rough working model of a new automatic, designed by Lt. Hawkins who had been directing work upon the Murphy rifle. "This [Lt. Hawkins'] form of rifle is now so far as is known by the Board and from its action in the rough, unperfected model, the design seems to show considerable promise."[10] Complete drawings and fabrication of a finished rifle were recommended. The new model was ready by May 1907[11] and was reported upon by the board in June. [12] Difficulty in the bolt catch, which failed to retain the bolt as the barrel moved forward in counter-recoil, led to the recommendation of redesign of the bolt catch before continuing the test. That change effected, further modifications were experimented with over a period of three years more.[13] The report of the Board upon the first modification of 1907 has not been located in the Armory files.

But progress upon the Hawkins' rifle was slow and not until mid-February 1910 could the Commanding Officer, Colonel S.E. Blunt, announce that the redesigned arm would be shortly ready for testing.

> "It was found that in the original design of this rifle that sufficient space was not allowed between head of bolt and end of cartridge where the former was in its recoiled position. The space was so small that the cartridge did not have sufficient time to rise before the bolt commenced its forward movement thereby causing a jam. …The jamming was however overcome by…shortening the cartridge… With the exception of occasionally faulty extraction which can be easily overcome, the rifle now functions satisfactorily."[14]

If formal test of this modified rifle was conducted, no record of the report has been found in the Armory files. But in February 1911 the Commanding Officer declared that while experiments had been confined and several slight improvements of design achieved, every effort to overcome overheating of the barrel and consequent tendency of the barrel to remain in its recoiled position had been unsuccessful. He recommended that the experimentation be dropped:

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[10] Ibid., Par. VII
[11] S.A. 109/g, O.O. 37392-4, 6th Ind., May 14, 1907
[12] Ibid., Report of a Board of Officers… June 28, 1907
[13] S.A. 109/I, O.O. 26791-0-1365, 1st, 2nd, 4th, 6th, 7th Ind., Sept. 20 1907, Apr. 1, 15, 23, June 25, 1908
[14] S.A. 109/h, O.O. 38351-172, 3rd Ind., Feb. 14, 1910

> "While the design of this rifle is ingenious, it is not believed that it can be made to function satisfactorily, and moreover, a design having a recoiling barrel has many objections for a service arm"[15]

Again in the fall of 1912 Lt. Colonel W.S. Pierce, successor to Colonel Blunt as Commanding Officer at the Springfield Armory, advised abandonment of endeavor to develop any semi-automatic shoulder arm with a recoiling barrel, and meanwhile a promising model with a fixed barrel had been tested at the Armory. So after ten years of work the two first Springfield designs were abandoned.[16] Later, in August 1913, a totally new design was undertaken, the scheme of Captain Creedy C. Sheppard of the Ordnance Department, then stationed at the Armory. Upon this, work was carried on down to 1917.[17]

Specifications

Fortunately in the interim considerable process upon models had been made by various other inventors. In 1904 a printed form had been issued from the Armory entitled: Program of Preliminary Tests of Self-Loading Magazine Rifles and Carbines Submitted by Inventors at the Springfield Armory. (See Appendix I.)[18] Five years later a second circular appeared: Program of Tests of Self Loading Magazine Rifles and Carbines Submitted by Inventors at the Springfield Armory. (See Appendix II.)[19] With this list of requirements to be met American inventors and foreign armsmakers could better prepare their models. In the spring of 1909 at the request of the Ordnance Office the Armory sent out a further sheet: The Design of a Semi-Automatic Rifle Should Embody the Following Features:

> (1) A simple, strong, and durable mechanism, composed of as few parts as possible, readily dismounted and mounted with as few tools as practicable, and assembled with the minimum number of springs, screws, or pins. The mechanism should be as compact as practicable.
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> (2) The caliber should be about 0.30.
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> (3) The magazine or other attachment for holding cartridges to have a capacity of not less than eight. The Department will, however, consider a design submitted with a view of modifying or adapting the present service rifle to a semi-automatic rifle, in which case a capacity of 5 cartridges in the magazine will be sufficient.

[15] S.A. 109/k, O.O. 38351-107, 4th Ind., Feb. 11, 1911
[16] Ibid., 8th Ind., Nov. 21, 1912
[17] S.A. 114-1, 3, 4, O.O. 38351/675, 684, 689, Dec. 29, 1913, June 19, 1914, S.A. 114-5, O.O. 38351-712, Jan 28, 1914; Notebook of firing and adjustment data, June 19, 1914, Jan. 11, 1917 in S.A. 114-1 to 5
[18] S.A. 109/c, O.O. 38543-11, Nov. 28, 1904, 2nd Ind.
[19] Ibid., 3rd & 4th Ind., March 23, 1909, March 29, 1909.

(4) The weight of the bullet to be not less than 150 grains.

(5) The initial velocity to be not less than 2650 feet per second.

(6) The bolt to be locked or in its firing position before the firing mechanism can be operated

(7) The breech-block to remain open when the last cartridge in the magazine has been fired.

(8) The trigger pull (measured at middle point of bow or trigger), not to be less than three nor more than 4 ½ pounds.

(9) A magazine cut-off, and a safety or locking device permitting arm to be carried cocked and with cartridge in barrel without danger.

(10) A minimum limit of fire, considering time for motion of parts, for reloading, etc., of 90 rounds per minute, when firing as rapidly as possible.

(11) (a) must be capable of use as a single loading arm, magazine in reserve. (b) Must be capable of use as a magazine rifle, fed by hand, with semi-automatic feature entirely cut out.

(12) Recocking the piece without moving bolt in case of mis-fire.

(13) Reasonable certainty of action in automatic loading and ejection.

(14) Comparatively easy action in ejecting by hand in case of mis-fire or jam.

(15) Good balance and shape, adapted to shoulder firing.

(16) Not to be automatic.

(17) Weight not to exceed 11 pounds. This does not include cartridges or bayonet.

THE FOLLOWING FEATURES ARE CONSIDERED DESIRABLE:

(1) In the construction, such separation of parts that each part may be readily replaced in case of repair. Parts riveted together or more or less permanently joined are objectionable.

(2) Vertical in preference to side ejection of cartridge case.

(3) No special tools for dismounting or assembling.

(4) An automatic indicator of the number of cartridges in the magazine, the mechanism to be so arranged as to prevent the entrance of dust, etc..

(5) Cartridges of length over all not more than three inches. The use of shorter cartridges will allow of reproduction in length of receiver, and will facilitate feeding. This is considered a very desirable feature.

THE FOLLOWING FEATURES ARE PREFERABLE:

(1) A bolt securely locked to the barrel until the bullet has left the bore.

(2) Interchangeability of parts between rifles of the same model.

(3) A bolt in one piece, to a bolt with a separate head.[20]

Public interest was now more sharply than before concentrated upon the specific problems involved in the development of semi-automatic shoulder arms. Not until April 1913 was minor amendment to these official requirements made.[21]

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[20] S.A. 109/g, O.O. 38351-75, 3rd Ind., April 5, 1909

[21] S.A. 109/k, O.O. 38351-593, 1st Ind., April 26, 1913

So while men at the Armory worked upon the design and construction of the Murphy and Hawkins rifles, a number of independent inventors, American and foreign, developed their own ideas. In the summer of 1902 Colonel Phipps, having studied specifications and drawings of a design of a St. Louis man, J.J. Reifgraber, wrote in his rejection of the proposed model: "Gas operated shoulder arms to date have not met with success."[22] Both Springfield experimental models of this early period were recoil-operated. But during the first decade of testing more gas-operated than recoil-operated designs were to be examined, and it is of some interest to note that in the 1930s Garand's gas-operated rifle was to be accepted as more useful than the rival blowback model of John Pedersen.

Adaptations of Automatic Side-Arms

Inasmuch as automatic pistols had been familiar weapons for many years, it was not surprising that the first types of semi-automatic shoulder arms were adaptations of automatic side arms. Thus the Bergmann automatic carbine tested in 1901 was an automatic pistol with minor modifications to transform it to a shoulder arm. The Luger carbine tested the next year was a similar, albeit more successful, adaptation made by lengthening the barrel and fitting on a removeable [sic] shoulder stock The test of the Luger model, like that of the Mauser carbine tried out in October 1903, was pronounced unsatisfactory because of difficulty with the ammunition supplied. From the Armory came word that the cartridges for the Luger pistol, theoretically useable in the carbine also, were not powerful enough to operate the section of the longer-barreled carbine.[23] The Mauser carbine was briefly dismissed with the comment that since the action was like that of the Mauser automatic pistol upon which a full report had been made in Appendix 15 of the Report of the Chief of Ordnance for 1900, no exhaustive test was considered necessary. The poor performance of the Mauser carbine was attributed to the faulty ammunition.[24]

One other pistol-carbine was tested, the Mannlicher Military Carbine. The report of July 23, 1904, describing the arm as a recoil-operated semi-automatic, functioning by a

[22] S.A. 109/a, O.O. 37739-2, July 15, 1902, 2nd Ind..
[23] S.A. 109/a, July 3, 18, 1902
[24] S.A. 109/b, Oct. 10, 1903

rectilinear retrograde movement of the barrel, receiver, and bolt, declared the weapon liable to malfunctioning from dust and not having a strong enough bolt spring, counter recoil spring or firing pin impact to withstand military service. Unless redesigned it was therefore pronounced unsuitable for further consideration.[25] No further formal tests of these pistol-carbines were conducted, presumably because in the interim more serviceable types of semi-automatic shoulder arms were being evolved.[26]

The Schouboe Semi-Automatic Rifle

The rifle which was considered apparently the most promising of any fully tested before 1907 was a Danish model, the invention of Lt. Jens Schouboe, put out by the Dansk Rekyl Riffel Syndicat of Copenhagen. A first test was conducted by the Board of Officers convened at the Armory for that purpose in September 1903. The weapon, a recoil-operated arm, functioned sufficiently well to result in the Board's requesting the inventor to embody a series of changes in the design and then to resubmit the rifle.[27] Report of the test of the redesigned model was made on April 7, 1905.[28] Tests of further modifications were made in 1906, 1909, and 1911. "The most serious defect noted was the overriding of the cartridge or the follower of the bolt, and in the former case the consequent jamming of the cartridge at the front end as the bolt moved forward."[29] The difficulty lay in the pressure created by the 1903 cartridge, for, with the Danish ammunition, functioning was satisfactory. So the rifles were returned for further changes.[30]

The attempt to adapt the Schouboe design to use with 1903 cartridges proved unsuccessful[31] and not until 1909 was another model, also unsatisfactory, submitted.[32] Report of the 1909 test has not been found. In April 1911 the Report of the Officers testing the latest Schouboe model was emphatically condemnatory:

1) The magazine could hold but 5 cartridges
2) The safety feature were [sic] unsatisfactory

[25] S.A. 109/c, July 23, 1904
[26] S.A. 111/c – O.O. 18884-58, April 14, 1905
[27] S.A. 111/c. O.O. 35921-28, 1st Ind.
[28] S.A. 111/c, O.O. 35921-40, 6th Ind.
[29] Ibid., Report of a Board of Officers… Par. 39
[30] Ibid., 8th Ind., June 29, 1905
[31] S.A. 111/d, O.O. 35921-78, 1st & 2nd Ind., Report, May 26, 1906, 6th Ind., June 7, 1906
[32] S.A. 111/h, O.O. 35921-123, Nov. 23, 1909

3) Rate of fire, 45 rounds per minute, was insufficient [sic]
4) It was not readily useable as a magazine rifle
5) In case of misfire recocking necessitated moving the bolt to the rear
6) It was not accurate, due to the recoiling barrel
7) Broken parts were not readily replaced
8) Tools were needed for dismounting and assembling
9) There was no automatic indicator showing the number of cartridges in the magazine
10) There was no device to show whether or not the rifle was loaded
11) The bolt was in two pieces instead of one
12) There was no adjustment for the retractor spring or the percussion spring
13) The arm lacked strength and durability

The report concluded:

"It is inferior to our service rifle in accuracy, and serviceability and in rapidity, except when used as a semi-automatic."[33] By that time, however, the competition had become much keener and each invention showed the result of cumulative experience.

Attachments for the Service Rifle M1903

Three attempts were made to find devices to convert the standard service rifle M1903 to a semi-automatic. The first was undertaken by W.D. Condit of Philadelphia who, through his collaborator, after eighteen months' work upon a M1903 offered for preliminary test and criticism a gun called the "Smith-Condit Self-Loading, Gas-Operated Rifle."[34] The test of March 13, 1905 was not exhaustive, but the Board of Officers suggested a series of changes which would improve the model enough to warrant a full test. The redesign requested was to include

1) A device to show when the magazine was empty.

2) Location of the safety-lock where it could be more easily seen.

3) Redesign to permit removal of the bolt mechanism without disassembly of the whole arm.

4) If the device for regulating the gas vent was necessary, some means of showing the corresponding position of the vent.

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[33] S.A. 111/I, O.O. 35921-138, April 11, 1911
[34] S.A. 109/b, O.O. 26791-0-250, Oct. 29, 1903, 1st Ind; S.A. 109/c O.O. 38544-38

5) An arrangement to permit using the service cartridge clip.

6) A reduction of the 10 ½ pound weight.[35]

But the improved model attachment was never resubmitted, if indeed it was ever worked on at all.[36]

The second endeavor to devise a method of converting the M1903 to a semi-automatic was Franklin K. Young's then of Chatham, Massachusetts. Young obtained from the Armory one of the new 1903 service rifles from which to work and wrote in the fall of 1906 to say that his converted model was completed.[37] But the invention later described by Colonel A.H. Russell of the Ordnance Department as "built up by additions to the present Springfield magazine rifle, with, perhaps a few changes,"[38] was not submitted to examination at the Armory until November 1910. The model was not constructed for a severe test but the design gave such promise that the Board recommended fabrication of a rifle of strength to withstand the regulation test. A modification of the M1903, Young's rifle omitted twenty-three parts but replaced these with thirty-one, and contained three springs fewer than the service rifle.[39] The cost of manufacturing guns of this design in quantity was estimated by Colonel Blunt of the Armory to be $16.00 per rifle. "This design follows so closely that of the regular service rifle that but a few alterations would have to be made in the machines, tools and fixtures; hence the low estimate."[40] Young therefore began work upon the manufacture of a carefully built rifle, but did not present it for further examination until October 1912.[41] Although after attempting to meet criticisms made then Young again brought his rifle to the Armory for view, still no formal test was made.[42] By special action of the Board of Ordnance and Fortification at this point (March 1913) arrangements were made to have one rifle of the design manufactured at the Armory under the supervision of the inventor.[43] After some months work the mechanism was informally tested several times

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[35] S.A. 109/c, O.O. 38544-38, April 1, 1905
[36] S.A. 109/e, 38351-39, Feb. 28, 1907
[37] S.A. 109/e, O.O. 38351-30, Feb. 18, 1905; 109/d, O.O. 38351- Aug. 3, 1905; S.A. 109/e, O.O. 38351-37, Oct. 29, 1906
[38] S.A. 109/m, O.O. 38351-374, Oct. 29, 1910
[39] Ibid., 2nd Ind., Nov. 29, 1910
[40] Ibid., 8th Ind., Feb. 27, 1911
[41] Ibid., O.O. 38351-411, 3rd Ind., Dec. 20, 1912
[42] Ibid., O.O. 38351-457, 2nd Ind., Jan 21, 1913
[43] Ibid., O.O. 38351-518, 2nd Ind., April 30, 1913, O.O. 38351-507, 1st Ind., March 14, 1913

in the fall of 1913[44] only to have the Commanding Officer report that the final successful operation of the mechanism was not due to any of the features of Young's design, but was wholly dependent upon the inclined bolt lug. As funds allotted for experimentation upon this design were expended Young was informed that further development must be conducted elsewhere at his own expense.[45] The mechanism was never resubmitted for test.

A third scheme for converting the service rifle to a semi-automatic was offered by Grant Hammond and his backer Dr. Thomas Darlington in December 1909. As in the case of the Smith-Condit device and the Young, the advantages of a conversion in place of a wholly new arm were self-evident. The first tests, begun on December 10, 1909 and continued from February 18 to March 1, 1910, and renewed on June 24, 1910, showed the gas-operation attachment not strong enough for service use, the action affected by dust and the rapidity of fire attainable insufficient.[46] In June 1911 again Hammond submitted for test an attachment based this time upon a different principle. The report upon this rather reluctantly pronounced the defects too numerous and too hard to overcome to warrant further consideration of the device. The Board thought the mechanism complicated and likely to get out of order; the rapidity of fire was less than the desired ninety rounds per minute; misfires were too frequent because of uncertainty of action of the firing mechanism; the bolt catch was uncertain of action; the gas chamber tended to clog with residue from the powder; the metal parts were exposed where likely to burn the hand of the rifleman; the springs and main spring were affected by the heat generated in firing; cartridge loading and ejection was uncertain; balance was poor; and the bolt flew back and forth so rapidly when the attachment was in use that it would strike the hand of the soldier holding the gun as many did.[47] In spite of this damming list of faults the Board was apparently regretful to reject wholly the Hammond attachment for, assuming that it were possible to remedy the weaknesses named, the cost of conversion of 1903s already in service was estimated at $35 apiece.[48] But in September 1913 the final verdict was given that it was too costly for the Ordnance Department to try

[44] Ibid., 38351-507, 4th Ind., Nov. 11, 1913
[45] Ibid., 8th Ind., Dec. 15, 1913
[46] S.A. 109/h, O.O. 39041-13, Dec. 10, 1909; 39041-49, June 24, 1910
[47] S.A. 109/I, O.O. 39041-58, 3rd Ind., Incl. 1, June 7, 1911
[48] Ibid., 5th Ind., June 19, 1911

to develop any revision.[49] This decision was doubtless influenced by the hopes still at the time held of the feasibility of the Young mechanism on the one hand, and the enthusiasm over the seeming possibilities of Captain Sheppard's rifle or the Bang, on the other.

New Designs of Semi-Automatics, 1910-1914

From 1910 down through 1914, in addition to the semi-automatic attachments, rifles of Springfield Armory design, and the Schouboe, tests were made of some six other models. Drawings of others were examined but no models sent for test.[50] Five of the six models tested were discarded rather promptly, the Standard Arms Company model, the Dreyse Automatic Carbine, the Kjellman Automatic Rifle, the Benét-Mercie, and the Rock Island Arsenal model. Only the Bang semi-automatic received prolonged consideration.

The "Standard Semi-automatic Sporting Rifle" was twice tested in the early month of 1910. It may have been a further development of the "Smith-Condit Self-Loading Gas-Operated Rifle" (see above p.8), inasmuch as W.D. Condit was Secretary of the Standard Arms Company. The new rifle was gas-operated. The Board of Officers examining the Standard refused to recommend it, not because of malfunctioning of the semi-automatic mechanism, but because of the rifle's unsuitability as a military arm. Not only was it not designed for service ammunition, it was labeled not strong enough to use that high pressure type. Its rapidity of fire was less than ninety rounds per minute and the length of time needed for disassembly and the number of tools needed for reassembly told against it. There were other lesser faults, but probably the chief objection was the rifle's general lack of sturdiness.[51]

The same criticism of not being strong enough to use service ammunition resulted in the rejection of the Dreyse Carbine and the Kjellman Automatic rifle. In the case of the Dreyse, tested on September 12, 1910, the report declared the gun neither safe nor sturdy enough.[52] The Kjellman, a recoil-operated arm of Swedish invention, was of lesser caliber

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[49] S.A. 109M, O.O. 39041-67, Sept. 15, 1913
[50] e.g. S.A. 109/h, O.O. 34384-65, 2nd Ind., Incl 1, June 21, 1909; 109/j, O.O., 38351-237, 2nd Ind., May 21, 1910; 109/m, O.O. 38351-628, July 21, 1913; 109/m, 38351-645, Incl 1, October 22, 1913; S.A. 110-2, O.O. 38351-731, March 6, 1914.
[51] S.A. 109/I, O.O. 38351-213, April 8, 1910; S.A. 109/h, O.O. 38351-232, 2nd Ind., Incl 1, June 16, 1910
[52] S.A. 109/h, O.O. 38351-239, 2nd Ind., Sept. 12, 1910

than .30, did not achieve the desired rapidity of fire or initial velocity, and displayed various other weaknesses. On the other hand, several advantageous features, the 9.72 pound weight, the balance, the few tools required for dismounting, the useableness either as a self-loader or as a repeater, the arrangement whereby the bolt had to lock before the firing mechanism could be operated, and several others, led the Ordnance Department to instruct the Armory to repair the damage done the rifle during the second part of Test XI, (See Appendix II) and then ship the arm to Rock Island Arsenal.[53] Rock Island was to undertake further firing tests.

In October 1913 the Rock Island Arsenal itself submitted for test at Springfield a semi-automatic designed and manufactured at the western arsenal. After only two shots had been fires, however, the bolt broke. As the mechanism failed to meet the requirement of simplicity, strength, and compactness, the Commanding Officer of the Armory, recommended that no new bolt be fabricated or further firing tests be conducted.[54]

A few weeks before the unqualified disapproval of the Rock Island design, the Benét-Mercíe automatic shoulder rifle was tried out. This was basically a modification of the Benét-Mercíe automatic machine rifle, the U.S. M1909, lightened and adapted to use as a shoulder arm. The report of the Board of Officers in Springfield announced the rifle to be ingenious of design but too complicated and expensive. Comprising 211 parts, the semi-automatic would be too costly to manufacture for service use.[55]

The Bang Semi-Automatic Rifle

But the semi-automatic arm upon which especially high hopes were placed after 1911 was a gun invented by a Dane, S.H. Bang. Tests followed by modifications of design and then further tests were to be carried on for some years. After the World War the Ordnance Department set Captain Hatcher of the Ordnance service to work upon perfecting a model using the Bang principle.[56] The Bang gun first submitted to test at Springfield, however, in May 1911, was designed for use only with 7.5 or 8mm ammunition. Therefore, after a first test the rifle was returned to the manufacturers with

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[53] S.A. 109/I, O.O. 38351-265, 2nd Ind., Nov. 9, 1910, O.O. 38351-272, 4th Ind., Dec. 16, 1910
[54] S.A. 109/m, O.O. 38351-531, Oct. 29, 1st Ind., Oct. 30, 1913
[55] S.A. 109/m, O.O. 39153-931, 1st Ind., Oct. 7, 1913
[56] Annual Report of Operations, Springfield Armory, Fiscal Year ending June 30, 1920, #67

request that the inventor adapt it to the U.S. .30 caliber service ammunition and make several other changes of design.[57]

The new 1911 model, tested on July 30, 1912, was enthusiastically received and the Board of Officers reported that "the functioning of this rifle was more satisfactory than has heretofore been obtained at this Armory from any other rifle of this type."[58] In spite of some defects, notably the wedging of the cartridge in the magazine, and the opening in the bolt unlocking sleeve's not being properly regulated for the service ammunition, the United States Ordnance Department endeavored to secure rights to manufacture 100 of these Bang guns to issue for trial in the field. While the conditions proposed by the Aktieselkabet Bangs Skydevaaben of Copenhagen, the manufacturer, were so drastic as to cause the Ordnance Office to refuse them,[59] the Ordnance Office did arrange with Bang personally to supervise at the Armory some alterations upon the one rifle tested in July. The firings of this altered rifle, conducted in October, showed perfect functioning of the mechanism but such heat was developed that the stock was scorched.[60] In fact twenty months later Captain Sheppard noted that tests of the Bang had shown that if a wooden stock were used upon a semi-automatic shoulder arm some kind of insulation of stock from barrel was essential.[61] Only the fact that by the end of 1913 Armory officials believed Captain Sheppard's own design more promising than the Bang led the Ordnance Office to drop for the time being testings of the latter.[62]

Renewal of Tests the next year followed, an endurance test of an altered 1911 model, and some weeks later a complete test of the 1913 model in which were embodied a number of changes desired by the Ordnance Department.[63] The report of the testing Board noted the improvements in the 1913 model, but listed several weaknesses. In the words of Lt. Colonel W.S. Pierce, the Commanding Officer:

> It is not believed that this rifle in its present stage of development is satisfactory as a military arm, although it is the most promising semi-automatic shoulder rifle known to this office. The weight of the rifle [9.93 lbs.] is somewhat against it; its

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[57] S.A. 109/k, O.O. 38351-305, -339, May 27, Sept. 16, 1911
[58] S.A. 109/k, O.O. 38351-380, 6th Ind., Sept. 4, 1912
[59] Ibid., O.O. 38351/409 Oct. 3, 1912
[60] S.A. 109/k, O.O. 38351-400, 1st Ind., Oct. 14, 1912
[61] S.A. 114-4, O.O. 38351-675, 684, 689, June 19, 1914
[62] S.A. 109/m, O.O. 38351-511, 1st, 2nd Ind., Mar. 13, Sept. 15, Sept. 18, 1913; O.O. 38351-685, 1st Ind., Dec. 26, 29, 1913
[63] S.A. 110-7, O.O. 38351-750, 1st Ind., June 12, 1914; S.A. 110-9, O.O. 38351-757, 1st Ind., June 3, 1914

> accuracy is not equal to that of the service rifle; and its ease and certainty of operation are not yet satisfactory.[64]

The Bang 1913 model was kept at the Armory to serve as a basis for developmental work. But little further was to be accomplished till after the World War.[65]

[64] S.A. 110-13, O.O. 38351-526, 8th Ind., Nov. 13, 1914, Incl.
[65] S.A. 110-18, O.O. 38351-786, 1st Ind., Dec. 12, 1914; Annual Report of Operations, Springfield Armory, 1916, #11; 1917, #11.

Appendix I

PROGRAM OF PRELIMINARY TESTS OF SELF-LOADING MAGAZINE RIFLES AND CARBINES SUBMITTED BY INVENTORS AT THE SPRINGFIELD ARMORY

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1. The piece will be dismounted and assembled, and the times, number and kinds of tools required for each of the following operations noted"

(a) To dismount the breech and magazine mechanism with the exception of the lock

(b) To dismount the lock.

(c) To assemble the lock.

(d) To complete the assembling of the piece. The number of parts and the kinds of springs will be recorded. The number of pins and screws will also be noted.

2. PRELIMINARY FIRING – The piece will be fired as a self-loader 100 rounds into butt to observe the general behavior. No time will be taken and the firing will be deliberate enough to prevent the necessity of cooling during this test.

3. RAPIDITY WITH ACCURACY – The piece will be fired from the shoulder at a target 6' x 2', range 100 feet, under the following circumstances, the cartridge disposed at will upon a table.

(a) Number of shots and hits firing for one minute, using gun as a self-loader. Test begun with magazine empty.

(b) Number of shots and hits firing for one minute, using gun as a repeater. Test begun while magazine empty. Any cartridge missing fire in this or other tests will be opened to ascertain the cause of failure.

4. RAPIDITY AT WILL – The same as Test Three, except that a piece may be fired from the hip without aim into a butt at short range. Hits will not be considered.

5. DUST – With the mechanism closed, and both ends of the barrel tightly corked, the piece will be exposed in the box prepared for that purpose to blast of fine sand for two minutes and then removed. The surplus sand may be removed by blowing thereon, jarring the piece or wiping with the bare hand only. It will then be fired twenty rounds under the following condition.:

(a) Magazine empty when exposed to dust. Before firing, charge the magazine and fire as self-loader.

(b) Magazine loaded when exposed to dust. Remove and wipe cartridges, re-load and fire as above.

In case the self-loading mechanism fails to work in either tests (a) and (b) the piece will then be tried as a repeater.

6. VELOCITY – The velocity of the bullet at a distance of 53 feet from the muzzle will be determined, taking the mean of five shots.

7. ENDURANCE – The piece will then be fired deliberately 500 rounds as a self-loader for endurance, cooling the barrel after each 50 rounds.

8. EASE OF MANIPULATION – The general working of the piece will then be examined by the members of the Board.

9. DECREASED CHARGES – The piece t be fired 12 rounds as a self-loader with cartridges in which the powder charge has been decreased so that the first four fired will give pressures 25% less, the second four 15%, and the last four 10% less than the service pressure.

10. EXCESSIVE CHARGES – The piece to be fired five times as a single loader with cartridges in which the charge of powder is so increased as to produce a pressure in the chamber of 64,000 pounds per square inch.

11. PIERCED PRIMERS – The piece will be fired once with a service cartridge in which the primer has been thinned so as to insure piercing.

12. RUST – The mechanism will be thoroughly cleansed of grease, the ends of the barrel tightly corked, and the piece then placed in a solution of sal ammoniac for five minutes. After exposure to the open air for twenty-four hours, ten shots will be fired into a sand butt, using the piece as a self-loader. In case the self-loading mechanism fails to work, the piece will then be tried as a repeater.

GENERAL REMARKS – During the above tests the piece will be entirely in the hands of the Board and no alterations or repairs other than those possible on the ground will be allowed, except by special permission of the Board. If the piece fails in any test the remainder of the program may be discontinued in the discretion of the Board. Any piece which successfully passes the foregoing tests may be subjected to such supplementary tests to further determine its endurance or other qualities as may be presented by the Commanding Officer.

Appendix II

PROGRAM OF TESTS OF SELF-LOADING MAGAZINE RIFLES AND CARBINES SUBMITTED BY INVENTORS AT THE SPRINGFIELD ARMORY

Test I.

(a) The gun will be dismounted and an examination made by the Board of all the working parts of the gun.

(b) The number and means of all parts, and the kinds of springs will be noted. The number of pins and of screws will be noted.

Test II.

The times, number and kinds of tools requires for each of the following will be noted:

(a) To dismount the piece.

(b) To assemble the piece.

(c) To dismount the breech and magazine mechanism with the exception of the lock.

(d) To assemble the breech and magazine mechanism with the exception of the lock.

(e) To dismount the lock.

(f) To assemble the lock.

Test III.

The piece will be fired as a self-loader 100 rounds into butt to observe general behavior. No time will be taken and the firing will be deliberate enough to prevent the necessity if cooling during this test.

Test IV.

RAPIDITY WITH ACCURACY – The piece will be fired from the shoulder at a target 6'x2', range 100 feet, under the following circumstances, the cartridges disposed at will upon a table.

(a) Number of shots and hits firing for one minute, using gun as a self-loader. Test begun with magazine empty.

(b) Number of shots and hits firing for one minute, using gun as a repeater. Test begun with magazine empty. Any cartridge missing fire in this or other tests will be opened to ascertain the cause of failure.

Test V.

RAPIDITY AT WILL –

(a) Same as Test IV (a) except that the number of hits will not be considered and that the piece may be fired from the hip without aim into a butt at short range.

(b) Same as Test IV (b) except that the number of hits will not be considered and that the piece may be fired from the hip without aim into a butt at short range.

Test VI.

VELOCITY – The velocity of the bullet at a distance of 53 feet from the muzzle will be determined, taking the mean of five shots.

Test VII.

DUST – With the mechanism closed, and both ends of the barrel tightly corked, the piece will be exposed in the box prepared for that purpose to a blast of fine sand for two minutes and then removed. The surplus sand may be removed by blowing thereon, jarring the piece or wiping with the bare hand only. It will then be fired twenty rounds under each of the following conditions.

(a) Magazine empty when exposed to dust. Before firing charge the magazine and fire as self-loader.

(b) Magazine loaded when exposed to dust. Remove and wipe cartridges, re-load and fire as above.

In case the self-loading mechanism fails to work in either of tests, (a) and (b), the piece will then be tried as a repeater.

Test VIII.

ENDURANCE – The test will be fired deliberately 500 rounds as a self-loader for endurance, cooling the barrel after each 50 rounds. The general working of the piece will then be examined by members of the Board.

Test IX.

DECREASED CHARGES – The piece to be fired 12 rounds as a self-loader with cartridges in which the powder charge has been decreased so that the first four fired will give pressure 25% less, the second four 15%, and the last four 10% less that the service pressure.

Test X.

EXCESSIVE CHARGES – The piece to be fired five times as a single loader with cartridges in which the charge of powder is so increased as to produce a pressure in the chamber of 64000 pounds per square inch.

Test XI.

The gun will be fired twice with each of the following cartridges:

(a) Cross-filed on head to nearly the thickness of metal

(b) Cut at intervals through extractor groove into powder space.

(c) Cut longitudinally nearly through the body of shell

Test XII.

RUST – The mechanism will be thoroughly cleansed of grease, the ends of the barrel tightly corked, and the piece then placed in a solution of sal ammoniac for five minutes. After exposure to the open air for twenty-four hours, ten shots will be fired into a sand butt, using the piece as a self-loader. In case the self-loading mechanism fails to work, the piece will then be tried as a repeater.

GENERAL REMARKS – During the above tests the piece will be entirely in the hands of the Board, and no alterations or repairs other than those possible on the ground will be allowed, except by special permission of the Board. If the piece fails in any test the remainder of the program may be discontinued in the discretion of the Board. Any piece which successfully passes the foregoing tests may be subjected to such supplementary tests to further determine its endurance or other qualities as may be prescribed by the Commanding Officer.

SPRINGFIELD ARMORY,
March 29, 1909