

THE JOHNSON SEMIAUTOMATIC RIFLE

HEARING

BEFORE THE

COMMITTEE ON MILITARY AFFAIRS

UNITED STATES SENATE

SEVENTY-SIXTH CONGRESS

THIRD SESSION

ON

S. 3983

A BILL TO PROVIDE FOR THE ADOPTION OF THE
JOHNSON SEMIAUTOMATIC RIFLE AS A
STANDARD ARM OF THE MILITARY
AND NAVAL FORCES

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MAY 29, 1940
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THE JOHNSON SEMIAUTOMATIC RIFLE

WEDNESDAY, MAY 29, 1940

UNITED STATES SENATE,
COMMITTEE ON MILITARY AFFAIRS,
Washington, D. C.

The committee met, pursuant to call, at 10 a. m., in the committee room, Capitol, Senator Morris Sheppard (chairman), presiding.

Present: Senators Sheppard (chairman), Chandler, Bridges, and Johnson of Colorado.

The CHAIRMAN. The committee will come to order.

The committee has before it S. 3983, "To provide for the adoption of the Johnson semiautomatic rifle as a standard arm of the military and naval forces."

The reporter will insert the bill at this point in the record.

(S. 3983 is as follows:)

[S. 3983, 76th Cong., 3d sess.]

A BILL To provide for the adoption of the Johnson semiautomatic rifle as a standard arm of the military and naval forces

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Johnson semiautomatic rifle, caliber .30, is hereby adopted as a standard arm of the United States military and naval forces, to be known as the United States semiautomatic rifle, M2, caliber .30.

The CHAIRMAN. Mr. Melvin M. Johnson, Jr., will make a statement and take charge of his side of the matter.

STATEMENT OF MELVIN MAYNARD JOHNSON, JR., REPRESENTING JOHNSON AUTOMATICS, INC., ACCOMPANIED BY JOHN BAB- COCK HOWARD

Mr. JOHNSON. If the chairman please, I am here on behalf of the Johnson Automatics, Inc., appearing in favor of this bill.

Mr. HOWARD. My name is John Babcock Howard. As general manager and treasurer of Johnson Automatics, Inc., I desire to incorporate in the record Mr. Johnson's qualifications, he being our chief witness and representative of the company.

Melvin Maynard Johnson, Jr., of Boston, Mass., age 30 (captain, U. S. Marine Corps Reserve), graduated from Harvard University, B. S. 1931, and from Harvard Law School, LL. B. 1934. He was captain of the Harvard Rifle and Harvard gun teams (also on Harvard varsity crew). He began shooting Springfield rifles at the age of 12 and has had a great deal of experience with firearms of all types.

Johnson graduated from the Field Artillery Reserve Officers' Training Corps, Harvard University in 1931. He transferred to the

Marine Corps Reserve in 1933. He was promoted to first lieutenant, in 1936, to captain in 1938. He has taken various courses and instruction in military subjects.

Johnson has written extensively on the subject of military weapons, and so forth, in such magazines as the Marine Corps Gazette (over a dozen articles); Army Ordnance (five), American Rifleman, and so forth, and has also written for law review journals. He has lectured on and instructed in weapons and other military subjects on many occasions. He has recently completed the manuscript of a prospective book on automatic weapons. He is the inventor of the Johnson rifle and Johnson machine guns.

Johnson is a member of the Massachusetts bar, and an instructor in law at Boston University. He is the president and a director of Johnson Automatics, Inc., New York City; American Semi-Automatic Arms Co., Inc., Boston, Mass.

Johnson has personally fired over 80,000 rounds of M1 and M2 ammunition in testing some of the Johnson rifles.

Mr. JOHNSON. In view of circumstances which are taking place in Europe, we feel that it is particularly imperative at this time that the American people should have sufficient equipment with the very least delay humanly possible.

We are in favor of this bill because we feel that the Johnson rifle is particularly well adapted for military use, and because the Johnson rifle is particularly well adapted to mass production in a short time in large quantities.

In presenting our views on this bill, I wish to emphasize the manufacturability of the Johnson rifle.

There are various witnesses here whom I know who have had some experience in firing the Johnson rifle, either personally or had something to do with tests or demonstrations of the Johnson rifle.

However, the particular point at this time seems to us to be the question of having sufficient equipment.

I realize very well that the War Department is in favor of having one single standard rifle and one single standard of each type of equipment so far as possible. However, in the history of our Army we have never yet fought in any war with one single type of rifle, and in fact with respect to other weapons, such as machine guns, light machine guns, and automatic or machine rifles, we have had several types. I believe there were something like 5 machine guns used by the United States forces during the World War, namely the Chauchat, Hotchkiss, Lewis, Vickers, Marlin, and possibly the obsolete Benet, old Colt, and 2 then new Browning types. When we entered the World War we had approximately 600,000 Springfield M1903 rifles.

I will take the liberty, since this is of public concern, of asking any gentleman from the Ordnance Department or any other gentleman from the War Department to correct me. I think my figures are generally correct. We had 600,000 rifles.

Now as I understand it, we adopted the Enfield M1917 rifle as an auxiliary to supplement the M1903 rifle. The Enfield rifle was to some degree in production at the time we entered the World War. As a result, during the war we manufactured caliber .30 rifles at five different plants, at the Springfield Armory, at Rock Island Arsenal, and we manufactured the Enfield at Eddystone, as well as at Winchester and Remington.

We manufactured, so far as I can figure it, caliber .30 rifles at the rate per annum of approximately 2,300,000. I will ask Mr. Jervey or Colonel Drewry, who are present, if that is approximately correct. I have those figures from several sources. I understand from General Pershing's book on his experience in the World War that we actually shipped abroad something over a million and three-quarters caliber .30 rifles which were made during the period of the war.

The CHAIRMAN. To save time, we won't ask questions of any others while you are testifying. They can make notes on these figures you give, and it will save time for them to refer to it if it is necessary for them to refer to it.

Go ahead.

Mr. JOHNSON. By the end of the war we had produced upward of 3½ million caliber .30 rifles. At one time the production reached 50,000 rifles per week.

The fact that we had two standards was somewhat inconvenient from the standpoint of supply problems, but on the other hand, I would like to make the statement as strongly as I can that I think it is a matter of policy that we should first have sufficient equipment, even if to get that equipment we are obliged to resort to several different models in any category. I am well aware of the advantages of a single standard.

We have at the present time, as a result of the past general feeling of the American people, I think it is fair to say, perhaps an inadequate amount of war equipment. I may be usurping my prerogative, if I have any, to say that it is my conviction that if there is any blame to be attached for that, it is to be attached to the people of the United States, who, like the people of England, did not wish to have any army, were not willing to pay the price that was necessary to maintain an army, were not willing to provide funds for the often necessarily extensive experimentation and trial of military inventions.

Now we have, with regard to rifles, as I understand it, we have a large number of the relics of the World War, Enfields and Springfields. I understand that there are approximately two million caliber .30 rifles of the two types, Enfield and Springfield, which are in reserve. It has been admitted that we would have to use those rifles at the beginning of another emergency. Those rifles use the same ammunition, caliber .30, M1 or M2 or M1906. Both of those rifles load with Springfield clips, a 5-shot brass clip or a charger from which the cartridges are stripped into the magazine.

So far as I am aware, most of the other United States caliber .30 weapons and certain of their accessories are well adapted to the use of that clip. For example, the loading machine that is used on the Browning machine gun M1917, I believe is adapted to the use of that clip to strip cartridges to be loaded into the belt.

Now, to refer for the first time specifically to the Johnson semi-automatic rifle, in that connection the Johnson rifle was particularly designed during 1938 and 1939 to be adapted to the Springfield-type clip.

I want to state here very frankly that I enjoyed the recommendations and advice of many friends in the Army, in the Marine Corps, particularly people in the Ordnance and Infantry; in fact, some of the officers who were in General Lynch's office at one time specifically discussed with me the advantages of the use of the Springfield clip in

a rifle in view of the large number of rifles which we have adapted for that clip.

I am not trying to go into a digression on how to load a rifle. That is a technical matter, and there are certain criticisms of the Springfield-type clip, but I do want to state here that I think we must take into consideration the fact that we have those two million rifles already which load with that clip, and that it is certainly an advantage of the Johnson rifle that it is adapted to the Springfield clip.

Also, the rifle is well adapted for the use of any standard caliber .30 ammunition. I think the records of tests will establish that point as far as it is necessary.

Now, to speak specifically for a moment about the action of the rifle. I have first mentioned what I think are the most important basic characteristics that we need in rifles, we have none too many, especially of semiautomatic types, we need them very badly and in a hurry.

I do want to make this point about the Johnson rifle. It is of the short-recoil type.

In developing that rifle, like any designer, I have tried to incorporate as many features as were practicable consistent with other factors which bear on the matter, particularly manufacturability and simplicity of design, and so far as possible a reliable mechanism. In developing the Johnson rifle I have tried to read considerably on the subject of automatic weapons. I have here, which I would like to put in evidence, as it were, the Infantry School Mailing List, 1933-34, volume VIII, June.

On page 212 is an article by the infantry school on semiautomatic rifles. I read this, I think, at the time that it came out, as I have subscribed to this publication, and there is a reference on page 212 to the various types of action of automatic weapons, which are gas, blow back, and recoil.

There is a reference to the gas-operated type, and on page 213 I will read from the Mailing List a reference and hand this to the reporter.

(The book referred to was filed with the committee.)

Mr. JOHNSON (reading):

The recoil-operated type utilizes the kick or recoil from the explosion to perform the necessary operations. It is generally conceded that this mechanical principle furnishes the best possibilities for the type of gun desired.

And there is then a description of one particular type of rifle, the gas-operated caliber .276 Garand.

The CHAIRMAN. How much of that do you wish to put in the record?

Mr. JOHNSON. Just the part which I have read, sir.

The CHAIRMAN. Very well.

Mr. JOHNSON. Having that in mind, having fooled around, as it were, with automatic weapons, I finally tried to develop a short-recoil action.

That action was first developed and fired successfully in 1936 [indicating]. This is the first action of the Johnson rifle.

The CHAIRMAN. We will call that exhibit A.

(Exhibit A was filed with the committee.)

Mr. JOHNSON. It is the basic—

The CHAIRMAN. Hold that so I can see it.

Mr. JOHNSON. Yes, sir. It has the basic essentials of the rifle. This used a Springfield barrel—yes; I have here a Springfield barrel. I show you a Springfield barrel.

The CHAIRMAN. Exhibit B.

(Exhibit B was filed with the committee.)

Mr. JOHNSON. B. It was adapted specifically to this basic action. This action consisted of a bolt of the rotary type, of a frame or receiver to carry it. The barrel has already been mentioned. The means is provided on the barrel to lock the bolt to the barrel. There is a means provided for ejecting the empty shell, there is a main spring [pointing to the rear of the action] which is connected to the breech lock. The ejection part is here—pointing to the middle and side of the receiver.

This was put together with a certain amount of praying, a string was tied to the trigger, and the speaker retreated behind a corner and pulled the string. The rifle fired and for some reason the empty shell came out.

There were some models made after that. I will not take the committee's time to bring them or show them.

The CHAIRMAN. You are exhibiting now two more models of the Johnson rifle?

Mr. JOHNSON. Two of the latest type; yes, sir.

The CHAIRMAN. We will call those exhibits C and D.

(Exhibits C and D were filed with the committee.)

The CHAIRMAN. Which would you name first?

Mr. JOHNSON. This rifle—

The CHAIRMAN. This one you are showing now is earlier than the other one?

Mr. JOHNSON. No, sir; this is the latest in point of time but one.

The CHAIRMAN. Yes. Well, what is the other one?

Mr. JOHNSON. The other one is slightly after that. Merely a difference in the type of bayonet equipment.

These two rifles represent the adaptation of two types of bayonets to the latest model of the Johnson rifle.

Going back just for the moment, models of the rifle were made after 1936, after the advent of exhibit A, which were naturally not what could be called perfected models. Without going into the detail which has already been put in the record on several other occasions, this rifle has been demonstrated, too, and tested by the Ordnance Department, and there was a demonstration at Fort Benning of the rifle in 1938 for the Infantry Board, which was a test of this particular rifle, exhibit C; that particular rifle was tested in December 1939.

Now, just a few brief words on these two exhibits, C and D.

These are Johnson rotary-feed type clip-loaded semiautomatic rifles.

The CHAIRMAN. The only difference between C and D is in the bayonet?

Mr. JOHNSON. Is in the bayonet. I will, then, cover the point on the bayonet.

I have here in my hand exhibit C, which uses the dagger bayonet.

I now have in my hand exhibit D, which has the sword bayonet.

We cover that point in passing; the object of the sword bayonet is to eliminate tying the bayonet to the recoiling barrel.

Thus I show you the barrel recoiling and the bayonet does not recoil with the barrel.

Returning to exhibit C, the bayonet which we call the dagger type recoils with the barrel.

I have no comment to make about the bayonets except that they offer two types; one weighs a pound, the sword type; the other a half pound, the dagger type.

The CHAIRMAN. Is there any particular advantage in recoiling with the barrel or not recoiling with it?

Mr. JOHNSON. Our opinion is that the recoiling barrel with this bayonet tends to increase the penetration of the bayonet. That is quite demonstrable, but off the record, we don't want to cut up the committee room. The sword bayonet may be of any length desired. If the blade protrudes 8 inches beyond the muzzle the over-all length of the blade would be approximately 16½, possibly 17 inches. The over-all length of the Springfield bayonet blade is 16 inches.

While we are being so gory, this sword bayonet presents a blade directly underneath the barrel so that in closing with a man it may be practicable to strike him with some effect on the shoulder or neck, in this fashion [illustrating] by striking the gentleman on the shoulder or in the neck with the blade, which may be at least embarrassing for the opponent. And we believe that it has that particular advantage at close quarters.

The CHAIRMAN. You believe it is preferable to the dagger bayonet, generally?

Mr. JOHNSON. Well, for the record, we have both types and as far as we are concerned we offer the weapon with either type of bayonet.

THE CHAIRMAN. Well, do they have special uses, does each type of bayonet have a special use?

Mr. JOHNSON. There is so much doctrine, sir, on the subject of bayonets, and with the Chief of Infantry sitting here I wouldn't venture to make any personal remarks about bayonets. We have tried to offer two types of bayonets and so far as being an ugly piece is concerned perhaps the sword type possibly is more ugly and possibly has more effectiveness. That is a question which is more or less a tactical one.

The CHAIRMAN. But you can furnish either?

Mr. JOHNSON. We can furnish either.

The CHAIRMAN. Or both?

Mr. JOHNSON. Or both.

One further point, the attachments which are required for the sword bayonet are such that they can be quickly installed in any of our rifles which are not previously adapted to that type. So the answer is that we do not have any choice as to the two types. I don't want to go into a lot of technicalities. There is one point which I think I should mention which I think the representatives of the War Department here and the Navy Department and Marine Corps will appreciate, which we find in the sword type bayonet. I believe that certain Marine officers here will be able to tell you that this is a substantially correct statement, that the center of impact of the rifle is not changed appreciably by the attachment of the sword bayonet. The accuracy isn't affected so far as we can discover by either bayonet.

The dagger bayonet is not well adapted for functioning with the M-2 ammunition. If it is desired to fix the bayonet at all times in combat then I would frankly recommend the sword bayonet. Some

others feel that when ammunition is exhausted that the day is done or that the bayonet dagger type may be attached when the magazine is empty and the weapon is no longer used as a rifle.

I will venture to say that if I had ammunition in my own gun in combat, if I could be prevailed upon to stand up in combat, that I would be inclined to use the ammunition until it was exhausted before resorting to the bayonet in any case.

Now, the next point, the matter of loading.

Using exhibit D, I show you the Johnson rifle and I insert a clip of five cartridges which are stripped off from a Springfield clip.

Off the record, sir, I assure you that these to the best of my knowledge are dummies.

I then load the chamber.

I then insert a single cartridge into the magazine and the weapon now contains 11 rounds—11 cartridges.

Now briefly, I show you a few advantages in this magazine. And I wish to state particularly for the record that some of the basic features incorporated in this magazine were discussed with some very cooperative friends of mine in the services. The first point is to always have the magazine fully loaded at all times. I now simulate firing by drawing out a cartridge. One shot having been fired I take a fresh cartridge and put it back in the magazine.

Without taking the committee's time, that of course can be done to any degree with any number of cartridges from one up to the magazine capacity.

The CHAIRMAN. What is the magazine capacity?

Mr. JOHNSON. Ten cartridges and one in the chamber.

For example, I will simulate functioning with five or six rounds—five or six cartridges.

I now take a Springfield clip and replace five, without opening the breech, which contains a cartridge ready to be fired at any time.

The CHAIRMAN. All the time there is one in the breech?

Mr. JOHNSON. There is one in the chamber, ready to be fired. If I were in combat, and I started to load this cartridge and wanted to fire, I can because there is a cartridge in the chamber.

By feeling with the thumb I know my magazine is full. I have put back five rounds from a clip and one round single loaded.

To empty the magazine or to change the type of ammunition as for example to change from ball ammunition to tracer, I press the magazine cover and remove the cartridges from the magazine. I then remove the cartridge from the chamber.

Now we have a great deal of machine gun ammunition in combat as I understand it. That ammunition is loaded in belts—at least the machine gunners hope so—otherwise it may be in cartons. Very frequently it is not loaded in clips. If it were desired to load this weapon in the absence of clips the cartridges can be loaded into the magazine singly and the weapon is capable of functioning as a magazine rifle without the use of a clip or charger. At any stage in the proceeding desired one may load the chamber. The process can be done with the bolt closed or open.

The CHAIRMAN. Is there any different mechanism for taking the empty cartridge out of the breech from that used in taking the empty cartridges in the clip out, in the magazine?

Mr. JOHNSON. Well, for removing the cartridges, sir, you press the magazine.

The CHAIRMAN. That is from the magazine?

Mr. JOHNSON. From the chamber you raise the handle and pull it back.

The CHAIRMAN. Well, it is a different mechanism?

Mr. JOHNSON. Well, that is common to all weapons, sir; you have to pull the breech open to pull the cartridges out of the chamber.

For firing single shots I insert a cartridge in the magazine with the bolt open and close the bolt and that can be done as long as desired [demonstrating].

To sum it up, the magazine in this rifle can be loaded in any combination of ways and with the bolt open or closed. The procedure that we recommend for the magazine—there are several—is, for example, in target firing and continuous firing, is to fire all but one cartridge and then reload 10 cartridges. We always leave a cartridge in the chamber and it is quicker to load two clips at one time than to load one 5-shot clip and go through that by firing and then to load another.

However, in combat if troops were instructed to fire not over five or six or possibly seven rounds unless an emergency arose they would always have something in reserve and would always reload with a 5-shot clip, therefore having something in the magazine for any emergency. Furthermore, the soldier need never be defenseless while loading the magazine, for it—unlike others—can be reloaded while the rifle is cocked ready to fire.

The CHAIRMAN. Why do you call this semiautomatic?

Mr. JOHNSON. Because it fires but one shot for each function of the trigger. As for example, when the trigger is pulled the action operates, the operator then releases the trigger and pulls it again.

The CHAIRMAN. In an automatic machine gun, pressure on the trigger fires all the shots in the magazine?

Mr. JOHNSON. That is correct, sir.

Since that has been brought up, and not to confuse the committee with exhibits, here is a Johnson full-automatic-type weapon which was developed which is exhibit E, which is the same Johnson action adapted for full automatic firing.

The CHAIRMAN. You have two handles thereon, don't you?

Mr. JOHNSON. Yes, sir; this is the magazine [pointing to the center] and the grip [pointing to the rear of the magazine] in this form. This gun is cocked with the bolt open. When the trigger is pulled it loads, locks, and fires and continues to do so until the trigger is released. This is essentially the action of the Johnson rifle except it is full automatic. So that is exhibit E.

The CHAIRMAN. One of those grips is for shoulder and the other is for holding it against the body. One of the grips was against the shoulder.

Mr. JOHNSON. That is the buttstock. The buttstock is against the shoulder.

The CHAIRMAN. That's right. The pistol-type grip is for the hand?

Mr. JOHNSON. Yes, sir.

The CHAIRMAN. Like the grip of a pistol?

Mr. JOHNSON. Yes, sir.

The CHAIRMAN. I see.

Mr. JOHNSON. Now, this next exhibit which is F—I hesitate to show this, and I should prefer, except for the urgency of everything that

goes on today, that this would have first gone down to Colonel Drewry at the Ordnance office. This is not entirely finished, and I have a hesitancy in showing sort of an unfinished symphony, but this gun is of some significance in this case, and so I feel it is justifiable to show it now. It gives me an excellent opportunity with so many distinguished gentlemen from the War Department here.

This gun is our latest attempt on a Johnson light machine gun, which might more technically be called an automatic rifle, taking such definition from articles and definitions prescribed by the Chief of Infantry, who is here today.

The chairman spoke a moment ago of the semiautomatic and this weapon is either full or semiautomatic. It has a few distinct features. In the first place I show you a rifle, a Johnson rifle, and this light machine gun, exhibit F, and you will see that fundamentally and in fact in a great many respects they are the same weapon. The Johnson light machine gun weighs but 12 pounds. Now, our objective has always been to try to get the same basic mechanism and as many parts as possible to be the same in both the rifle and the machine rifle or automatic rifle. And this gun, exhibit F, has at least 75 percent rifle components in it, our idea being that if we are in production on a Johnson semiautomatic rifle we will have established a very major part of the production of a machine rifle or automatic rifle or light machine gun. I haven't had an opportunity to finish the work on increasing the capacity of the magazine for this gun so I will not go into the matter of the magazine at the moment. But the action of the gun I now show in semiautomatic style. The gun is cocked with the bolt closed on a cartridge in the chamber and this gun now fires one shot for each function of the trigger. It is designed that way so that the operator will get the maximum accuracy of which the gun is capable when fired semiautomatically. All other guns of this class are cocked with the bolt open, as was this weapon here, exhibit E.

I now show the Johnson light machine gun, exhibit F, prepared for full automatic firing. The gun is cocked with the bolt open. That is chiefly to eliminate the danger of what is called cooked cartridges. If the gun is left cocked with the cartridge in the chamber, being an air-cooled gun, there is always danger of preignition.

Now I show this gun, exhibit F, on full automatic. I pull the trigger and the bolt closes, locks, and fires.

I now show the operating switch in the vertical position which puts the gun on safety. In the forward position semiautomatic, in the rear position full automatic. To go to semiautomatic you throw the switch forward, the gun locks and cocks and that is prepared for a single function of the trigger. The unit which includes the part which, as it were, transfer this rifle, I show here. I release a catch and pull off the buttstock unit which discloses a main spring and the rest of the weapon disassembles the same as the Johnson rifle with the barrel coming out from the front end and the bolt unit coming out from either end [demonstrating]. That operation includes the bolt which is substantially the Johnson rifle bolt, the barrel which is the Johnson rifle barrel, complete, firing pin, also of Johnson rifle.

For the record, I am showing parts taken from the Johnson light machine gun. The operating handle also common to both weapons and the receiver in particular and the ejector, particularly the receiver, is the Johnson rifle receiver. That being a major component, being put in production on the rifle, it is thereupon in production for

the machine gun. The buttstock unit—there is no need further to take the committee' time, is now on semiautomatic—[illustrating]. It is now on full automatic—[illustrating].

So much for the Johnson light machine gun.

Now, one more point for the action and then I should like if I may to introduce to the committee some of the distinguished witnesses who have been so kind as to come here today to testify on manufacturability. But first, the question of the barrels in this gun.

I am now using the Johnson rifle, exhibit D. I remove the barrel from the Johnson rifle. Earlier I spoke of the adaptation of a Springfield barrel, exhibit A, and I again show you a Springfield barrel adapted to the Johnson rifle or machine gun.

I then show you a barrel made by Winchester from the M70 Winchester caliber .30 rifle. That barrel being 20 inches long, the other barrel 24. I show that to illustrate that it is possible to have a carbine or standard length barrel in the same rifle by merely exchanging the barrels. Also two different makes of barrels, both of which are or have been available in production and many of which are apparently on reserve. I have no knowledge of their condition, but they are apparently in reserve.

Now, the question of adapting the Springfield or Winchester barrels, or the adaptation of the Enfield barrel or the adaptation of the M1917 barrel. I now show you an Enfield 1917 barrel which has been adapted to the Johnson rifle, together with the Springfield barrel. You will note that the Enfield barrel is longer, that having been the standard length of the Enfield barrel, I believe 25 inches, the Springfield being 24 inches.

Now the question of the facility of adapting these barrels I must I think make clear. There has been some confusion about it.

I point to the rear of the barrel and I point to the Johnson locking bushing which is screwed on—threaded on—to the Springfield thread on the rear of the Springfield barrel, by exactly the same process that the same barrel is assembled into a Springfield rifle.

I then show you in the center of the barrel the Johnson barrel guide bushing. The operation of assembling that bushing is practically identical—this is my statement based upon our experience—with the rear sight fixed base on a Springfield rifle.

It is driven on as is the fixed base—I am going to get involved off the record now in exhibits—I am exhibiting a Springfield '03 rifle.

Shall that be an exhibit?

The CHAIRMAN. That will be exhibit G.

Mr. JOHNSON. I show you on exhibit G the rear sight fixed base which is driven on to the Springfield barrel and pinned with a spline pin in the same manner that this bushing (pointing to the Johnson adapted Springfield barrel) is adapted to that barrel. There is nothing any more unusual in that operation than there is encountered in putting the Springfield rifle together in its basic assembly. The Johnson front sight is a one-piece sight—pointing to the front of the barrel—with two spline pins. The purpose of adapting those barrels to the Johnson rifle is because it was desired as far as possible to have some part of the gun and particularly an important part of the gun available and perhaps in production in advance of the production of the entire rifle.

Now, just two or three points on the barrel and then I would like to introduce the manufacturers. Barrels are the item which wear

out the quickest in a rifle. It is understood that the life of a rifle barrel runs from sometimes as low as 5,000 to 8,000 rounds up to perhaps 15,000 rounds. Since a semiautomatic rifle is a quick-fire weapon, it naturally wears out the barrel quicker than a Springfield. Therefore the feature of being able to remove these barrels in the field for cleaning, for replacement, and repair by the soldier is certainly not a disadvantage.

The Johnson barrel is adapted to being readily cleaned from the breech. The rifle has been engineered particularly so that it has been established that the barrels are interchangeable providing the drawings have been followed, and we will now go into that in a moment, so that it is possible to exchange barrels, and there is not a head-space problem. And we have determined that from making production models from drawings and checking that out.

The CHAIRMAN. Is that one of the exclusive features of the Johnson rifle?

Mr. JOHNSON. Perhaps, sir; there might be another rifle lurking in some shop that has that feature. I think I can safely say without contradiction that this is the first high-powered rifle that has offered a quickly detachable barrel.

The CHAIRMAN. Now by way of brief summary what are the other exclusive features of the Johnson rifle?

Mr. JOHNSON. Well, I will try to avoid any particularly questionable points.

The CHAIRMAN. That is what I said, exclusive features of the Johnson rifle.

Mr. JOHNSON. Removable barrels.

The CHAIRMAN. Removable barrels constitute one feature.

Mr. JOHNSON. Yes, sir.

The CHAIRMAN. Now what are the others?

Mr. JOHNSON. It has a unique high-powered, short-recoil action. The action isn't technically pure short recoil at that, but I don't think the committee would care to be troubled with a long-winded description of all of those points. They are well established and are covered in our handbook which Mr. Howard will submit for inclusion in the record, and in his summary of features.

The magazine is capable of being loaded in all the variety of ways as I have demonstrated. Those features were outlined and we consider those to be as of this date exclusive—quite exclusive.

Senator CHANDLER. What is the weight of that rifle fully equipped?

Mr. JOHNSON. Without the sling strap $9\frac{1}{2}$ to just over 10 pounds. We use a standard barrel. Present practice appears to be to make barrels smaller in the outside dimension; one type of barrel I know of used in .30 caliber, the M1 Garand, is a smaller barrel than the barrels we are now using which reduces the weight I don't know exactly how much. I can reduce the weight of this weapon appreciably by reducing the weight of the barrel. It is a standard 22-inch barrel as issued.

Senator CHANDLER. When the soldier uses that rifle in the field it has a strap. What is its weight with everything attached to it?

Mr. JOHNSON. The Army sling strap probably weighs 6 to 8 ounces, this weapon with it weighing $10\frac{1}{4}$ to $10\frac{1}{2}$ pounds.

Senator CHANDLER. How does that compare with the weight of other rifles?

Mr. JOHNSON. This rifle here—I am referring to exhibit G I believe it is—the Springfield with the front sight cover but without the sling strap was particularly weighed in comparison with ours and this particular rifle No. 1526954 weighed nine pounds seven ounces without the sling or nearly 10 pounds with sling. This is the type C stock.

The next exhibit is the M-17 rifle made by Remington, 304,234. Both of these rifles are new. This rifle weighed 10 pounds one ounce or about 10½ pounds with the sling strap. The weight of rifles varies materially with the condition of the wood in the stock, whether or not that wood is dry or soaked with oil. And that does make a distinct variation. Springfield rifles run from 9 pounds up to 9½. I have seen Springfield rifles which weigh less than this, but that is a rifle which was furnished us and which is new and as issued. With or without sling the Johnson and M1917 rifles are the same weight. The Congressional Record indicated a few days ago that we have on hand three times as many Enfield rifles as we have Springfield rifles.

The CHAIRMAN. What about the sight of a Springfield barrel and a barrel fixed in the stock?

Mr. JOHNSON. Does the Chairman mean the accuracy?

The CHAIRMAN. Yes.

Mr. JOHNSON. Without going into detail on that we were greatly pleased to find that the report of the Ordnance Department as of last December found that the Johnson rifle was "at least reasonably accurate." Does the Chairman wish me to make some statement about the barrel mounting in connection with accuracy?

The CHAIRMAN. Yes.

Mr. JOHNSON. This barrel fits in a sleeve, it is permitted to vibrate freely.

The CHAIRMAN. That is the Johnson rifle.

Mr. JOHNSON. This is the Johnson rifle. The barrel is permitted to vibrate as it will. It is my belief and I believe there is sufficient technical approval of the point that the so-called floating barrel, the barrel which isn't tied down to some bed—

The CHAIRMAN. That is the point I want to bring out.

Mr. JOHNSON. Tends to be fully as accurate and perhaps more accurate. Rifle barrels are very peculiar things. I don't wish to take the committee's time with all the technical authorities over here from the War Department to talk about barrels but of course barrels vibrate. They are keyed up more or less like a violin string. When the bullet goes down the barrel the barrel vibrates. Accuracy is obtained by uniformity in the vibration of the barrel with every shot. Only then would you have perfect accuracy. Now the theory that is incorporated in this rifle—taking the Johnson rifle—is that we let the barrel vibrate naturally except that we limit any lateral movement at the rear portion by the bushings, and I show you two bushings, one out of the rear of the barrel and one 9 inches forward—which limit the lateral play of the barrel yet permit it nevertheless to vibrate freely and naturally from the point beyond the forward bushing—pointing to the center of the barrel.

Senator CHANDLER. May I ask you, are the fixed barrels more accurate than those removable barrels in your opinion?

Mr. JOHNSON. That depends on each design in its entirety. There is a great deal of technical split of authority on barrels. Some of the people say to start with—

Senator CHANDLER. The reason I asked that, I am not sure that "reasonable accuracy" would be enough. Sometimes you have to be accurate. If your opponent was accurate and you were reasonably accurate you would be in bad shape.

Mr. JOHNSON. I heartily agree with the Senator. I show you a Springfield rifle which to quote Mr. Ripley, believe it or not, we have not tried to alter in any way, and this barrel—I show you this barrel—is floating in the stock, as you will see. The barrel is free to float as it were, to float around. It is secured only at the breech. It has what is technically known as the lower band on this, the M-1903 rifle. We have tried this rifle out and I think one of our organization hopes to fire a few scores with it this summer if we don't burn up the barrel in the meantime in test firing which we frequently conduct for comparison. But I just point to the fact that this barrel is apparently floating. And I will state that from extensive tests I have found the Johnson at least as accurate as the average M-1903 Springfield.

The CHAIRMAN. That is the Springfield.

Mr. JOHNSON. The Springfield.

The CHAIRMAN. But that barrel isn't removable like the Johnson is it?

Mr. JOHNSON. No, sir; that is normally removed by the armorer, not the soldier.

The CHAIRMAN. The advantages then of the removable barrel like that is it facilitates replacement and cleaning?

Mr. JOHNSON. Yes, sir. The War Department's requirement for a light machine gun specified the requirement that the barrel shall be instantly removable from the front. This rifle—pointing to the Johnson rifle—and the Johnson light machine gun, conform to that requirement, both of them.

The CHAIRMAN. Are those the latest requirements of the Ordnance?

Mr. JOHNSON. I believe I am correct in stating those requirements were very graciously furnished me by the War Department back in March and that was one of the requirements which the War Department desired.

I think that as far as any of these guns are concerned that personally I am just a little bit of a pragmatist and if the thing works, why, it works, and if it doesn't work, we try something else.

The fact that the barrel recoils on the Johnson rifle does not in and of itself in our opinion detract from the accuracy. If the barrel were fitted very loosely with an abnormal and unnecessary clearance so that you could hear it rattle violently when you shook the rifle of course the rifle wouldn't be as accurate. The manufacturing experts here will be glad I think to bring out the fact that there are no tolerances which they find which would cause any undesirable effects in the bedding of the barrel. It should be noted that the Johnson barrel is mechanically bedded. No fitting is required.

Now I have only one more point which I feel that I must make before going to the manufacturers and that has to do with the question of the recoil of the Johnson rifle, which as I recall the Ordnance report based upon our No. R17 rifle—I show you that rifle here—showed that the recoil was approximately 10 to 12 percent less than the Springfield, measured by a standard Ordnance machine.

Now I do not have any occasion to bring up the demonstration at Fort Belvoir except in one connection. There was a report furnished

this committee and there was I think a slight misunderstanding about a man who fired one of our rifles. That was one of those affairs where appearances were slightly deceiving. I therefore wish to introduce a letter accompanied by an affidavit signed by John B. Morrissey of the New York National Guard.

The CHAIRMAN. Very well, Was he present?

Mr. JOHNSON. Mr. Morrissey came down to Belvoir and asked permission to shoot the Johnson rifle. It was thought, and I believe the report on the test by Capt. R. H. Brown, stated, that he was "bruised, battered, and bleeding" after firing 150 shots out of one of the Johnson rifles. Mr. Morrissey states here—

The CHAIRMAN. Read it.

Mr. JOHNSON. I just wish to show this so that nobody will think the soldier is going to be bruised, battered, and bleeding after he fires the Johnson rifle. He states:

GEORGE W. COLE & Co., Inc.,
New York, May 24, 1940.

Capt. MELVIN M. JOHNSON, JR.,
Johnson Automatics Inc., 84 State Street, Boston Mass.,

DEAR CAPTAIN JOHNSON: In view of the articles I have read and the stories which are being circulated concerning the recoil of the Johnson rifle and its effects on my face during the recent tests at Fort Belvoir, I am writing this letter in refutation of the stories and so that you will have a record of what actually occurred.

Prior to firing, I had cut my thumb, and this cut was kept open as I had to use my thumb in loading the rifle. When firing, my cheek rested on the gun stock and in this way became smeared with blood.

I wish to state emphatically that the recoil of your rifle in no way injured my face. Both the Garand and the Johnson rifles, although the type of recoil is different, have about the same force and effect on the shooter, and both of them have less recoil effect than the Springfield. Hundreds of rounds can be fired by either rifle without any harmful effect on the shooter. I explained this to several observers at the time.

I went to Fort Belvoir because my hobby is rifle shooting. Except for two shots, which I fired from your rifle at the Camp Perry matches in 1939, I had had no previous experience with it, and hoped to have a chance, at Fort Belvoir, to try your rifle for the first time at 300 and 600 yards. I consider that my record in beating Capt. Rothwell Brown at 600 yards at Fort Belvoir 472 to 436 proves the Johnson rifle to be extremely accurate, particularly as I understand that Captain Brown is the Garand rifle expert in the Army.

As a member of the Seventh Regiment New York National Guard, I have had considerable experience with Garand rifles at Camp Smith, Peekskill, N. Y., and also at the Armory in repairing them.

With any rifle it takes a certain amount of practice to load it quickly, and had I had previous experience with the Johnson rifle I could have made a better showing at Fort Belvoir.

You are at liberty to use this letter should you wish to bring this matter to the attention of the Military Affairs Committee when the hearing takes place.

I should be very glad to testify before the committee if it is desired.

Very truly yours,

JOHN B. MORRISSEY.

And there is an affidavit attached confirming the facts.

The CHAIRMAN. Very well.

Mr. JOHNSON. Now there was one other point I should like to mention. It was stated in that report that one of the members of the Twelfth Infantry cut his forehead. The Twelfth Infantry members fired approximately 30 or 40 shots each, each of 4 men, or a total of 120 shots. I believe that is approximately right—on the day before the Belvoir firing, and it was explained to them that this sight—I am pointing to the receiver sight on the Johnson rifle—is quite close to the rear of the receiver. It was explained that if the

operator put this head right up against the sight [putting head up against the rear sight] that it would be possible for that sight to hit him in the head. And that is possible. The solution of that, I think, is quite obvious, and that is simply to move that sight forward so that it will not be within reach of anybody's head, or to keep the head several inches from the sight.

That hasn't been evident enough to prompt us to move the sight forward. I deeply regret that that happened at Belvoir.

I show you that if the operator assumed a normal position, the position which we recommended—but perhaps he forgot—there would be no difficulty. [Illustrating with head about 2 or 3 inches from the sight.] There would be no difficulty of hitting in the eye. Of course, I have had the opportunity of firing this rifle a great deal as has one of the members of our organization who is here, Mr. Whitney, and also there are others present who have fired the rifle considerably. They don't think that matter is particularly important, I take it.

I think it is a fair statement that any rifle, if the operator puts his face right up against it, when it moves back in firing, is going to hit him.

Senator CHANDLER. What is its kick-back?

Mr. JOHNSON. According to the Aberdeen Proving Ground report, it was, I think, 10 to 12 percent less than the Springfield. That is an approximate figure, as I recall it. There is a difference of opinion by every shooter about the kick of guns. I refer to Mr. Morrissey's letter.

Senator CHANDLER. What would you say about how far that will kick back?

Mr. JOHNSON. How far it will kick back?

Senator CHANDLER. Yes.

Mr. JOHNSON. Well, the gun moves back, of course, when it fires [illustrating] the barrel recoils and unlocks the bolt—pushing the barrel back, unlocking the bolt. [Demonstrates.] And during that time there is a certain amount of absorption of kick in rotating that bolt, and the kick is used in unlocking the bolt. The kick does it.

Now we have noticed that the gun tends to push slowly back. It doesn't seem to be a quick movement, it seems to be rather a slow, pushing movement. All guns, as Mr. Morrissey stated in his letter, vary in the way in which they recoil. But we have had individuals who have fired a considerable number of rounds with the Johnson rifle; at Aberdeen one of the civilians fired on 2 successive days 600 rounds from the shoulder, 600 from the hip, and followed that the next day by firing 600 rounds from the shoulder, followed by 600 rounds from the hip. That individual [indicating] on one occasion fired 800 rounds in approximately 16 to 20 minutes from the shoulder. I take off my hat in tribute to that gentleman, who is present here, Captain Brown of the Infantry. I wouldn't have done it myself. I think he is quite a rugged man. You would have thought he would have tired of hearing the rifle shoot.

Senator CHANDLER. Would you undertake to tell me how much recoil there was when you fired it just one time?

Mr. JOHNSON. I have stated it was about 10 to 12 percent less than the Springfield.

Senator CHANDLER. But I don't know what it is in the Springfield.

Mr. JOHNSON. The Springfield is approximately 13½ to 14½ foot-pounds, and I think the recoil on this rifle was supposed to be in the vicinity of 12 in the M1 ammunition.

Senator CHANDLER. That still doesn't tell me anything.

Mr. JOHNSON. Oh, the gentleman wishes to know how far the barrel recoils?

Senator CHANDLER. No. In normal position when you hold that rifle and get ready to fire it—

Mr. JOHNSON. We have never measured that.

Senator CHANDLER. When you put it up there it moves back here. I wonder how much it moves back.

Mr. JOHNSON. Well, it depends on the individual. If a man stood—

Senator CHANDLER. No; it moves back whoever holds it. If you move it closer to you—

Mr. JOHNSON. Well, I don't have any measurements on that.

Senator CHANDLER. Can you make a measurement? Can you make that, any of you fellows? Or am I asking you something you can't do?

Mr. JOHNSON. It would depend on how the man lay, whether he were kneeling, sitting, or prone.

Senator CHANDLER. Well, if a man were standing up and it was an inch from his eye, would it hit him in the eye? That fellow manifestly held it close to hit him in the eye. Suppose he had held it 2 inches?

Mr. JOHNSON. No, sir. I have held it that close and it hasn't kicked me.

Senator CHANDLER. If I were the soldier I would try to find out where to hold it so that when it did kick back it wouldn't kick me in the eye.

Mr. JOHNSON, I am grateful to the Senator for that statement. I hold the gun now like I would ordinarily hold a gun.

Senator CHANDLER. That is about 3 inches. And it will not kick back there?

Mr. JOHNSON. It hasn't kicked me yet.

Senator BROOKHART. Take the Enfield rifle.

Mr. JOHNSON. Yes; taking the Enfield rifle, I don't know how far I am now.

Senator CHANDLER. You are about 4 inches from your eye. With that it is a little farther away than the Johnson rifle.

Mr. JOHNSON. I would say, in view of that experience, it might be well to move that sight to finish the argument.

Senator CHANDLER. The man who uses that rifle will try to hold it to make it effective.

Mr. JOHNSON. Yes. The sight is designed to make it so, with the eye about 3 inches from the sight.

Senator CHANDLER. And if it kicks back and cuts his eye, he will hold it so it won't be effective. They will have to show him how to hold it.

Mr. JOHNSON. That is not difficult. We recommend a front position lying more behind the gun. The conventional position with the Springfield rifle is holding it at an angle. The front position prescribed with the new machine rifle which was developed by the Infantry Board. We can put the sight a foot from the eye, if necessary. But it gives a better field of vision when kept closer.

Now if the chairman please, I would like to get on to the manufacturing here, because I don't want to take the committee's time. The gentlemen who are here have been very kind to come here. I think it is fair for me to say that they show a very high degree of patriotic motive in taking their time to come here. These gentlemen have come from Michigan.

The CHAIRMAN. Where are they from?

Mr. JOHNSON. Some of them are from Detroit, two organizations are from Detroit, one is from Jackson, Mich., and then we have the representatives of the Taft-Peirce Co. of Rhode Island, whom I would like to introduce first. Now, what we propose to show is simply this, that we took this Johnson rifle—I am talking now about manufacturing problems—we took this rifle to an engineering concern and they have no financial interest and were not in any way committed to this company nor any company that is present here—in any way. They took the Johnson rifle, engineered it for mass production; made the complete production drawings; made models from those drawings. All of the rifles shown here as our latest models were made by Taft-Peirce from those drawings.

I want to bring out the procedure which was followed to show that the weapon has been soundly prepared for production. I then would like to introduce three manufacturing organizations who have examined the Taft-Peirce drawings and the models, and who are prepared to give a general idea at this time as to their opinion of the manufacturability in large production of this rifle, the Johnson rifle.

I would like to first present Mr. C. B. Gardiner, assistant manager of the Taft-Peirce Manufacturing Co., Woonsocket, R. I., who can tell you about the engineering and preliminary preparation which was made.

The CHAIRMAN. Mr. Gardiner, will you come forward?

STATEMENT OF C. B. GARDINER, TAFT-PEIRCE MANUFACTURING CO., WOONSOCKET, R. I.

The CHAIRMAN. Will you give your name and address, please?

Mr. GARDINER. C. B. Gardiner, Taft-Peirce Manufacturing Co., Woonsocket, R. I.

This company is an engineering organization, the Taft-Peirce Manufacturing Co., operating solely on a contract basis. That is, we have no interest in any products which we develop or manufacture. Over a period of 50 years, we have developed and assisted to mass production a great many mechanical devices ranging in types from type writers to airplane motors, including even the Gillette razor.

Never, however, in that period have we had anything to do with rifles until the Johnson came along; in other words, we are not an arms company.

Early in March in 1938, Mr. Johnson brought to us a hand-made model of his rifle which he disassembled into its components, as he has done here before you, and asked us what steps we would recommend to put that—put such a rifle into production.

We protested that that was a job for an arms manufacturer, that we had no experience whatsoever in the manufacture of firearms, and recommended that he take his problem to an arms manufacturer.

The Johnson Co. said that that was just what they did not want to do, because they felt they had a mechanism which was susceptible of mass production on the same basis as automobiles or washing machines or any other commercial mechanical device which is made in quantities by modern production methods.

After a brief study of the mechanisms by our engineering staff, I quote from a report dated March 10, 1938, to me by our chief engineer, as follows:

I recommend the following procedure as the proper and most practical steps to take in preparing for production of approximately 50 rifles per day. That figure of 50 rifles was taken as an arbitrary figure. It can be expanded to any amount.

This report is based upon the hand-made model which was brought to us and which so far as we knew was all there was available; that is, there were no drawings, there was no other description, simply a hand-made model.

First, prepare a first-class set of working drawings and estimates on proper limits and tolerances and material specifications.

Second, prepare a manufacturing study specifying jigs, fixtures, gages, and machine tools of operations and estimated time per operation.

Third, construct three models to prove the working drawings, the limits and the tolerances and the working materials.

Four, design and build jigs, fixtures, and gages necessary for production and,

Five, proceed with production of parts on a basis of 50 per day.

This program appeared reasonable to the Johnson people, and they authorized us to proceed with the steps in the order that I have named them. First, with a view to compare parts that could be commercially manufactured. In other words, they wouldn't require special machinery, extremely accurate precision work, but parts that could be made in any reasonably good machine shop, put limits and tolerances on for drawing, and we made drawings of each detail down to the smallest pin or spring, as is customary in modern production. Then we built three rifles by hand; one rifle to the high limits of the drawings; one rifle to the low limits; and one rifle to the medium, in between.

The purpose of those three rifles was to assemble parts in combinations to secure the tightest conditions under which the assembly of parts, the rifle, would be called upon to function, and also under the lowest conditions under which the rifle would be called upon to function if the tolerances established on the drawings were maintained.

Those rifles were not merely production models in any sense of the word, they were actual gages made by highly skilled men accustomed to working not in thousandths of an inch, but in tenths of a thousandth of an inch.

The various components were tested in various combinations under all conditions, and it was found after they had been thoroughly tested that the limits and tolerances which we had established on the drawings would function reliably.

And, as I said at the outset, those limits and tolerances were established to make the rifle capable of production by any ordinary machine shop; also they established complete interchangeability, and in the course of testing the gage models, the proof of the models of the rifles' interchangeability was not taken for granted. It was proved.

Following that we made a manufacturing study outlining the operations, part by part, each cut—each operation—all heat treatment, down to the last detail, based on an estimated production of 50 per day, the minimum, but which could of course be multiplied many times.

The study is here, and as you can see it represents a substantial volume of work, consists of blue prints laid out, and by engineers' drawings, tools that would be required, jigs, fixtures, and gages, every last step that would be necessary to put the rifles into production.

Following that, we made with the assistance of a few simple tools 16 working models from the production drawings, which so near as it is possible to simulate would be the actual rifles as they would come off the production line. And some of those rifles are here before you.

Here are complete working drawings with limits and tolerances for each part of this production rifle.

These drawings could be turned over to any capable machine shop and parts made to them which can be—should be easily done—I mean in a good machine shop—can be assembled and will function as an accurate, dependable rifle.

Senator CHANDLER. Mr. Gardiner, let me ask you a question.

Mr. GARDINER. Yes, sir.

Senator CHANDLER. You mean you have drawings there and plans, and you have indicated tools that are to be used?

Mr. GARDINER. Yes.

Senator CHANDLER. And with your showing you can proceed to make 50 of these a day?

Mr. GARDINER. Yes, sir.

Senator CHANDLER. And that is as far as you have gone so far?

Mr. GARDINER. Yes.

Senator CHANDLER. There is no arrangement to make any more?

Mr. GARDINER. We are acting solely as development—

Senator CHANDLER. I understand that, but I say you would be in position now to start right now to make 50 of these rifles a day?

Mr. GARDINER. Yes; but of course 50 is a drop in the bucket. It wouldn't be worth setting up a production line.

Senator CHANDLER. I understand that.

Mr. GARDINER. From our point of view these parts like this go together in assembly, and when they are assembled they function as a semiautomatic rifle. However, we treated them just as if when they were assembled they made a washing machine or radio or anything else. It is all the same to us.

Senator CHANDLER. How many of those rifles could be produced in a day, assuming you had the plans for them and you had a factory big enough; what would be the capacity of an ordinary factory with plans; how many of those could you make in a day, assuming you had everything ready and you were doing your best?

Mr. GARDINER. It all depends on how many you wanted. You could make a thousand a day. I would rather select mass-production engineers who are here, I understand, to answer that question.

Senator CHANDLER. All right, let it go.

Mr. GARDINER. I have tried to sketch the part that Taft-Peirce has played in this development.

Senator CHANDLER. Yes.

Mr. GARDINER. And we aren't interested in the manufacture of the rifle in any way. We haven't sufficient capacity, we aren't a production plant. In emergency our facilities would be, as they are now, taxed to capacity in making tools, jigs, fixtures, gages, for the airplane industry, and other industry, and for economic production in any factory, and we just couldn't attempt and have flatly refused to even consider the possibility of manufacturing these rifles, so that

our interest in it isn't as a prospective job, but simply from the point of view of the development work that we have done to date as production engineers.

The CHAIRMAN. Thank you. It is now 12 o'clock. We realize that you gentlemen have come a long way, and Senator Chandler and I are going to try to go through with it this afternoon for you, so we will recess now until 1:30.

(Whereupon, at 12 o'clock, a recess was taken until 1:30 p. m., of the same day.)

AFTERNOON SESSION

(The hearing resumed at 1:30 p. m.)

The CHAIRMAN. Mr. Gardiner, will you resume the stand?

STATEMENT OF C. D. GARDINER—Resumed

Mr. GARDINER. For the sake of the record, I would like to clarify the question of quantities in which these guns could be produced from the work we have done. We have carried the drawings and the manufacturing study to the point where it would be possible to produce an unlimited quantity of them, depending only upon the number that will be required.

So far as our work was concerned, it is like—well, an architect makes a plan of a house and from this plan you can make one house or a thousand houses just like it. That was as far as our work has been carried, but it is a production engineer's job from there on to make them in quantities.

The CHAIRMAN. Very well. Whom will you have next?

Mr. JOHNSON. The representative of the Kelsey-Hayes Co., Mr. Williams.

The CHAIRMAN. Mr. Williams, have a seat. Give your name and so forth, please.

**STATEMENT OF PERRY WILLIAMS, VICE PRESIDENT OF THE
KELSEY-HAYES WHEEL CORPORATION**

Mr. WILLIAMS. My name is Perry Williams, vice president, Kelsey-Hayes Wheel Corporation, with plants in Detroit and Jackson, Mich., and Europe.

The CHAIRMAN. Will you proceed in your own way, please?

Mr. WILLIAMS. We are mass producers of hydraulic brakes, passenger wheels, truck wheels, hubs and rims for the automotive industry, serving practically all of them.

We have made a study of this, simply, purely, from a manufacturing standpoint. We aren't gun manufacturers but we were impressed with the simplicity. We were also surprised at the generous tolerances allowed, in fact they are much more generous tolerances than we are used to working with with hydraulic cylinders, brakes, and that sort of thing. And we have gone at this more from pieces similar to what you see here. They are like parts we are making now, similar in production. And in our opinion this assembly could be tooled for in a comparatively short space of time, depending on obtaining what

additional equipment or special equipment you might need, to produce 200 or 300 an hour very comfortably.

The CHAIRMAN. Two or three hundred rifles?

Mr. WILLIAMS. An hour. It is just a question of getting the equipment in. From our finding this barrel where it might be the slowest of the special equipment involved—but from my understanding there is barrel capacity in the country—we can produce at least 10,000 of these barrels a day. Because I understand they did produce that many when the war stopped before and that equipment must still be available. If it is not, it can soon be replaced if necessity demands it.

As far as the study that has been made by Taft-Peirce, it is very thorough and it shows that they have designed and engineered this so it can be put in mass production with concerns such as our own or I would say in concerns similar to our own. There isn't any problem to it as far as that is concerned for manufacturing, it is all just parts that can be obtained and manufactured without much trouble and we would be——

The CHAIRMAN. No technical difficulties?

Mr. WILLIAMS. There is no technical difficulty at all. And I just came down here to state that we as an automotive accessory concern have examined it and would be willing to state that we could get in production in a very short space of time, in mass production.

Just to give some idea of the ability of our company to manufacture and assemble machine-made products on a large scale on short notice, let me say that in Detroit the automotive trade consider 90 days a long time to tool up for a new product. After all that only leaves us about 9 months in which to do business, including working out the usual problems in any initial production run. These must be ironed out very speedily as you will appreciate when I tell you our daily production on some of our principal products.

For example, we manufacture automobile and truck wheels at a rate of nearly 2,000 wheels per hour or 30,000 wheels per two-shift day—that means assembling 50,000 finished parts per hour or 750,000 finished parts per day as each wheel consists of about 25 individual pieces.

For another example, we produce over 1,000 automobile hydraulic brake systems per hour or 18,000 per two-shift day—that means making and assembling over 120,000 parts per hour or 2,160,000 parts per day.

We also manufacture 20,000 brake drums per day and 25,000 wheel hubs per day including heat treating and hardening of the same. We manufacture 16,000 tractor wheels per day, 800 tractor brakes per day, 800 tractor brake drums per day, and 5,000 miscellaneous automobile wheels per day.

We employ 5,000 men per day in our United States plants alone. We also have plants in Canada and England.

In closing, may I add that many of our manufacturing tolerances are kept within a thousandth to a half thousandth of an inch, which is much finer work than the Johnson rifle specifications call for.

The CHAIRMAN. Well thank you very much. Whom will you have next, Mr. Johnson?

Mr. JOHNSON. If the Chairman please, the representative of the Sparks-Withington Co. We have the honor of having with us the Honorable William Sparks, formerly mayor of Jackson, Mich.

**STATEMENT OF WILLIAM SPARKS, PRESIDENT, SPARKS-
WITHINGTON CO.**

The CHAIRMAN. Will you give your full name and address?

Mr. SPARKS. William Sparks, president of the Sparks-Withington Co. I feel possibly that I may have been called on to tell what I think about this job as a mass production job and so that I might qualify as knowing something about mass production I think it might be of interest to you to know that our company at the present time in 2 of its 6 plants are producing 16,000 automobile hours per day. Each one of those horns represents 175 pieces. This rifle represents 103. That necessitates that we must do a total of operations on horns each month of 95,040,000 operations.

During the last war we produced 2,000 75-millimeter shells per day, 9,000 helmets per day, 72,000 hand grenades a day.

(There followed a discussion off the record.)

Mr. SPARKS. Now then I hope that qualifies me as a mass-production person.

We want to say that we have examined this rifle and this is no more difficult to produce than lots of things that we have done before and are doing today. I quite concur with Mr. Williams of Kelsey-Hayes. Any questions?

Senator BRIDGES. How long would it take you to get into production on a rifle of this type?

Mr. SPARKS. We would get into production within 6 months at the rate of 1,000 a day. Any other questions?

The CHAIRMAN. I believe that's all. And we thank you very much. Glad to have you with us.

Call your next witness.

Mr. JOHNSON. The next witness, may it please the Chairman, is a representative of the Hupmobile Motor Co., the Honorable J. Walter Drake who is present and the head engineer, Mr. Scott.

**STATEMENT OF J. WALTER DRAKE, OF THE HUPP MOTOR CAR
CORPORATION, DETROIT, MICH.**

Mr. JOHNSON. Mr. Drake was formerly Assistant Secretary of Commerce.

The CHAIRMAN. Yes; we all know Mr. Drake.

Mr. DRAKE. Well, it is a pleasure to be back here in the Capital, Senator.

The CHAIRMAN. Glad to have you back with us.

Mr. DRAKE. Well I have only a few brief words to say about this project, Mr. Chairman. I am here with Mr. Scott our manufacturing manager, who might be glad if you would call for a brief statement after I have finished.

I have gone over the mechanism of the rifle and these pieces that are lying on the table. I am not an engineer but a motor car executive. I am very familiar with this type of work and have had off and on about 30 years' experience in the motor industry building the Hupmobile car, and, in my opinion and that of Mr. Scott who will tell you in a little different way, these parts here of the Johnson rifle are no more difficult to make true to specifications, in fact are easier than the machine work that we have been doing for 30 years in building the engine power plants, axles, and other parts of our car. I

might give you an illustration and I would ask Mr. Gardiner to check me if I make a misstatement about tolerance, the tolerances, that you are allowed one way and another in making these parts. They are considerably freer than we are held down to in making parts for a motor car. If we were to build a Hupmobile engine with as much as three one-thousandths in some of the parts like the moving parts inside the engine, gentlemen, you would take it back and say, "Give me a good engine, this rattles too much." We can't do that. We have to have it done sometimes to as much as half a thousandth, as these gentlemen who are familiar with these mechanical matters know.

There are no problems in the manufacture of these Johnson rifles so far as the manufacture of these parts is concerned that should trouble us in the least after our experience or, as Captin Sparks said, in a factory like his.

As to production I would agree with him that it is entirely feasible to get up to production of a thousand per day within 6 months. There is nothing about it that would present any great problem along that line.

But I don't want in any manner of means anything I have said to be used as an inference that I know anything about making guns or am I a gun maker. I wouldn't consider this a gun maker's problem, as it is purely a machine tool and tool-making proposition. I would be glad to answer any questions but I would be much more pleased if you would like to ask Mr. Scott something particularly here because he has had 30 years' experience in practical shop machine tooling, and I asked him to come down.

The CHAIRMAN. Thank you very much.

Mr. Scott, will you give your full name and so forth.

STATEMENT OF GEORGE ROBERT SCOTT, PRODUCTION MANAGER, HUPP MOTOR CAR CORPORATION

Mr. SCOTT. My name is George Robert Scott, production manager for the Hupp Motor Car Corporation.

To give you a brief outline of my experience, I have been building motor cars, trucks, engines, and parts in automobile and truck manufacture the past 30 years, particularly in the production line. I had an opportunity to look this gun over on two different occasions and we have submitted it to our engineers and also to our production departments and we also see no production problems. We don't mean to say that it is going to be a run-away cinch but it is just a problem for manufacturers to work out that can be worked out and can be worked out readily. As far as mass production on this gun is concerned it depends entirely on your tooling, you can tool to do 50 a day or a 1,000 a day, or any other number you wish.

The CHAIRMAN. What would be the principal machine you would use, or would you use a number?

Mr. SCOTT. You would use various kinds of machinery, milling machines, boring machines, automatic screw machines, and such equipment as that. And they are machines that many manufacturers have. For instance, we have quite a great number of these machines, broaches, screw machines, and the tooling of this gun as I have stated previously is the crux of the whole matter.

The CHAIRMAN. Would a number of new tooling machines have to be made to produce thousands a day?

Mr. SCOTT. Oh, yes. Not machinery but tooling fixtures, jigs, and fixtures, and that sort of thing to hold your work and do the job quickly and accurately. As stated by Mr. Drake, the limits on this gun are far in excess of the limits on many parts we make.

The CHAIRMAN. In other words, you have the tooling machines already in existence?

Mr. SCOTT. I would think that we had in the Hupp organization the major portion of the tools. There is some of this boring equipment that if we were to make the barrel we would have to procure.

The CHAIRMAN. What about your raw materials?

Mr. SCOTT. The raw materials as I understand it as far as I have gone into this gun, any of the materials that go into the manufacture of this gun can be procured from any well stocked steel supply house. There are no special analyses that we have been able to find required for this gun, and it would seem to me that all the steels could be obtained readily

The CHAIRMAN. Where are those supply houses located?

Mr. SCOTT. In every city, as a rule.

The CHAIRMAN. Every city in the United States?

Mr. SCOTT. Oh, yes.

The CHAIRMAN. What factories make those as a rule?

Mr. SCOTT. They buy the steels from the mill and they hold them on hand for the convenience of their customers. For instance the Ryerson Co. in Detroit and others besides carry large stocks of all kinds of steels.

The CHAIRMAN. In other words they have an intermediate position between the makers of those supplies and the users of it?

Mr. SCOTT. That is correct. As far as the assembly of this gun is concerned, to me it does not present any problems, the assembly after machining.

The CHAIRMAN. You agree with the others that you could be in shape to make a thousand a day within 6 months?

Mr. SCOTT. Well I think that would require a lot of work and a lot of attention but I think possibly it could be done. You understand that I have only seen this gun twice and our organization has had the opportunity to go over it as possibly some of the others, but we have noticed in our analyses there isn't any problem.

The CHAIRMAN. Well thank you very much.

Mr. JOHNSON. If the chairman please, I would like to bring out a few points in conjunction with what has been said here. We have tried to bring out by the testimony of these gentlemen who have been kind enough to come here that in varying degrees they have examined this rifle from the manufacturer's point of view. We are quite prepared to go ahead further with such companies as these to give them the opportunity which the gentleman just mentioned, Mr. Scott, to go more thoroughly into the matter, which we understand wouldn't take any great length of time, a matter of days, perhaps 20 or 30 days at the most, to pretty thoroughly examine all of these parts and map out a program of manufacture.

Mr. Scott, would you care to bear me out on that point?

Mr. SCOTT. Yes, I think so. I think we could be ready to start in 30 days.

Mr. JOHNSON. We have not yet had an opportunity to let, for instance, Mr. Scott's organization have an opportunity to go thor-

oughly into the question. We have tried to bring out that the weapons can be made easily, that it isn't a strange and unusual piece of work which requires special operations, but instead is capable of being adapted to the automotive industry, which has been pretty well represented here at this meeting by these gentlemen.

Now, one bit of background I would like to present on this weapon from the manufacturing point of view. This rifle was developed, so to speak, in Boston and some work has been done in Rhode Island and some work has been done in New Haven. I want to state that I have had at all times the fullest cooperation from the ordnance representatives in the Boston and Hartford Ordnance Districts, two officers in particular; in the Boston District, Maj. J. S. Crawford; in the Hartford District, Col. Robert Sears.

Those two officers have at all times given every assistance that was possible to us. In going to the Taft-Peirce Co., represented by Mr. Gardiner, we were urged by the officers whom I have mentioned, Major Crawford and Colonel Sears particularly, to go to that company, or to a company similar to it, in order to do the work which Mr. Gardiner outlined here. And in particular this made it possible to have such gentlemen as appeared here today to make the statements they have made in regard to the manufacture and building of this weapon. Now in that connection, other points which were urged upon me personally by Major Crawford, to be specific, were that the parts must be interchangeable, that interchangeability would make it possible to put this gun in large-scale production, and the tolerances and the drawings and the data were all developed with that in view.

Now I also want to emphasize that we have tried, so far as possible, to see that the parts were adapted as Mr. Scott and some of the others have indicated, to the average type of machines, machinery which they have in a great many of these plants. I think that that is, perhaps, the most important feature of this rifle that we could possibly present here at this time. I think that the question of mass production in a short time is transcendent in this emergency, and that is the position that we have tried to take here.

Now we have covered the manufacturing side. I would like to take this opportunity to learn if there are any further questions that the committee would care to ask me about that phase of the rifle?

The CHAIRMAN. I think you have gone into it very thoroughly, Mr. Johnson.

Mr. HOWARD. I have here a letter addressed to this committee, dated May 29, 1940, by Mr. J. E. Owsley of the High Standard Co., manufacturers of "High Standard" pistols. I would like to have Mr. Owsley's letter incorporated in the record of these hearings, for this letter gives further testimony in support of the statements made here earlier today by Taft-Peirce Mfg. Co., Kelsey-Hayes Wheel Corporation, Sparks Withington Corporation, Hupmobile Motor Car Corporation.

Mr. Owsley speaks with authority as a firearms manufacturer, especially as his company equipped and tooled a large plant in New Haven during the last World War and established large scale production within approximately 6 months from date of the initial large order for machine guns. As a matter of fact, a former Ordnance officer told me the other day that Mr. Owsley's company achieved satisfactory large-scale production of a certain machine gun in a much

shorter time than the old established concerns were able to do in that national emergency. In other words, the Marlin Rockwell Arms Corporation proved that quantity production on a large scale could be successfully achieved in a matter of a few months in spite of the usual production problems which are ever present in the initial manufacture of any article. The Marlin Rockwell Co., I understand, was producing at the rate of over 600 machine guns per day at the close of that war and the performance of those weapons were regarded as very satisfactory at that time.

HIGH STANDARD CO.,
New Haven, Conn., May 29, 1940.

Senator MORRIS SHEPPARD,
Chairman of the Senate Military Affairs Committee,
Washington, D. C.

DEAR SIR: I would like to have appeared before your committee to tell you my opinion of the Johnson guns.

I believe they are the simplest guns to make and have already gone on record to the British by offering to make this gun for them. With proper financing of a large enough order, we could be in production at the end of 120 days from signing of contract and in 6 months be producing 500 per day.

I am basing this on experience as general manager of the Marlin Rockwell Arms Co. of the World War on a gun more difficult and expensive to make.

The merits of the Johnson versus others, I will not go into, suffice it to say there is none better, in or out of the war. Four Johnsons can be made to one Garand and at about half the price under high pressure production.

Very truly yours,

J. E. OWSLEY.

Mr. HOWARD. Among other manufacturers who have been contacted on the Johnson rifle and who have quoted prices on the complete rifle, or certain of its parts to us or to our contract manufacturers are the companies listed in the accompanying letter: Harrington & Richardson Arms Co., Worcester, Mass.; Modern Tool and Die, Boston, Mass.; Worcester Taper-Pin Co., Worcester, Mass.; J. Stevens Arms Co., Chicopee Falls, Mass.; Iver Johnson Arms & Cycle Works, Fitchburg, Mass.; Marlin Firearms Co., New Haven, Conn.; Underwood, Elliott, Fisher Co., Hartford, Conn.; Underwood, Elliott, Fisher Co., Bridgeport, Conn.; Pitney Bowes, Stamford, Conn.; Winchester Repeating Arms Co., New Haven, Conn.; H. W. Cooley Arms Co., Cabourg, Ontario, Canada; Freeberg Wood Carving Co., Chicago, Ill.; Mossberg, New Haven, Conn.; Smith & Wesson, Springfield, Mass.; Thompson Electric Co., Lynn, Mass.; Moore Drop Forge, Springfield, Mass.; Lyman Gun Sight Co., Middlefield, Conn.; Hedason Manufacturing Co., New Haven, Conn.; Holbrook Drop Forging Co., Worcester, Mass.

Mr. JOHNSON. We are quite prepared, and in fact, are preparing and continuing to go ahead with these gentlemen to get more detailed information. But I did want to emphasize, it seems to us that the first and most important thing is, can we make it? Can it be adapted to existing shops? Can it be done quickly in large volume?

(Here Mr. Johnson was permitted to insert in the record a news item from the Boston Globe, May 19, 1940.)

[From the Boston Globe of May 19, 1940]

MELVIN JOHNSON FOR "FARMING OUT" RIFLE PRODUCTION—MAKER OF SEMI-AUTOMATIC SAYS METHOD NECESSARY TO REPLACE OLD WEAPONS

Lamenting the United States' lack of adequate arms for its soldiers, Melvin M. Johnson, inventor of the Johnson semiautomatic rifle and president of Johnson Armaments Trust, declared last night that this country should adopt immediately

the "farming-out" method of rifle production to supplement as soon as possible the 42,000 semiautomatic Garands and more than 1,000,000 "out-moded" Springfields now available for American armed forces.

Speaking before 150 members of the United States Naval Reserve Officers Association of the First Naval District at the Navy Yard, Charlestown, Johnson declared that the United States has never had an arms industry and "has throttled and killed off its chance to have one."

America had 600,000 Springfield rifles manufactured over a period of 11 years when the United States entered the World War. Now the United States, Johnson asserted, has only 42,000 Garand semiautomatic rifles plus the million or more outmoded Springfields, "which would be all right if there wasn't anything else."

"What are we going to do about it?" Johnson asked. "How are we going to get enough rifles, if we want semiautomatic rifles? And we certainly can't get light machine guns, because Hitler has most of those."

"It doesn't matter which rifle we use, the Garand or the Johnson, although naturally I think my weapon is better, but I could probably fire the Garand if I had to. We have only 42,000 rifles at present and obviously haven't enough production at present. By 1941 or 1942 at the present rate we might have 200,000 semiautomatics—but that's 2 years from now."

"The answer is the farming-out method. We must give one company the manufacture of the barrel, another the stock, another the magazine. If the mountain won't come to Mahomet, Mahomet must go to the mountain."

Capt. Charles G. A. Johnson, president of the association for the First Naval District, presided, assisted by secretary Lt. Comdr. John C. Hurd, United States Naval Reserve. Among the guests was Brig. Gen. John H. Sherburne, Massachusetts National Guard, retired.

Mr. JOHNSON. Now, there are a number of other gentlemen here who can give us some information on certain other phases of these weapons.

Earlier in this hearing certain questions were asked me, one in particular was about accuracy. I have not personally testified very much about matters pertaining to functioning and use by various shooters. We have had a great deal of firing with these rifles by a great many different people, demonstrations, and certain tests. Rather than continue to testify myself about my own rifle, I see that there are several persons here who have had some experience with this rifle.

The CHAIRMAN. Well, this is one place where you mustn't let modesty interfere with your presentation. You have to use all those horns Mr. Sparks was making.

Mr. JOHNSON. Well, we would be very glad to mount one on the gun itself. However, there are several gentlemen here who have had experience in firing the Johnson rifles and guns, and I think the committee might find it informative if those gentlemen were willing to tell the committee what they can. Now, the gentlemen I have in mind in particular are two officers from the Marine Corps. One officer in particular has done firing personally, Captain Van Orden. There is also a gentleman from the National Rifle Association, Mr. F. C. Ness. Mr. Ness has written several articles about the Johnson rifle which have been published, and he has done some firing.

I beg the chairman's pardon, and also the Colonel's pardon for not mentioning Colonel Edson. As a matter of fact, Colonel Edson has also fired the rifle. He did some firing personally at Aberdeen last fall; both he and Captain Van Orden know something about the rifle, in addition to Mr. Ness. I would be glad if the chairman would ask them any questions.

The CHAIRMAN. Very well. You are in charge of your side. Whoever you wish to call.

Mr. JOHNSON. I wish to make it clear, in mentioning anyone in the service I cannot put them on my side. If they testify they have to testify in their capacity. Mr. Ness, of course, is a civilian.

The CHAIRMAN. Well, then, on that basis I prefer to call on them so they won't be identified in a partisan way on either side of this bill. I will ask Colonel Edson to give here his views on it, a non-partisan viewpoint. Of course an Army officer isn't supposed to take sides.

Colonel, give your full name and address for the record.

STATEMENT OF LT. COL. MERRITT A. EDSON, UNITED STATES MARINE CORPS

Colonel EDSON. My name is Merrit A. Edson, lieutenant colonel, United States Marine Corps, at present in charge of the target practice section, at headquarters, Marine Corps.

I first want to make clear the policy of the Marine Corps on the production or standardization of any small arms weapons.

We are not a large enough organization to develop or manufacture any weapons of our own. We are dependent entirely upon the United States Army for such development, manufacture, and standardization of small arms, and we look to the Ordnance Department as the main source of production and supply of our weapons during any emergency.

We do, however, reserve the right to conduct our own tests on arms which have been adopted as standard by the Army, and then in the light of the requirements which may be placed upon us for landing operations, and so forth, to decide whether the weapons in question are adaptable to our needs as replacements for arms which we already have.

I want to emphasize again, however, that we consider the Army as our main source of supply and development.

The CHAIRMAN. If some other weapon appealed to you outside of those declared standard by the Army, is it your custom to submit your ideas?

Colonel EDSON. We test the weapons which have been adopted by the Army. So far as I know, we have never conducted any separate tests on a weapon and adopted it separately, with the exception of the Thompson submachine gun, which was adopted in 1927 for use under conditions where its characteristics were more desirable than any standard weapon available at the time.

The CHAIRMAN. Or recommended its adoption?

Colonel EDSON. Yes, sir. That is correct. Our requirements are not great enough to warrant it.

The CHAIRMAN. What occasion have you had to come in connection with the Johnson rifle?

Colonel EDSON. I personally have had the opportunity of seeing the weapon fired; I have fired it a few times at Aberdeen, as Mr. Johnson said, during the test that was—

The CHAIRMAN. That was under a test conducted by the Government?

Colonel EDSON. By the Ordnance Department, United States Army.

The CHAIRMAN. And that is why you could legitimately handle it. I see. Handle the rifle, the guns and rifle.

Colonel EDSON. Yes. We, of course, watch or try to secure any information on any weapons that may meet our needs that we can.

The CHAIRMAN. What was your opinion about the Johnson?

Colonel EDSON. The Johnson has, in our opinion, several very good features. It uses the standard barrel for the rifle, it has a magazine which is capable of utilizing the five-round clip that is now used by the Springfield rifle, it is a recoil-operative weapon which we think may make it more rugged and more dependable under rough usage which we would give it in landing operations or in the field. From reports which we have received, it appears to be quite reliable.

I think that answers your question, sir.

The CHAIRMAN. How does it compare as a rule with other well-known makes?

Colonel EDSON. We have had no opportunity to test the rifle in the field.

The CHAIRMAN. You mean the Johnson?

Colonel EDSON. The Johnson; yes. And, after all, that is the final test of any piece.

Senator JOHNSON. Well, Colonel, you state from reports. Whose reports, the makers, manufacturers?

Colonel EDSON. No, sir; Captain Van Orden has fired this piece for accuracy over the standard course and at 1,000 yards, I believe. We have read the reports of Mr. Ness and Mr. Johnson has furnished us with numerous reports on accuracy firing which he has conducted or which have been conducted in his presence.

The CHAIRMAN. Is there any particular reason why the Army should not have two or three makes of rifles among its standard weapons, provided they met with certain general requirements?

Colonel EDSON. I think that is a question for the Army to answer sir, rather than me.

The CHAIRMAN. You have just what type of rifle at present?

Colonel EDSON. At the present time the Marine Corps has the Springfield rifle as its standard arm. We have a Browning automatic rifle which was developed during the last war, and which is now modified into a light machine gun as an accompanying infantry weapon of .30 caliber.

We have not adopted as yet any semiautomatic rifle nor are we yet convinced that there is an urgent requirement for a semiautomatic rifle.

The CHAIRMAN. The Springfield you use, then, isn't a semiautomatic?

Colonel EDSON. No, sir; that is the bolt-action rifle.

The CHAIRMAN. What do you call it, what kind of action?

Colonel EDSON. Bolt action.

The CHAIRMAN. Oh, yes.

Colonel EDSON. The bolt has to be operated by hand for each shot that is fired. That is the standard infantry arm in the Marine Corps. It is a piece which has been in the service since 1903.

The CHAIRMAN. Thank you, Colonel.

Colonel Jones, would you—

Colonel JONES. I represent the Navy Department, sir.

The CHAIRMAN. Oh, I see.

Colonel JONES. I am a marine officer, sir, and I am in the Bureau of Ordnance, Navy Department.

The CHAIRMAN. Very well; we will hear him later.

Captain Van Orden, will you give your initials and address and title, and function in the Army?

STATEMENT OF CAPT. GEORGE O. VAN ORDEN, COMMANDING OFFICER OF THE RIFLE RANGE, MARINE BARRACKS, QUANTICO

Captain VAN ORDEN. I am the commanding officer of the rifle range at the Marine Barracks, Quantico.

The CHAIRMAN. Have they held any tests down there involving the Johnson rifle?

Captain VAN ORDEN. For the last year I have had numerous opportunities to fire the Johnson rifle, beginning at Wakefield, Mass. Last summer I was commanding officer of the rifle range at Wakefield. Captain Johnson was in that vicinity, and I thought it was my duty to keep myself informed as much as I could of developments in firearms so I contacted him, asked him to let me see his rifle and fire it. Since about last July or August I have had many opportunities to fire the rifle, to visit the Johnson laboratories at Woonsocket, and to talk to Mr. Gardiner, of the Taft-Peirce Co.

The CHAIRMAN. You are familiar, then, of course, with the practical use of all the well-known rifles?

Captain VAN ORDEN. Yes, sir. That is my job. I am a training officer in weapons and marksmanship.

The CHAIRMAN. Will you tell us what you know and think of the Johnson rifle?

Captain VAN ORDEN. I would like to refer to some notes, if I may. I have done so much firing that I want to be sure I am right in my figures.

The CHAIRMAN. Very well. Go ahead.

Captain VAN ORDEN. The first firing that I carried on was at Wakefield, Mass., in the month of September 1939. My interest in testing the Johnson, I think I should explain.

My duties have been, for many years, to be a training officer; my duties have been training marines how to kill people on the battlefield with rifles. And during these years I found out that the training of men is about 75 percent psychology and 25 percent going by the book. And you have got to make a man want to fight, you have got to make a man not afraid to fight, you have got to make a man full of enthusiasm, you have got to give him confidence more than anything else. If he hasn't confidence in himself and in his weapon, all the training, all the drill in the world won't do him any good.

So when I started testing this rifle, what I was thinking about more than anything else was accuracy to build confidence in the man.

The CHAIRMAN. In other words, a gun must be accurate and a man must know it to be accurate before he can have confidence?

Captain VAN ORDEN. Yes, sir. When he stands there on the battlefield he has got to know if an enemy shows his head he can knock it off. Strange as it seems, I believe that only about 20 percent of the young men that come in to serve now like to shoot a rifle. About 75 percent like to shoot in fun as in a shooting gallery at clay pipes, but when it comes to training for war and combat firing, it is hard work and they don't like it. For most of them there is no additional compensation, and being young they can't look ahead and see

that one of these days the use of the rifle will mean the opportunity to live or die, and all that. And you have got to make them want to fire.

And if they don't have absolute confidence in the rifle, they won't make that effort.

The CHAIRMAN. You have got to make them feel something will develop when they fire that rifle perfectly?

Captain VAN ORDEN. Yes.

Senator JOHNSON. Is practice voluntary?

Captain VAN ORDEN. No, sir; it is compulsory. Every marine has to fire 2 weeks every year with a rifle, no matter what his duty or rank, so long as he is less than 40 years of age. But making them do it isn't the answer.

Senator JOHNSON. Do you rate them?

Captain VAN ORDEN. Yes; we do. We have qualifications as marksman, sharpshooter, expert, and unqualified. If a man qualifies as sharpshooter he gets \$3 a month additional compensation for a year; if he qualifies as expert he gets \$5 a month extra for a year, but only about 30 percent of the men, 30 to 50 percent, depending on their training, can qualify in the extra-compensation grades. The rest of them just shoot because they have to.

The CHAIRMAN. Proceed.

Captain VAN ORDEN. I was going at this rifle from an accuracy viewpoint. At the start, Captain Johnson gave me two rifles to fire, one of them was rotary rifle, rotary magazine; another was a vertical feed rifle, which was more of a sporting rifle, and he doesn't show it here today, not being a military type. He gave me the two rifles and after inspecting them and finding them to be mechanically safe to fire I selected several men in the rifle-range detachment to fire the rifles over a period of several days. I fired the rifle myself. I am rated as a distinguished marksman and have qualified as an expert rifleman over a period of years. I considered myself as representing the expert grade. Lieutenant Fisher also fired the rifle. While he is graded as an expert rifleman he just does qualify as an expert and would represent the exceptionally well-trained man. Then I selected two enlisted men of average size and strength who were qualified as sharpshooter and as marksman.

One of them wore glasses. I think the four of us represented a good cross section of the average marksmanship of the Marine Corps.

One of the last two men isn't very bright. We have to protect his type particularly. He has to learn to shoot and do it right, even if he isn't quick to respond. I was trying to see what the reaction would be on the average man in the time of war in understanding all this. Automatic rifles may look very complicated, so we had this one man there to see what his response was going to be. I asked Captain Johnson to instruct these men in the care and cleaning of the Johnson rifles, nomenclature and functioning, manipulation and sight setting. This instruction was given in about 40 minutes. The subject is so closely related to what the men already knew from their training with the rifle, the automatic rifle, and the automatic pistol that they were able, on the first attempt, to field strip and assemble the rifles and to load, fire, and unload them without fumbling or error; even the mentally slow man had no trouble.

As a basis for comparison of accuracy it was decided to fire the Marine Corps semiautomatic rifle course prescribed for the U. S. rifle, caliber .30, M1. To test the usability of each type of rifle submitted it was decided to have each man fire the course with different rifles on successive days. To further test the interchangeability of parts I planned to spend one day firing a rifle made up of parts of both.

CONDUCT OF THE TESTS

On the first day one officer and one enlisted man fired the rotary rifle and one officer and one enlisted man fires the vertical rifle. Two sighting shots were taken at 200 yards followed by each firing the semiautomatic rifle course in the regulation manner. It was the first time either of the men had fired any semiautomatic rifle and considerable time had elapsed since they had last fired the M1903 rifle. The ammunition used was M1, Frankfort Arsenal lot No. 2066, manufactured in 1938. The weather was clear, sky clear, light bright, temperature 75°. The wind was very difficult, varying from 5 to 20 miles per hour from 9 o'clock.

On the second day the rifles were exchanged by the pairs of shooters. While other conditions remained the same the weather was stormy, sky overcast, light dark, temperature 70°, and the wind was gusting from 10 to 20 miles per hour from 9 to 11 o'clock.

On the third day the pairs retained the same rifles, with the exception that at a different time from the other shooting I fired a composite rifle made up of the parts of both at 600 yards only. The weather was similar to that of the second day, plus rain.

On the afternoon of the third day two additional vertical rifles were offered for test and they were fired to test their functioning.

It is notable that the weather was bad throughout, so that scores were lower than might have been attained.

The results of the firings were as follows:

	2s	3s	5s	6s	2r	3r	5r	Total
Captain Van Orden:								
First day (vertical).....	47	44	47	45	78	76	71	408
Second day (rotary).....	42	41	40	42	74	80	65	384
Third day (composite at 600s only).....			45	44	46	45	45	
Lieutenant Fisher:								
First day (rotary).....	41	43	43	43	78	76	67	391
Second day (vertical).....	39	42	46	50	77	78	74	406
Third day (vertical).....	42	46	48	43	73	80	69	401
Private (1st cl.) Pongonis:								
First day (rotary).....	37	41	38	45	79	78	50	368
Second day (vertical).....	42	39	44	47	75	77	69	393
Third day (vertical).....	43	40	46	37	77	78	80	401
Private (1st cl.) Welch:								
First day (vertical).....	41	41	40	45	73	64	67	371
Second day (rotary).....	41	43	44	44	76	78	68	394
Third day (rotary).....	44	42	46	41	80	72	73	398

The composite of the best scores fired total 431.

During the 792 rounds fired there were no failures to feed, extract or eject. There were no broken parts. On the first day the rotary rifle double-fired once and misfired once. When tried the second time in the same rifle the cartridge still failed to fire.

During the firing it appeared that the rotary rifle was materially easier to load by an inexperienced man than was the vertical rifle. This is due to the position of the magazine recess, and while the re-

leasing of the magazine is a simple process, it still requires training and exercise. This, coupled with the undesirability of having specially formed magazines that may become damaged or lost, seem to set the rotary rifle up as the most desirable military rifle of the two.

The CHAIRMAN. What rifle is that?

Captain VAN ORDEN. That is this rifle here. The rotary rifle.

The CHAIRMAN. The Johnson?

Captain VAN ORDEN. Yes, sir.

The CHAIRMAN. The Johnson rotary rifle is what he is talking about now.

Captain VAN ORDEN. The vertical rifle with the single stock conforms more to the principles of design of a target rifle, while the rotary rifle has a two-piece stock. However, the composite rifle was built up on the two-piece stock and the scores made at long range were good considering the weather conditions. The results of tests and demonstrations at 600 and 1,000 yards were so excellent as to indicate that the two-piece stock, as applied to this rifle, is good practice.

The enlisted men showed no confusion when confronted with the problem of firing the new rifle. Considerable difficulty was experienced by them in changing magazines in the vertical rifle, but they manipulated the rotary rifle with ease. In order to fire the 16 rounds prescribed in the semiautomatic rifle course rapid fire stages, it was necessary, with the vertical rifle, to load 1 round in the chamber, insert a 5-round box magazine and then reload with two 5-round magazines as the firing progressed. With the rotary rifle, 1 round was loaded in the chamber and 10 in the magazine. Then, at any opportune moment after the firing of the fifth round and before the firing of the eleventh, an additional 5 rounds was loaded from the regular clip so that the 16 rounds were fired with but one pause, and that selected by the firer at any one of 5 moments available to him.

Before each day's firing, the bolt, receiver and chamber were dried of oil to check on the performance of the rifle when unlubricated.

The CHAIRMAN. What is the receiver?

Captain VAN ORDEN. This part here [indicating].

The CHAIRMAN. Describe it so the reporter can report what it is. Describe it, Mr. Johnson.

Mr. JOHNSON. The receiver is the unit which holds the bolt and the barrel. It is sometimes called the frame. It joins those two basic component parts.

The CHAIRMAN. Very well. Go ahead, go ahead.

Captain VAN ORDEN. The firing of the marksmanship exercises plus the firing of approximately 1,500 rounds to examine into and test the functioning of the rifles failed to produce a stoppage of any kind except the misfire mentioned before. It therefore appears that the rifle will function perfectly without lubrication.

After firing 150 rounds of M1 ammunition, the functioning of the rotary rifle was tested with 40 rounds of M2 ammunition. There were no stoppages.

To determine the probability of continued performance if the rifle were subjected to dust and dirt, the bolt, receiver and magazine of the rotary rifle were lightly oiled and then covered with dirt from the firing line. 80 rounds were then loaded and fired in rapid succession without a stoppage.

The cleaning of the rifles was found to be an easy and rapid operation, inasmuch as the rifles could be completely disassembled in a moment's time and all recesses easily gotten at.

The firing proved the data contained in pages 11 to 18 of the Military Handbook of the Johnson semiautomatic rifle.

Certain modifications of and additions to the rotary rifle are desirable to develop the full potentialities of the rifle as a military arm. None complicate or alter the functioning of the weapon or its production. They are discussed as follows:

One of the outstanding features of the rotary rifle is, that if the rotary box magazine becomes damaged or out of order, it may be replaced as a unit at small cost. However, the cover of the magazine is so constructed that, when the unit is disassembled from the rifle, it may open to the extent of allowing the follower to slip out of the magazine and release the tension of the follower spring. The services of an armorer would be required to reassemble the mechanism. A stop pin, removable by the armorer, should be so placed as to prevent the cover from opening too far when the magazine is disassembled from the rifle.

The direction of the magazine retaining pins were so arranged as to make it necessary to remove both parts of the stock to remove the magazine. The pins should have been so directed that the magazine could have been removed after one part of the stock had been taken off. These pins were changed as recommended in the production models.

The graduating of the elevator of the rear sight in hundreds of yards for M1 ammunition was not particularly satisfactory. The system prevented small changes in elevation, essential if hits are to be made on small targets at long range. An elevating device has since been added to the rear sight that permits minute adjustment between steps of the elevator. A clearly marked step representing 250 yards elevation should be provided on the elevator so that, when adjusted with the elevation adjustment screw, the sight being set in the 250-yard step, the rifle will be exactly calibrated at that range. Then, when employed in combat, the rifle will produce for the firer the characteristic of the M1 cartridge that a prone-man target can be hit at any range from point blank to 400 yards, provided the sights be calibrated at 250 yards and the aiming point be the center of the figure.

There should be much clearer definition of the wind-gage markings than appeared on the rifles tested.

A butt plate trap assembly should have been provided so that an oil and thong case might be carried in the stock. The recess in the stock could be elliptical in form so that a spare firing pin and extractor could be carried as a safeguard against breakdowns. In the production models the trap and well was provided.

The triggers of all rifles tested were of the "single trigger" type: That is to say, one direct pull of the trigger serves to release the sear. The fault of this system is that there is a long drag and creep in even the most carefully adjusted triggers. This condition is disastrous to good marksmanship, on the target range or in combat. The trigger system of the Johnson rifle can be, and was, modified to be a "double trigger," or one in which a slack is taken up on the first pull and the rifle is fired by a gradual second pull. This system is the one to which

our men are trained. Two-trigger mechanisms were modified at our request and were most satisfactory.

Senator JOHNSON. Did you have any difficulty getting hold of a gun to fire?

Captain VAN ORDEN. Yes, sir. The only time we would have an opportunity to shoot one would be when Captain Johnson would bring one down and say, "Look at this." He would let me take it out and fire it any way that I wanted to. One thing about it, he just turned the rifle over to me and told me to go ahead and mistreat it or anything I wanted, to find out what it would do. I have never seen the Johnson rifle break down in any way except in the breaking down of one extractor during the "Mud Test" at Aberdeen. The extractor can be changed without removing the bolt from the rifle, which is a very important point. Failures to feed will occur in any weapon, and failures to eject, even with the 1903 rifle; I feel that we should not hold things like that against a weapon. They happen regardless of the excellence of the design or matters of that kind; more often than not they are due to the ammunition. The Johnson firing pins hold up; the ejectors and the extractors work and the bolts keep their head space. The stock remains tight on the rifle, and the rifle doesn't change its zero from day to day, which makes it possible to hit the same mark every day with the same sightsetting.

The CHAIRMAN. Senator Johnson, do you want to ask any further questions?

Senator JOHNSON. No.

The CHAIRMAN. Does Senator Brookhart want to ask any questions?

Senator BROOKHART. Captain Van Orden, have you recently made some firing tests with the M1?

Captain VAN ORDEN. Yes, sir.

Senator BROOKHART. Will you tell the committee in the record of that?

Captain VAN ORDEN. I would say this comparative test was about on a par with the test firing at Wakefield, too few men, too few arms, but I think we did get something out of it, all right. In making experiments, we fired in two phases which interlocked. I had heard a remark that the United States rifle, caliber .30, M1, would change its zero when fired at varying rates of fire over a period of time and that it would change its zero from day to day, so it would be impossible for a man to get a hit on a man target at a reasonably short range.

At Quantico I had access to about 40 rifles and in order to try to make a fair comparison I asked a lieutenant to go to the armory and pick two M1 rifles off the rack.

Senator BROOKHART. That would be called the Garand?

Captain VAN ORDEN. Yes. The lieutenant selected two rifles at random.

I got three of the best rifle shots I had available there at the time; Corporal David Crew, a Distinguished Marksman, Sgt. Ronald J. Nourse, another Distinguished Marksman, with a great deal of experience, and Corp. William L. Jordan, also a Distinguished Marksman. I had Jordan fire the 1903 rifles because he was considered an excellent rapid-fire man, very excellent at manipulating the 1903 rifle. What I wanted was to get the M1 and the 1903 firing at the maxi-

imum top speed and see at what point zero started to change from overheating. [Reading from report:]

PROCEDURE

(a) At 300 yards slow fire, prone position with the sandbag, target A, sighting shots were taken until the center of impact of an eight-shot group lay on the center of the five ring.

(b) The sighting targets were replaced with new "A" targets mounted on new cloth, both without a hole in them.

(c) Corp. William L. Jordan, Jr., United States Marine Corps, firing M1903 rifle No. 847799 (S. A.), firing on target No. 34, Corp. David O. Crew, United States Marine Corps, firing M1 rifle No. 4075, firing on target No. 35, and Sgt Ronald J. Nourse, United States Marine Corps, firing rifle M1 No. 3513, on target No. 36, each fired 80 rounds of cartridges, ball, caliber .30, M1, F. A. lot No. 2068 (38) at an attempted rate of 30 rounds per minute. Jordan's elapsed time with the 1903 rifle was 5 minutes 40 seconds, Crew's time, 4 minutes 10 seconds, Nourse's time 4 minutes 20 seconds.

(d) The targets were withdrawn, red crosses marked on each shot hole of the group. The targets were quickly run up for the second phase.

(e) The riflemen fired 80 rounds more at the attempted rate of 30 shots per minute. Jordan's time was 5 minutes 50 seconds, Crew's time 3 minutes 15 seconds, Nourse's time, 3 minutes 10 seconds.

(f) The targets were withdrawn and blue crosses marked on the shot holes of the second 80 rounds. The targets were up for the third phase.

(g) Thirty minutes having elapsed and the rifles having been cleaned and cooled, a third group of 80 rounds were fired at an attempted rate of 15 rounds per minute. Jordan's time was 6 minutes 15 seconds, Crew's time, 5 minutes 8 seconds, Nourse's time 5 minutes.

(h) The targets were withdrawn and green crosses marked on the shot holes of the third 80 rounds. The targets were run up for the fourth phase.

(i) Thirty minutes having elapsed and the rifles having been cleaned and cooled, a fourth group of 80 rounds were fired at an attempted rate of 10 rounds per minute. Jordan's time was 7 minutes 55 seconds, Crew's time 7 minutes 20 seconds, Nourse's time 7 minutes 45 seconds.

(j) The targets were withdrawn and black crosses marked on the shot holes of the fourth 80 rounds.

OBSERVATIONS

(a) The condition of the rifles before and after firing were as follows:
1903 rifle No. 847799:

Headspace: Less than 1.946 inches.

Bore: No defects.

Bolt: No defects.

Stock: No defects.

Other: As firing progressed the sight moved 2½ points right in windage, probably due to overheating.

M1 rifle No. 4075:

Headspace: Less than 1.946 inches.

Bore: No defects.

Bolt: No defects.

Stock: No defects.

Other: None.

M1 rifle No. 3313:

Headspace: Less than 1.946 inches.

Bore: Finely pitted on lands near muzzle.

Bolt: No defects.

Stock: No defects.

Other: Loose gas cylinder; condition same before and after firing.

Senator JOHNSON. That is the Garand?

Captain VAN ORDEN. Yes, sir. [Continuing:]

(b) Condition of the firers before and after firing:

Corp. William L. Jordan, Jr., age 27, 4½ years service, weight 190 pounds, height 71 inches, condition after firing: Slightly sore shoulder, no effects the following morning. Corp. David O. Crew, age 41, 12 years service, weight 210 pounds, height 71 inches, condition after firing: No effects. Sgt. Ronald J

Nourse, age 32, 10 years service, weight 198 pounds, height 67 inches, condition after firing: No effects.

FINDINGS OF FACTS

(a) Mechanical performance: Rifle No. 847799 had no stoppages and developed no defect except the slipping of the sight in deflection. Rifle No. 4075 failed to feed four times and failed to fire once. The cartridge fired on the second attempt. Rifle No. 3513 consistently failed to feed correctly the seventh round of every clip. One stoppage in each M1 rifle was caused by the misalignment of cartridges in the clip, a projecting cartridge causing a prolonged stoppage.

(b) Accuracy performance (based on hits per gun per minute divided by shots per gun per minute; and scribing on the target two horizontal lines one 9½ inches above and the other 9½ inches below the center of the target, the contained space representing the height of a man target in the prone position. A hit is a shot which strikes this contained space):

(1) United States rifle, caliber .30, M1903, No. 847799, fired by Corp. William L. Jordan, Jr., United States Marine Corps:

320 rounds in 25 minutes 40 seconds=12.5 shots per gun per minute.

287 hits in 25 minutes 40 seconds=11.2 hits per gun per minute.

89.6 percent efficient.

Senator BROOKHART. That is the Springfield?

Captain VAN ORDEN. The Springfield '03. And Sergeant Nourse firing M1 No. 3313.

Senator JOHNSON. That is the Garand?

Captain VAN ORDEN. Yes, sir. [Continuing:]

Fired 320 rounds in 20 minutes 15 seconds=15.8 shots per gun per minute.

188 hits in 20 minutes 15 seconds=9.3 hits per gun per minute.

58.8 percent efficient.

(3) United States rifle, caliber .30, M1, No. 4075, fired by Corp. David O. Crew, United States Marine Corps:

320 rounds in 19 minutes 53 seconds=16 shots per gun per minute.

121 hits in 19 minutes 53 seconds=6.03 hits per gun per minute.

35.5 percent efficient.

In other words these two rifles fired more shots and got less hits than the man firing the old bolt action rifle. [Continuing:]

(c) Changes in elevations of the centers of impact:

(a) The positions of the centers of impact of the several rifles as firing progressed considering elevations only, were as follows:

Number of rounds	Rifle, M1903, No. 847799	Rifle, M1, No. 3313	Rifle, M1, No. 4075
0.....	0.....	0.....	0.....
80.....	Plus 2 inches.....	No change.....	Minus 5 inches.
160.....	Plus 4 inches.....	do.....	Minus 9 inches.
240.....	do.....	Plus 6 inches.....	Minus 23 inches.
320.....	Plus 6 inches.....	Plus 9 inches.....	Minus 36 inches.

[NOTE.—Center of impact of M1 rifle No. 4075 moved off the bottom of the target at about round No. 264 but moved back to the bottom edge of the target at about round No. 290.]

What I wanted was to have the Johnson rifle there at that time and shoot it under the same conditions. We didn't have one that day so I got hold of one later and fired the second test.

On the 7th of May I fired a competitive test between the Johnson and the United States rifle, caliber .30 M1.

Senator BROOKHART. That is the Johnson and the Garand?

Captain VAN ORDEN. Yes, sir; we tested the rifles on the 6th and 7th of May. We were able at that time to have more rifles and better qualified people to fire them. We had three Johnson semi-automatic rifles there at that time, all rotary magazines rifles, these same ones here; I believe they are the same, Nos. 13, 14, and 15. We had two rifles, caliber .30 M1, we had selected for being without

defect; picked the best one we could get our hands on. We had four shooters. We had Fist Sergeant Harker, an outstanding rifleman and an outstanding rifle coach of 20 years' service.

Gunnery Sgt. Claude N. Harris, recently the national rifle champion and one of the greatest rifle shots of the day, 12 years service.

Platoon Sgt. Thurman E. Barrier, a distinguished rifleman and a distinguished pistol shot with a Nation-wide reputation as a marksman, and is, in addition, an expert in munitions; 8 years' service.

Platoon Sgt. Victor F. Brown, a distinguished rifleman and a distinguished pistol shot and highly experienced with the M1 rifle; 11 years' service.

The shooters were selected on their reputations as fine soldiers, outstanding riflemen, principals of Marine Corps national match rifle teams, and for being gentlemen of the highest integrity.

Chief Marine Gunner Calvin A. Lloyd, a rifle team coach of international reputation, coached the shooters during the firing.

Procedure: On May 6, the shooters were assembled and given 2 hours instruction in the M1 rifle and the Johnson rifle, the subjects of stripping, assembling, manipulation, and sight setting being covered to the satisfaction of the several shooters. The plan for the test was stated in substance as follows:

This test is to find what the highest score each of you can make firing both rifles under equal conditions. We do not say that one rifle is superior to the other; we ask that you withhold judgment and opinions until the test is completed. We will expect you to fire every shot with the intention of hitting the bull. In slow fire you may make corrections between shots and in rapid fire between strings. In rapid fire we ask you to fire as many shots as you can in 1 minute, keeping in mind that a high total score is important. You will take any stoppages as they come and reduce them and continue firing as best you can. In short, make the rifles speak for themselves. Guard against favoring one or the other until the test is completed.

We will fire sighters at 300 yards until your center of impact is in the center of the bull. You will then fire 10 shots slow fire for score. Following this you will fire three runs of rapid fire, firing as many rounds as is practicable in 1 minute, starting with rifles empty. Your target will be marked after each run.

During this phase of the firing two of you will fire an M1 rifle and two will fire the Johnson rifle. On completion of this phase you will change rifles among you so that an M1 shooter will now fire the Johnson. The phase will then be repeated.

Following this we will move to 1,000 yards and fire sighters until the centers of impact are in the bull. You will then fire 20 shots for score, slow fire. Following this, we will fire as many rounds as may be practicable in 1 minute, starting with a loaded rifle. As before, the rifles will be exchanged and the phase repeated. Mr. Lloyd will coach each pair at 1,000 yards, so that the maximum of information can be obtained on the performance of each rifle at the long range.

The score attained will be your total scores slow fire and your average scores rapid fire. It may be seen that, in this test, rapidity of fire will be as important as accuracy, for the scores will be built up by the shots per minute. However, if there are inaccuracies in the rifles, the scores will be low regardless of the rate of fire. Therefore fire your rapid-fire shots as fast as you can, but do not fire any shot unless you think it will be good.

The rifles were then gaged and carefully inspected. All five rifles were without defect and in excellent condition.

Cartridges, ball, caliber .30, M1, FA, lot 2068, was selected by chance for the test.

The test was continued on May 7 with the following results:

300 yards—target A, slow fire, 10 shots; prone

Shooter	Johnson rifle, No.—	Score	M1 rifle, No.—	Score
Harker.....	R14	49	3536	42
Harris.....	R15	46	3739	43
Barrier.....	R14	46	3536	47
Brown.....	R15	48	3739	45
Total.....		189		177
Average.....		47.3		44.3

300 yards—target A, rapid fire, 3 1-minute runs; empty rifle to start

JOHNSON RIFLE

Shooter	Rifle No.—	Most shots per gun per minute	Least shots per gun per minute	Average shots per gun per minute	Best score
Harker.....	R14	25	19	21.7	101
Harris.....	R15	20	16	17.3	81
Barrier.....	R14	20	14	17.3	90
Brown.....	R15	12	10	11.0	54
Total.....		77	59	67.3	326
Average.....		10.3	14.8	16.8	81.5

Shooter	Rifle No.—	Lowest score	Average score
Harker.....	R14	85	92.0
Harris.....	R15	66	71.3
Barrier.....	R14	61	77.7
Brown.....	R15	52	53.0
Total.....		264	294.0
Average.....		66.0	73.5

M1 RIFLE

Shooter	Rifle No.—	Most shots per gun per minute	Least shots per gun per minute	Average shots per gun per minute	Best score
Harker.....	3536	24	18	20.3	73
Harris.....	3739	24	18	20.3	101
Barrier.....	3536	16	16	16.0	65
Brown.....	3739	19	16	17.0	77
Total.....		83	68	73.6	316
Average.....		20.8	17.0	18.4	79.0

Shooter	Rifle No.—	Lowest score	Average score
Harker.....	3536	62	68.0
Harris.....	3739	74	84.3
Barrier.....	3536	69	62.0
Brown.....	3739	70	73.3
Total.....		265	287.6
Average.....		66.3	71.9

Comparison: Score per gun per minute divided by possible score per gun per minute (for shots actually fired):

Johnson rifle: $73.5/84.0 = 87.5$ percent efficient.

M1 rifle : $71.9/92.0 = 78.2$ percent efficient.

1,000 yards—target C, slow fire, 20 shots; prone

Shooter	Johnson rifle No.—	Score	M1 rifle	Score
Harker.....	R13	79	3536	61
Harris.....	R15	67	3739	58
Barrier.....	R13	84	3536	51
Brown.....	R15	78	3739	70
Total.....		308		240
Average.....		77.0		60.0

1,000 yards—target C, rapid fire, 1 minute run; loaded rifle to start

Shooter	Johnson No.—	Shots	Score	M1 rifle No.—	Shots	Score
Harker.....	R13	16	46	3536	16	35
Harris.....	R15	16	66	3739	16	45
Barrier.....	R13	18	40	3536	17	50
Brown.....	R15	14	58	3739	15	57
Total.....		64	210		64	187
Average.....		16	52.5		16	46.8

Comparison: Score per gun per minute divided by possible score per gun per minute (for shots actually fired):

Johnson rifle: $52.5/80=65.6$ percent efficient.M1 rifle : $46.8/80=58.5$ percent efficient.

Total score for all stages

Shooter	Rifle	300 slow	300 rapid	1,000 slow	1,000 rapid	Total
Harker.....	Johnson.....	49	92.0	79	46	266.0
	M1.....	42	68.0	61	35	206.0
Harris.....	Johnson.....	46	71.3	67	66	250.3
	M1.....	43	84.3	58	45	230.3
Barrier.....	Johnson.....	46	77.7	84	40	247.7
	M1.....	47	62.0	51	50	210.0
Brown.....	Johnson.....	48	53.0	78	58	237.0
	M1.....	45	73.3	70	57	245.3
Total score:						
Johnson rifles.....						1,001.0
M1 rifle.....						891.6
Average score:						
Johnson rifle.....						250.3
M1 rifle.....						222.9

Comparative efficiency

[Based on score per gun divided by possible score per gun for shots actually fired at all stages]

Rifle	300 yards slow fire	300 yards rapid fire	1,000 yards slow fire	1,000 yards rapid fire	Average
Johnson.....	Percent 94.6	Percent 87.5	Percent 77.0	Percent 65.6	Percent 81.2
M1.....	Percent 88.6	Percent 78.2	Percent 60.0	Percent 58.5	Percent 71.3

FINDINGS

(1) The mechanical performance of all rifles was satisfactory.

(2) M1 rifle No. 3536 dropped its center of impact after 68 rounds 18 inches; after 112 rounds an additional 20 inches; a total shift of mean point of impact of 38 inches at 300 yards.

(3) M1 rifle No. 3729 shifted its center of impact 13 inches high after 71 rounds at 300 yards.

(4) No other shifts of center of impact were observed during the tests.

(5) Starting with an empty rifle, the average time from "commence firing" to the first shot fired was 5.5 seconds for the M1 and 11.8 seconds for the Johnson. The fastest loading time for the Johnson was 8 seconds, the slowest for the M1 was 10 seconds, first shots of each pair only being counted. Starting with loaded rifles, the normal situation in the field, the first shots were fired in equally fast time.

(6) The combined accuracy-rate of fire performance of the Johnson rifles was 9.9 percent superior to that of the M1 rifles.

That completed the comparison test between the two rifles.

Senator BROOKHART. It is a fair rifleman's test. Could you furnish a copy of those scores for the record?

The CHAIRMAN. Yes; he is going to give all his papers to the reporter and have a complete statement with all the figures.

Well, we certainly appreciate the accuracy with which you have testified and the figures you have given.

Captain VAN ORDEN. Thank you, sir. I do believe, in all fairness to everybody, that we should stress the point that the rifles I had were few in number and by chance or luck I might have gotten good rifles of one kind and bad rifles of another.

Senator BROOKHART. When you had all those rifles, the percentage went lower than you reported.

Captain VAN ORDEN. Yes. Every time we fired different ones we got about the same results, they were consistent. Out of about 14 different M1's that I fired to see if they would change zero, about 10 of them did and 4 of them did not. And with the Johnsons I did everything in the world to try to make them change zero and they wouldn't do it.

The CHAIRMAN. Thank you very much.

Captain VAN ORDEN. If it please the chairman, it is my understanding that I am privileged to extend my remarks in these hearings.

It has often been stated that the difference between gas operation and recoil operation is a matter of opinion alone and that more can be said for gas than for recoil. However, my experience has been the reverse of this. I have observed the following disadvantages of gas operation. A gas operated weapon requires a piston, gas vent, gas cylinder, in addition to other parts which complicate the mechanism. A gas vent in the barrel promotes erosion and fouling unless its diameter is carefully regulated. If the size of the vent is not variable, the gun may not function. In the Browning automatic rifle there is a variable vent system which provides three different sizes of exhaust for the gas. It is often necessary to use the largest vent, and not infrequently the rifle must be disassembled for cleaning in order for the piston to receive sufficient gas to operate the mechanism. The connection between the piston and the action requires levers or links compensating springs and rods, and pivot pins which may wear and throw the linkage out of adjustment.

It is accepted that an accurate target rifle barrel must be free to vibrate as a tuning fork when fired. When a cylinder is carried on a barrel, or attached to it, it dampens the vibration of the barrel, prevents normal expansion, and induces inaccuracy in the barrel. The mechanism driving the action offers twice the area and mass subject to fouling and to damage. Carefully designed cams and links are required to insure the proper moment of unlocking in the action. While a delaying mechanism is also required in any recoil

operated weapon, it is less complicated than the delaying mechanism in a gas operated weapon.

Some of the more apparent advantages of recoil operation are that the same, if not greater force, actuates functioning as in gas operation. There are no vents in the barrels to promote erosion. In the recoil-operated weapon there are but three separate groups, the bolt, the barrel and the receiver. No links, pins, or timing gear to wear, enlarge, upset, or stretch other than those found on the bolt, the chamber, or the receiver of the recoil operated weapon are necessary. Strange as it seems, in the recoil operated weapons, the more fouled the action becomes the more positive seems to be the action on the cartridges fired. Having approximately half the actuating mechanism of gas operated weapons, the recoil operated weapon is therefore simpler and less liable to damage and fouling.

The absence of gas cylinders, pistons, and so forth, permit proper barrel bedding according to well established principles and promote increased accuracy. The barrel of the recoil operated weapon is removable and interchangeable. Being removable the barrels can be properly and easily cleaned and their life thereby greatly extended. In a shoulder weapon a recoiling barrel can provide extra thrust in bayonet fighting, as in the case of a boxer who in striking a blow, at the moment of contact with his glove on his opponent, straightens his elbow smartly. In support of these statements it is to be noted that the most successful machine guns, the Maxim and the Browning, are recoil operated. The least successful machine guns, the Benet, Lewis, and the old Colt, are gas operated. The German Army had standardized a gas operated rifle—the Mondragon—before the first World War but discarded it during the early months of the war as being unreliable and inaccurate.

On the subject of ammunition, too much cannot be said of the characteristic of the Johnson rifle that it can be loaded with the five-shot clip (spoken of as the '06 clip, of five rounds). It has always been accepted as desirable, that in ammunition supply all cartridges be packed in the same container and useful in all of the infantry weapons. I have before me a list of the standard packings of cartridges, ball, caliber .30 now available for issue to troops. Quoting from this table, we have: Cartridges, ball, caliber .30 M1, in cartons to 20, case of 1,500; M1 clips in bandoliers, cases of 1,152; '06 clips and bandoliers, cases of 1,200; machine gun belts of 250, cases of 1,250; link belts of 100, cases of 1,200; metal link belts of 100, having 80 ball and 20 tracer cartridges, cases of 1,200; cartridges, ball, caliber .30 M2 cartons of 20 and cases of 1,500; M1 clips and bandoliers, cases of 1,152; in '06 clips and bandoliers cases of 1,200; '06 clips and cartons, cases of 1,500. Thus there are 10 standard packings, all different, of caliber .30 ball ammunition available for issue. The weapons in which this ammunition is used and which are standard for issue to the troops, though not necessarily in their hands at this time, may be issued to them in time of war are in part: The United States rifle, caliber .30 M1903, United States rifle caliber .30, M1917, United States rifle, caliber .30, M1, the Browning automatic rifle model 1918, the Browning machine gun model 1917, the .30 caliber tank machine guns, the .30 caliber Browning aircraft machine guns, the Browning machine rifle, the air cooled cavalry machine gun, and the Vickers and Marlin machine guns. Of the 10 ammunition packings listed above, 2 are in M1 clips and ban-

doliers, cases of 1,152. This packing is for the United States rifle, caliber .30 M1. Were it not for the M1 rifle it would be practical and possible and highly desirable that the 10 packings could be reduced to one only, that the packing of cartridges, ball, caliber .30 M1 in '06 clips and bandoliers, cases of 1,200, a packing which would be suitable and sufficient for all of the infantry weapons in the hands of the troops.

One of the most serious problems in combat is the supplying of the troops with ammunition during combat and in fast moving situations it is difficult enough for the ammunition supply units to locate the position of the combat troops without having to determine which type of loading would be satisfactory for them. It may be that the machine guns are using the most ammunition or it might be that the rifles would be using the greater part of the ammunition. The accepted procedure for supplying ammunition to troops in the forward position, is for the ammunition service unit to form a dump in the rear of, as near as possible to the combat troops in line. It is then necessary for the troops to locate the ammunition and take from the dump the ammunition required by them. It would be exceedingly difficult for the ammunition supply unit, to attempt to determine what the particular armament of the troops before them would happen to be. The situation as regarding the arming of infantry troops at this time is such that it might be possible for the nearby units to be armed with the United States rifle M-1903 or the United States rifle M-1917, or the United States rifle M1. As mentioned before, one of the outstanding characteristics of the Johnson rifle is that it may use the ammunition and five round clip, the '06 clip, which is sufficient for all of the other infantry weapons. Were the Johnson rifle the semiautomatic rifle in the hands of the troops all the ammunition packings could be reduced to one type only and that type suitable for all of the weapons. The only problem of the ammunition supply service would then be to dump small arms ammunition near infantry units, no matter what their composition or position, for the one packing would suit all weapons.

It is to be further noted that cartridges, ball, caliber .30, M1 in '06 clips and bandoliers in cases of 1,200 weigh 100 pounds per case while cartridges, ball, caliber .30 M1 in M1 clips and bandoliers, cases of 1,152 weigh 99 pounds. Thus a case of small-arms ammunition packed in M1 clips, containing 48 rounds less per case weighs but 1 pound less than ball ammunition in '06 clips and bandoliers, and the difficulty of transporting ball cartridges in M1 clips is not materially less than that of transporting them in '06 clips and bandoliers. The space occupied by either case is identical. The difference in contents between an ammunition case loaded with cartridges in M1 clips and cartridges in '06 clips can be better visualized by the figures given for the capacity of a 30-ton railway car when loaded with ball ammunition. A 30-ton railway car can be loaded with 698,112 rounds of ball cartridges in M1 clips and bandoliers in cases of 1,152, but 720,000 rounds of ball cartridges packed in '06 clips and bandoliers, cases of 1,200, can be packed in the same car. Thus 21,888 more rounds of ammunition packed in '06 clips may be contained in a railway car than can be cartridges packed in M1 clips.

There has been frequent comment on the difficulty of loading single rounds into the M1 rifle. In the Johnson rifle it is very simple to load a single round, an operation which is highly desirable on fre-

quent occasions, as when a scout desires to fire one tracer bullet to locate a target, or when it becomes necessary or desirable to fire one or more armor-piercing bullets at a target. It is a distinct advantage to be able to reload the magazine without having to open the bolt, so that at every moment the rifle is ready to be discharged at the appearance of an enemy.

In conclusion, the following is a list of the advantages which the rifle conducted with the Johnson rifle made apparent to me: (1) It can be loaded from the 5-round clip; (2) the 10 rounds may be loaded in the magazine and one in the chamber and as each shot is fired one round may be replaced in the magazine, thus keeping the rifle fully loaded at all times; (3) it is a recoil operated weapon instead of gas operated; (4) its removable barrel facilitates cleaning and prolongs the useful life of the barrel; (5) the rifle positively functions well without lubrication; (6) the various group assemblies may be removed independently and quickly; (7) the rifle appears to be highly resistant to harsh treatment; (8) in rifles so far tested the parts were 100 percent interchangeable; (9) the extractor may be removed without stripping the rifle, a highly desirable feature; (10) excessive head space will be less likely to develop due to the eight locking lugs and the well protected bolt head; (11) the Johnson action has been included in a light machine gun model having many interchangeable parts with those of the shoulder weapon, a distinct advantage for troops in the field, particularly where those parts which are liable to breakage are interchangeable with the shoulder weapon.

As a result of visits to the Taft-Pierce plant in Woonsocket and as a result of conversations with production engineers, it appears that the Johnson rifle has the following great advantages over other types of semiautomatic weapons: (1) That the Johnson rifle is particularly adapted to the mass production methods of plants engaged in mechanical operations; (2) the Johnson rifle is a machine shop, rather than a gun shop rifle, and it appears that its parts can be easily and quickly made by many machine shops scattered throughout the country, even though those shops may have never before manufactured rifles or rifle parts. The rifle should be less costly to manufacture than the present standard rifle; (3) the special steels required for any of the parts of this rifle—(a) by the addition of a simple collar, an M-1903 barrel of an M-1917 barrel, or even a Browning machine gun barrel may be converted for use in a Johnson rifle or light machine gun; (4) The disadvantages we found in firing the Johnson semiautomatic rifles were minor in nature and easily changeable by the inventor. Namely, the type of sights, type of trigger, and the stock. I would suggest that the sight which is now standard on the M-1903 rifle has proven itself to be the best all-around military sight yet devised, having a combination of peep sight, triangle sight, and battle sight for the three sighting situations which may be encountered in combat. That is, the peep sight for long-range targets at which deliberate and carefully aimed fire may be delivered; the triangle sight to be used in situations where the target is obscured by fog or haze or poor light; and the battle sight for use in situations in which a quick shot must be delivered at a rapidly moving target. No substitute has yet been devised for an open notch battle sight for the delivery of fire against a quickly moving target at battle ranges up to three to four hundred yards. A windage adjustment is essential to accurate marksmanship

on a target range or on a battlefield and a windgage should certainly be included in this sight. While the sight now on the Johnson rifle is a clever arrangement, lacking a battle-sight notch, or a sight similar to the buck-horn sight makes it to me not a completely suitable combat and marksmanship sight. I would suggest that future production models of the rifle be equipped with a leaf sight similar in all respects to that of the M-1903 sight but equipped with a battle sight with a deeper and more easily located notch, and matched to a variable height front sight. The trigger to meet the requirements of American marksmanship training methods must be a double trigger; that is, with a take up on the first pull followed by a second pressure to discharge the piece. Such a double trigger is easy to provide for in the system carried in the Johnson mechanism. The shape of the stock is not exactly satisfactory to the Marines who fired the piece. In future models, it would be well to have a stock which conforms exactly in drop and other similar points to the type C stock of the United States rifle caliber .30 M-1903. The characteristic of the Johnson rifle—that the stock is an appendage rather than an integral part of the rifle makes it adaptable to the use of plastics as a substitute for wood in the making of the stock.

Mr. NESS. Mr. Ness, give your full name and address and title?

STATEMENT OF FRED C. NESS

Mr. NESS. My name is Fred C. Ness.

The CHAIRMAN. Your street?

Mr. NESS. 1550 North Danville, Arlington, Va.

I am employed by the National Rifle Association, and I am in charge of their technical division.

The CHAIRMAN. Will you tell us what you know about the Johnson rifle?

Mr. NESS. Well, I have fired perhaps half a dozen Johnson rifles for a little more than a total of 2,000 rounds of ammunition. These have been fired under all shooting conditions.

The CHAIRMAN. What experience have you had in firing rifles?

Mr. NESS. I have been nationally known as an arms expert since 1916 and as a writer on firearms in outdoor magazines since then.

I am not prepared with figures and have nothing to quote except to say we found—in our tests—the Johnson rifle to be finely accurate.

Perhaps the most indicative accuracy tests, which included 180 shots at 200 yards, was my average at that range of 6.89 and 7.53 inches

on two occasions. I shot every group. I did not shoot for scores as Captain Van Orden did. We test rifles for extreme spread, and we

also note, as they did, the center of impact, and note or log in changes when they occur.

The CHAIRMAN. You are employed by the National Rifle Association as an expert marksman?

Mr. NESS. Well, as an expert tester, you might say.

The CHAIRMAN. Tester?

Mr. NESS. And we try to find the average extreme spread of a certain number of shots. It would be 10 shots in most cases, that is, 10-shot groups.

The CHAIRMAN. As fired by an expert?

Mr. NESS. Yes; and the knowledge I got from that careful testing with the Johnson rifles was they at least are fully as accurate as the well-known model 1903 Springfield rifle.

That is the principal point. I have occasion to use a great many firearms and I have been greatly impressed by the Johnson rifle for a number of reasons: On account of the reliability with which it functions and handles many different loads. We hand-load ammunition and we load it to low pressure and to high pressure; and we also use service ammunition and commercial ammunition, and the Johnson rifle handled it all very well, indeed. And that was true of all the Johnson rifles tried.

In particular the thing that impressed me with the Johnson rifle was the simplicity of the action on account of the recoil-operation, the short-recoil system utilizing the barrel for that purpose, that is, a moving barrel.

And I did not expect it to be inaccurate just because the barrel moved, although I was told that it would be found so. But we have found that unless a gun is custom-built and very carefully fitted, that is as opposed to production manufacture or factory-made weapons, that it is better to have some freedom between the barrel and its support; it must not be considerable, but some slight freedom. We have that in the Remington commercial .30-06-caliber sporting rifle.

That was brought out before, today, the matter of floating type of fitting between a barrel and the wood and which is what I am discussing. The same thing prevails in the Johnson except that it is metal to metal. Mr. Johnson has a guide bushing and a ground receiver contacting at two separated places.

In all my shooting with the Johnson I had no occasion to change that impression of inherent accuracy. I consider the rifle finely accurate. I like, too, in the design the fact that the springs are away from the hot part of the rifle, which is the barrel; the operating spring, recoil spring, and return spring are back in the back end of the gun. I like the fact very much that the barrels could be removed. In fact, I have fired several .30-caliber barrels, a .270 Winchester caliber barrel, and a 7-millimeter barrel in the same gun, by simply interchanging the barrels and using a different cartridge as I changed barrels to that caliber.

I like that feature, and I think it is of great importance in the military type of gun because the barrels wear out quite rapidly if they are fired rapidly and heat up, and they can be easily replaced in the field in this Johnson design.

And that brings up another point: I like the open construction of the gun because it does not get as hot as a gun which is thoroughly encased with wood, such as the model 1903 rifle down there. The Johnson is, in my opinion, a better-ventilated rifle. The matter of magazine feed and all that has all been brought out, and I concur with what has been said about it. I think that is a wonderful feature.

I have used the rifle for handling qualities and have handled it like a shotgun on flying targets for repeated shots, and found it to handle very well and could be used effectively the first time I tried it that way.

I see a lot of advantage in the fact that the stock is not influential on the zero or point of impact in this rifle. It is away from the inletting of the barrel, because it is separate.

The CHAIRMAN. Did I correctly understand Captain Van Orden to say that the hand grip was unnecessary and that the hand grip under this rifle, the metal part of this rifle, was unnecessary?

Captain VAN ORDEN. No, sir. I meant it didn't affect the shooting qualities of the rifle as the stock did in other target arms.

The CHAIRMAN. Do you consider it an advantage, the hand grip?

Captain VAN ORDEN. It is essential for the holding of the rifle, but what I meant was in other accurate target arms very careful work has to be done in the barrel and the stock, and in this rifle here—the Johnson design—the stock is just merely an appendage.

The CHAIRMAN. I am glad I got that correct. Now, Mr. Ness.

Senator BROOKHART. You made some tests of the M1, the Garand, also?

The CHAIRMAN. Yes; did you make tests of that?

Mr. NESS. Yes, sir.

The CHAIRMAN. Would you let us know about that?

Mr. NESS. I would be glad to. I was just thinking of another point.

The CHAIRMAN. Well, proceed in your own way.

Mr. NESS. Another point in this connection. The rifle of this type, recoil type, doesn't have the disadvantage of fouling which attends shooting of gas-operated designs.

The CHAIRMAN. Fouling? Fouling in the barrel?

Mr. NESS. Fouling in the action. The accumulation of fouling on operating parts. And also, in that same connection, it isn't dependent on small, light-inertia parts which must be driven or smacked, struck a smart blow, as is necessary in any gas-operated design. It is just one other reason why I like this recoil-operated design.

That is all that occurs to me at the present moment.

The CHAIRMAN. Did you say anything about your experience with that other type of rifle?

Mr. NESS. The M1 Garand?

The CHAIRMAN. The Garand.

Mr. NESS. I have a more limited experience with the Garand, I have personally fired only two of them, a total of a little over a thousand rounds, but the Garand did not equal the Johnson in accuracy.

Placing the Garand on the Springfield 1903 standard, it did not equal the 1903 Springfield in accuracy, which the Johnson did.

The Garand rifle functioned very well up to a certain number of rounds, when it started to become fouled and to get sluggish. Now that might be considered a reasonable number, but it occurred around 400 rounds, and according to the manual, the soldier is supposed to, as I understand it, clean out some of the carbon. It did function very well up to that number of rounds. But the peculiarity I have noticed, in two Garands, is change of impact. In one of them I fired 130 shots very slowly, without a magazine, inserting the cartridges in the chamber, and at the rate of 130 shots in 3 hours. This firing was done at Camp Sims this year on a 600-yard range, and we were surprised to find that the center of impact changed a total of 12 minutes of angle or 6 feet at 600 yards. That is 72 inches change in elevation in the firing of 130 rounds. After I obtained another rifle to check that, I found out that was an exceptional case. The second

rifle worked the same way, but to a lesser degree. The second rifle we fired 128 rounds—well, in fairly good rapid fire. We didn't try to shoot it as fast as we could, but quite rapidly, because we used the magazine, and the relation of the change in impact was 45 inches at 600 yards, or 22 inches at 300 yards. The same change of impact which Captain Van Orden brought out in his tests.

Now my experience is limited to those two rifles.

The CHAIRMAN. Any further observations?

Mr. NESS. Nothing that occurs to me at the moment, except that I believe I have indicated that I think the Johnson is a much better rifle than the Garand, and, I do.

The CHAIRMAN. Very well. We certainly appreciate your testimony.

Mr. NESS. If it would please the committee I would like to add some comments on the Garand and Johnson rifles.

All Garand rifles already produced and those still in production at this time, are of the type that have the defect which, it has been testified, caused the considerable change in impact and the inaccuracy which I have publicly criticized and mentioned before this committee. The correction of this gas-port part at the front end of the barrel is undoubtedly an important one, but I take the position that it does not represent any essential change as far as my criticism is concerned. I say this because the basic relationship and arrangement of parts has not been affected by this improvement and I would expect these new Garand rifles to "walk" their groups and to change their centers of impact as the barrel is heated by firing. The operating rod is still coupled under pressure of spring tension to the front end of the barrel and tends to push up the muzzle and front sight as the barrel is heated. This will cause low shooting.

Furthermore, this new front end does not change the inherent nature of the gas-operated Garand and I believe it will continue to foul considerably from gas leakage and to a degree detrimental to the functioning of its parts, thus precluding continuous firing or service in the field without periodic removal of the carbon as it accumulates. This is a fault even of the best gas-operated action I have seen.

This reminds me of Major Schlieker's reference to another gas-operated rifle in development bearing the interesting and important implication that the Garand rifle might be obsolete before it has attained any desirable momentum of production or even a satisfactory production. This would emphasize the importance of immediately getting into a trial production on any suitable and worthy design of semiautomatic rifle, such as the Johnson, so that its production possibilities may be properly exploited and so that it may be given a proper service and combat test in adequate numbers to assure in time for our using services and proposed enlarged army an ample supply of shoulder arms. That must be done before it is too late. To make 240,000 Garands at 4,000 per month will consume 5 years.

As Senator Brookhart stated, we need accurate rifles and reliable rifles which will not gum up from their own carbon production. Even with so-called combat rifles, concentrated fire, which is possible only with inherently accurate rifles, is necessary to conserve precious ammunition which must be brought to the individual soldier on the line after his limited load of 120 rounds has been exhausted. It might,

for example, become imperative for the rifleman to find slits and small openings in a tank with his bullets. This calls for concentrated fire with accurate rifles. The Johnson rifle has demonstrated its suitability for such uses in the combat field.

The new defense tactics against parachute attacks involve sharp-shooting which again demands accuracy in the rifle and individual marksmanship on the part of the soldier. In this connection the recently developed shotgun scope sight, which has no aim-confusing magnification, unlike conventional scope sights, has proven to be remarkably effective. This has been proven by tests on low-flying planes at Fort Sill and I have used such a scope on the Johnson rifle. The top-loading Garand rifle is not adapted for the use of this modern sight of the future.

The Johnson rifle is exceptionally well adapted for the use of a telescope sight because of the solid unbroken line of the top of its receiver and because of the fact that it is loaded from the side and ejects its fired cases through the loading port in the side of its receiver. In this respect it is superior to the Garand, Springfield, and other bolt-action rifles which cannot be clip loaded when the telescope is in place. The Garand cannot be used at all with the telescope sight unless it is mounted extremely high or forward or on the side any of which positions are a handicap to aim and preclude quick aim. The receiver of the Johnson rifle happens to be well adapted for any sight of any type as it can be placed in any of several positions or different places and at any one of different distances from the eye.

The matter of recoil effect has been mentioned. This is a controversial matter which varies with the individual with any rifle, according to the temperament and physique of the shooter and the method of holding the rifle and resting the butt on the shoulder. At Camp Perry I fired the Johnson rifle prone without a shooting coat or other coat and thought it kicked appreciably less than the Model 1903 Springfield. I believe that its recoil is less disturbing to the shooter and to his aim than that of the Springfield and that the recoil effect of the Garand is even slightly less than that of the Johnson. However, at times my reactions to the matter have been quite the opposite and then I thought the Garand more difficult to control than the Johnson.

The matter of clip loading has also been brought up. It has been my experience that the Johnson is no more difficult to load than the Springfield with a given lot of clip-loaded ammunition. I have seen no clips broken in loading the Johnson magazine and I have seen this happen with the Springfield as well as fumbles. It can occur with either rifle when the thumb is placed near the middle of the cartridge instead of next to the clip where it belongs when stripping a clip.

In conclusion, I want to say that the important thing is to put the Johnson rifle into production to satisfy the present need for an adequate supply of semiautomatic rifles, not as yet satisfied or even assured for the near future by the continued slow production of the Garand rifles. At this critical time it would be sheer folly to flub the opportunity.

Senator Brookhart?

Senator BROOKHART. Let us let General DeLamater have the floor.

STATEMENT OF BRIG. GEN. WALTER A. DELAMATER, PRESIDENT OF THE NATIONAL GUARD ASSOCIATION OF THE UNITED STATES

General DeLAMATER. My name is Walter A. DeLamater, brigadier general, president of the National Guard Association of the United States.

Mr. Chairman, I didn't expect to come here, but you always have been so courteous to the National Guard the various times we have appeared before you on matters of legislation, when I got your telegram inviting me I felt that I should come.

The CHAIRMAN. I am very glad; thank you.

General DeLAMATER. I am not going into any criticism of the merits of any of the rifles except to say this; I spent a great deal of time this winter conferring with the Secretary of War and the Chief of Staff of the Army, and I would like also to state that the Chief of Staff has been most courteous, gracious, to the National Guard. There has been a wonderful spirit of cooperation. I don't think that the National Guard at any time has received such hearty cooperation and such a willing spirit, as is shown now and as has been exhibited by the Chief of Staff of the Army to us this year.

The CHAIRMAN. Fine.

General DeLAMATER. In talking to the Secretary of War and the Chief of Staff, and in going over various matters, particularly in the early part of the year when we were talking over matters regarding the Budget as well as legislation, the first priority was weapons, material and equipment, and which we agreed was important. I think that we all feel today in view of world conditions that it is necessary that something should be done. I don't think we have time to fuss around and delay—I don't think we have time to quibble over some little preferences—whether this is a little better or that is a little better. I think the main thing is our equipment. How long is it going to take us to get equipped; time is the important factor.

I think in the present situation we also realize that it is absolutely essential to have increased supplies of firearms. We have in our service today, mainly on hand, the Springfield rifle. I think it is recognized that we have got to have more fire power. That has been the tendency, and I think everybody agrees on that.

Now apparently it is going to take some time to furnish the Army with the Garand rifle that has been issued. I think the matter, if I may suggest, for the Military Affairs Committee to consider is the importance of getting automatic and semiautomatic rifles and getting them with the least possible delay; and whether this Johnson is a good rifle, and can it be produced quickly and in volume?

I have witnessed tests of both these rifles; I have talked to manufacturers, because I am interested naturally in the national defense in various phases, because they are liable to come up and be presented to us in our work. I feel that the Johnson rifle is an excellent rifle, and I think that we sometimes seem to believe that a rifle has to be made by slow motion and possibly by some experienced gunsmith, but I think it can be proved that this rifle can be made in volume and produced quickly, and I think that is the important thing.

If we went into service today we would have three rifles, we would have the Garand, and the Springfield, and Enfield, all .30 caliber.

The Johnson rifle can utilize Springfield barrels, as has been testified here today; it can use the Springfield clip. We can have the guns come along in volume production as an automatic or semiautomatic weapon, and for that reason I think the Army can use them. I agree that the ideal situation is to have one rifle, but I don't think we are at the point where we can have an ideal situation. The ideal situation would be not to have any war. But, nevertheless, we may be facing that. And so, to my mind, it is more important to have two semiautomatic rifles to have very few of one, and I think the thing to determine is the manufacturability of this weapon, and how fast the Garands can be turned out. We also realize you are now planning to increase the number of men in the service, and if something does happen, we know we have got to add still more men and far more semiautomatic rifles. That is the way I personally feel on the situation.

The CHAIRMAN. Thank you very much.
Senator Smith Brookhart.

STATEMENT OF SENATOR SMITH W. BROOKHART

Senator BROOKHART. Smith William Brookhart.

When I was before the other committee, I expressed the opinion that no gas-operated rifle was as accurate or reliable as a recoil-operated rifle.

The CHAIRMAN. Well, the Senator has kind of a background. Tell us about your connection with the rifle in America.

Senator BROOKHART. Well, I was a second lieutenant in the Spanish-American War in the Fiftieth Iowa Regiment. I was issued 30 rounds of ammunition per man to train my company.

They fired 10 rounds standing at 200 yards. If they got a 34 score out of a possible 50 they were permitted to move back to 300 yards and fire 10 more, kneeling, on the same target. If they didn't make the 34 score, the training ended with the 10 shots. In other words, the poorer they were, the less training they got. If they made a 32 score at 300 kneeling they were permitted then to move back to 500 and on a larger target for 10 shots, prone. But if they didn't make that 32 it ended with the 20 shots at 300. If they made the 32—in any event it ended with 30 shots.

Now, I didn't know that they were teaching in the military schools at the time that the poor shots get more hits in battle than the good ones, but later I found that in all of the schools of the Army they taught that theory in various forms. But I knew you couldn't train anybody to be expert at anything doing it 30 times.

When I came home I reorganized my company as captain, and I found 18,000 rounds of ammunition that the old captain had reported expended and just hid away. That was like finding a gold mine to a rifle shooter.

So I went out on the creek and built a rifle range back to 1,000 yards, and I expended that ammunition. When I got through I had more sharpshooters in my company than all the rest of the regiment, and I didn't get a third as much out of that ammunition as Captain Van Orden would or I would myself now. But we learned something just by shooting. That gave me a reputation and the Governor appointed me in charge of small-arms training in the State.

The CHAIRMAN. In the National Guard?

Senator BROOKHART. In the National Guard. I began then the training in 1907 of the State rifle teams for the national matches. And getting into the national matches I found there really great riflemen and men who understood shooting from the standpoint of hitting something. And that is where I learned rifle practice. My team shot in twenty-fourth place in the first match, twelfth place in the second match, tenth place in the third match, and fourth place in the fourth, defeating all of the National Guard teams and one or two of the Regular service teams. I think, the West Point teams were below us, as I recollect it, although I am not sure which it was now.

The CHAIRMAN. Were you on the team?

Senator BROOKHART. No; I was captain of the team. I have been the trainer all the time. I know how to shoot but I also know how to train instructors and to train shooters.

Well, from that I became captain of the Palma team that contested and won the championship of the world, and was appointed on the National Board for the Promotion of Rifle Practice. And there I had all kinds of disputes with the Ordnance Department and the General Staff. I got on the blacklist with both the Ordnance Department and the General Staff. But I stuck to straight shooting just the same.

I can give you the details of all that fight if you want it. I finally got it all overruled by a civilian Secretary of War, that was Secretary Baker. He order the school established at Camp Perry over the disapproval of the General Staff. I had been special instructor of two divisions before that school was established. The Eighty-eighth National Army Division and the Thirty-fourth National Guard Division. And then went into the school as chief instructor, and we trained some 6,000 or 7,000 officers in that school as instructors for all the divisions of the Army and I was promoted from major to lieutenant colonel.

Then we had an intermission and my staff—I had 40 assistants in the school—my staff was broken up and sent out to 12 Regular divisions that were still in this country.

Now I think that General DeLamater has got a right to speak about this rifle, as a representative of the National Guard, because it was the National Guard that trained the Army in the World War in marksmanship. My assistants, 36 of them, were National Guard men, two of them had been sergeants in the Regular Army, but they were Camp Perry men, and the other 2 were civilians but were expert riflemen.

When the fall came they decided to send us south. My staff was to be increased from 40 to 50, and I had commissioned some of them, and then we were to go south to work all winter—but in the meantime for about 30 days or so my staff was broken up and sent out to 12 Regular divisions that were still in this country. There were 20 Regular divisions organized, only 8 of them ever got over into the war.

Now, here is why I think the National Guard has got the right to speak on this rifle training. There were 17 National Guard divisions, they all went over, and the 18 National Army divisions did also. I went out to the Nineteenth Regular Division. It had 2 of the oldest Regular regiments, the Second and the Fourteenth, and I trained them for about a month and was then ordered to Benning as the director of marksmanship in the Benning school.

My commandant down there was Colonel Eames, my first commandant. He was the author of the theory that the poor shot gets more hits in battle than the good one. But I never had an arguemnt with him. He had given it up before I got down there. Because our school had really won its way, we were really commissioned to found a new firing school for the Army. And I stayed in there studying the lessons of the war, and arguing it out with those chaps until the 31st of October 1919 when I was mustered out of service.

That is, briefly, my experience with the rifle.

The CHAIRMAN. Well, what do you mean by a poor shot gets more hits than a good one?

Senator BROOKHART. Well, I will tell you how they proved it. They took a bunch of expert riflemen and took them out, estimating distances up to 1,200 yards and checked their error, and it averaged about 12 percent in guessing those distances. Well, that would be 144 yards, or, say, 150 yards. Then they would set up a line of targets and march them out to this 1,200-yard distance, and order them to set their sights 150 yards wrong. And then they would fire 10 shots at each of these targets and, being good riflemen they held the rifles good, they missed the targets, they shot under or over, according, as those sights were set. They didn't get hardly any hits. Some of them would ricochet up into the target, possibly if the sights were set under.

Then they would take a bunch of riflemen that were poorly trained, they would scatter their shots around more and get more hits.

Then they would bring in a bunch or rookies that never fired a rifle, and they scattered them all over the landscape, got more hits than anybody.

Then they said to these expert riflemen, "We gave you your own error of estimating distances, and you can't hit anything in battle."

That theory got into the books and got into the Army and in every school of the Army. There was a West Point class came to Benning. They had graduated early in order to get into the war before the 4 years' time was out. The Armistice was signed and so they sent them to Benning for further training. Those boys had had 150 official hours of dancing and 30 hours on the rifle at West Point.

As I say, it was my business as chief instructor of that Camp Perry school to find out the why and wherefore of this shooting, and how it fit into the man. However, I didn't want to try anything that the soldier on the battlefield couldn't use to best advantage. And from that I figured out first that there is a stage of battle where you need rapid-aimed fire if you can get it. Of course, we have the rapid fire with the bolt action, and if that should be increased by semiautomatic action, it would be a good thing. And here is the way the agitation started down at Benning; the Browning machine rifles came to us; we didn't get them at Perry at all. They had a semiautomatic adjustment so you could shoot them automatically or semiautomatically. And I looked those rifles over, the big clumsy things, that weighed 16 pounds, and I said my riflemen could shoot them semi-automatically and get more hits than the machine gunners could, shooting automatically. Well, that was a challenge, and we arranged a match. Three hundred yards was our distance and the prone target figure, eight men to the side, and we shot 1 minute.

It was the mad minute, you know. The team that got the most hits won the match. Those rifles could shoot faster than the Garand

or the Johnson, because they are loaded with 20-clip cartridges. Well, my riflemen had an average of 50 hits, Captain Preussner had an average of 55 hits. There were very few misses. They got them in the figure, nearly all of them. But they were the best riflemen in the world, of course. But they had the best machine gunners in the machine-gun section, and they got an average of 35 hits.

Well, that started a discussion on aimed shots against scatteration fire by automatics, and after many other trials we found the semi-automatic aimed fire always got the most hits.

Well, we laid down some specifications, and the first one was accuracy for the semiautomatic.

Now here is why we must have accuracy and the highest accuracy if we are going to do the best job training our soldiers. You take a soldier and if his rifle isn't accurate and his ammunition still more inaccurate, and he misses the target, you don't know whether to charge it up to the rifle or the ammunition or the man; but if you have an accurate rifle and an accurate ammunition and he misses the target, you know he flinched or shut his eyes or did something else, and it is your duty as an instructor to find it out and correct it.

Then if you can say to him from experience that this rifle does hit when sights are properly set, and it is properly held, and he believes that, that does give him the confidence that is most necessary; and you can train him in half the time and with half the ammunition than you can if you let down in the accuracy of a rifle.

So I demand the most accurate rifle possible for the training of the men. They are entitled to it. The man who goes into battle to fight for his very life is entitled to the best instrument there is to fight with. And that is an accurate rifle.

Now, that old theory that poor shots get the most hits, that has gone out now. Nobody in the Army is defending that any longer.

Now then, here is why I think the gas-operated rifle cannot be as accurate or reliable as the recoil-operated rifle. I have here what they call the automatic pistol for the Army. This identical pistol was issued to my son in the World War. When he was mustered out he bought it and has kept it since. There is hardly any change made in this pistol since those days. They have checked the trigger, and some other little things, but the real functioning is all the same. This pistol is a recoil-operated pistol, not a gas-operated concern.

Someone has said that all of these automatics are gas-operated one way or another. Well, in one sense they are; that is, they all get their power from the explosion of the cartridge, from the gas expansion that goes with the explosion; but we call it gas-operated when somewhere along the barrel you take out gas through a vent and push a piston back and open the machinery that will throw out the old shell and then there is a spring to pull it back the other way and pull the new shell in the chamber.

Now, this pistol has this part called a slide which slides back when the cartridge explodes. You see the barrel here. It is locked to the slide. At the muzzle end of the barrel it runs in this bearing, at the other end of the barrel when the slide is down the barrel locked into it. As that cartridge explodes it pushes the slide and the barrel and all back as you saw me pull it back that time. But after it pushes it probably one-eighth of an inch, and the instruction doesn't say how far that is, maybe only one-sixteenth of an inch even, the cam action

in there pushes the barrel out of that lock and then the barrel is stationary and the slide comes on back and throws out the shell, and of course the slide immediately goes forward and shoves in a new shell. The main spring pushes it forward.

That pistol without taking any gas out of the barrel anywhere but simply with the recoil action of that explosion, has been the regular pistol of the Army for about 25 years. And it is satisfactory. It is a little harder to learn to shoot than the old revolvers were, because it is a little heavier action, but it shoots good and if you get under combat conditions it is satisfactory all around.

I have always said that the rifle with the proper proportions of recoil operation would be the best form of semiautomatic rifle. And this is semiautomatic. This pistol, it isn't automatic. It fires one shot on the squeeze of the trigger. You aim it again, and then squeeze the trigger again for the next shot, but it reloads itself.

Now, during the war the Ordnance Department rejected the Lewis machine gun, a gas-operated gun much like this Garand rifle from which it is exactly copied. If you will get the drawings of the Lewis machine gun as I saw them the other day, and the drawings of the Garand rifle, you will see the gas-operation part is exactly the same. But the Ordnance Department have rejected that machine gun and never have adopted it—never have used it.

Now, so far as gas operation is concerned, it is less objectionable, a good deal less objectionable in a machine gun than it is in a rifle. Because a machine gun isn't supposed to be an accurate shooting-thing, it is a scatteration fire. That is what it is for. So if you use gas to operate a machine gun you can put a big vent that will push that piston back through that carbon and it will work when a rifle would not work. I wish we had the Garand rifle here. But let me have that Springfield.

The Garand rifle has a cylinder right under the barrel here [indicating]; in the first place, the barrel is reduced in weight from the Springfield barrel, so it will heat up easier and quicker than the Springfield barrel will. Then here comes this cylinder underneath the barrel. I don't remember the dimensions, and then from that a rod goes on back that kicks open the machinery that turns the bolt and throws out the shell, and all that. Also it is covered up with wood just like the Springfield is, only even more so, if anything. Now, naturally, that barrel will heat, since the heat is all confined in there. The Springfield won't heat so bad because you can't fire it so fast. But the only specific purpose of the semiautomatic rifle is rapid fire under the conditions of combat. And then you want it to fire rapidly, and you want it to fire accurately every shot aimed. I don't want to get my riflemen trained to shoot until he has a target that he sees and aims at; otherwise it is a waste of ammunition and he will shoot his ammunition up and have nothing but the bayonet to fight with, and I want to keep the bayonet clear out of the Army. I want him to rely on his bullets, I don't want him to have a double function psychology at all, I want him to have confidence in his ability to shoot, and if you train the riflemen, he will shoot. If trained to shoot he will think of that and not of the bayonet. If they learn to shoot and you give them their choice they will throw their bayonets away, every one of them, because they know they can easily beat a bayonet with a bullet. The first point in training, is that ammuni-

tion must be saved because of the problem of getting ammunition to men in combat, which is a very great problem. You can get ammunition to one machine gun lots easier than you can get it to 100 men, as far as that is concerned, and all the scatteration fire should be done by machine guns and none by rifles.

This Garand rifle, as I see it, is going to heat up every time in rapid fire, and that barrel is going to buckle more or less, and just as Mr. Ness said, you may get a 6-foot variation. And Captain Brown out at Belvoir shot 24 shots right in the dump at 600 yards, and I think he is as great an expert as they have anywhere. He claimed the trouble was his fault, that he held them down there, and I asked him where he was trying to hold and he said on the white line just below the bull's-eye. So I don't know where he was holding since they went 5 or 6 feet down below that, and I would just as soon think he was holding up to the top of the target as down at the bottom, if he couldn't tell where it was.

Now if the Garand rifle creeps around, and that is easy to test, from somebody holding the rifle, take them out, fire them and see if they don't creep around over the target, fire enough to see what percentage of them will do it. That can be determined easily.

But at any rate, if the barrel buckles up that way, the accuracy of the rifle is very much impaired.

Now, this Springfield, as Captain Johnson has explained to you, is a floating-barrel scheme; that is, they have released it at the first band so that at this point it rests on what they call a 6 o'clock rest, and then is floating then back to the second band. And that floating part may be interrupted somewhat by this rest up here at the first band [indicating]. So it isn't as true a floating barrel as the Johnson rifle is.

Now give me a Johnson rifle. They talk about tolerances, but there are just two close tolerances I want in this rifle. First, I want the tolerances of the boring as accurate as in a Springfield barrel, and, this uses a Springfield barrel so we have got that. In the next place this barrel is carried by these two bearings 9 inches apart, one at the breech and the other 9 inches up. I want those tolerances close. Why? So that the barrel, when it moves this three-eighths of an inch in its recoil action, will come back to the same position and same relation with this sight line every time before it is fired. And that is all that is necessary. If it will do that, then the movement of the barrel in the recoil does not hurt anything.

The pictures at the Boston Tech show that the bullet is out of this barrel when it moves back one-sixty-fourth of an inch only of that three-eighths; that is, when the bullet leaves the barrel. So really we need to cover only that one-sixty-fourth of an inch with a close tolerance.

Now, if it will do that, the only place we can buckle this barrel is between those two bearings 9 inches apart, and that is the thickest part of the barrel where buckling would be less anyhow and 9 inches is too short for anything but an infinitesimal buckling.

And then we have the floating barrel out here 13 inches with nothing attached to it to cause it to buckle at all.

Now, how about these floating barrel rifles for accuracy? I was at the Winchester plant the other day, and I was talking with Mr. Rugsley and Mr. Boad where they were making the Garand rifle.

I stated "You can't make an accurate, reliable shooting rifle out of the gas-operated rifle, taking the gas out of the barrel into a cylinder because that is going to spoil its accuracy." Mr. Rugsley said, "You wouldn't dare get out on a limb like that, look at the machine guns we have developed." I said, "Yes, but not one of them is developed for accurate shooting. They are all scatteration fire."

Then he had a rack of about 15 rifles standing along the wall there. I said, "There you have the best rifles, the best, most accurate shooting rifles in this world, everything from an elephant gun down to a squirrel shooting rifle, and every one has a floating barrel like this Johnson rifle." I said, "You know you can't make the accurate rifle for the hunter if you harness that barrel up with anything, you know you are getting in trouble. We have always had a question of bedding the Springfield barrel and settled it by floating it.

So the floating barrel is mechanically more favorable to accurate shooting. You get a whip; yes. I notice the Chief of Ordnance said to the House committee in 1939 that the whip of the barrel destroyed its accuracy on the Johnson rifle. That would be true if it didn't whip just the same every time. If there is nothing out there to interfere, it is going to whip just the same every time. And that means accuracy, so far as that is concerned.

Now I think the Johnson rifle, as has been testified here, can easily shoot as accurately as the Springfield, and that was the rule we laid down at Benning, when we were discussing it down there. I think probably it has a slight edge over the Springfield because of this better floating barrel than the Springfield. It wouldn't be much, but it might be a slight little bit.

So, shall we keep a rifle that is questionable in its accuracy like the Garand, or shall we take one that gives the most accurate results? Accuracy can do no harm for anybody shooting it, and for the man who knows how to shoot, it is certainly a big advantage.

As Senator Chandler said here today, if one fellow has accuracy and the other fellow only approximate, why, the inaccurate shooter is in trouble. And I think that is true.

Now I don't know that I have very much more to say. Yes; about this removable barrel. In cleaning the Springfield rifle we put it in the rack, take out the bolt, clean it from the breech. That is an order of the Army regulations, to do it that way. And there was a reason for that order. If you clean it from the muzzle you wear out the lands, and so forth, on the muzzle where they ought not to be worn, and it would effect the accuracy more. So the orders were, always clean from the breech.

The Garand rifle cannot be cleaned from the breech. It has got to be cleaned from the muzzle.

The Johnson rifle, you can take the barrel out and get at it easier than you do the Springfield for that purpose.

Now about the magazine. I think probably the Garand magazine will load a little faster than the Johnson magazine. For 40 rounds it will load 5 times, 8 to the time. You load 4 times, 10 to the time on the Johnson. But, is that a good thing, to change from that 10 units to 8? I notice that the Ordnance says that we ought to have uniformity. Now Senator Thomas put it in the record the other day that we have 800,000 Springfield rifles today, and 1,750,000 Enfield rifles as standard rifles of the Army.

If we have to go into trouble at once, we will have to use those rifles. They all load with the 5-cartridge clip. The Johnson rifle loads with the same clip. There is going to be no confusion or anything of the kind by taking the Johnson rifle. There is a confusion with that 8-shell clip of the Garand rifle, and a very distinct confusion. In the first place, those 8 shells firing 8 strings upset the whole mathematical method of training the riflemen. We do it in multiples of 5 or 10, the multiples in all the training regulations, but now you have got to change that whole thing, with the Garand. And there are only 42,000, I believe it is, Garand rifles made now against this vast number of these others. The 5- or 10-shot clip is a better thing to make your calculations of training than any that breaks in between.

The Garand itself should be changed to a 10-clip. Then again, I think that with the clip that loads 8, if you fire out one you can't replace it. And as you go ahead, if you are firing—in action in the service in battle, probably you would shoot slow fire, most of the time and have a shot now and then; then if there came a critical time when you wanted this rapid fire, you might have only 1 or 2 cartridges in your rifle, and lose 5 or 10 seconds loading when you ought to be shooting; whereas, with the Johnson rifle, you have the 10 in reserve all the time, and can shoot slow fire all day if you want to. If there was no other difference in the 2 rifles, the difference in the magazine would be enough to warrant changing to the Johnson rifle.

It may be possible that the same magazine might be designed on the Garand—I don't know how that is, but if the Garand is kept in the service for any purpose that change ought to be made.

Now we come to the sights. This Johnson sight is too close to the eye, just as the Enfield was. I had trouble with that Enfield guard hitting the men, cutting up their faces occasionally. It is perfectly easy to move that up all you want to, and it ought to be moved. The Garand has the sight in a better place, but that is not a defect in the rifle, it is a side issue, and that arrangement can be made.

Now, another thing about this sight. I don't like either one of the sights exactly the way they are made. I think the sights ought to have a minute or micrometer adjustment, if you want to call it that, so if you raise the elevation one click that raises it 1 inch for each hundred yards distance. The Garand has that. That is what we specified down at Benning.

I think the same adjustment ought to be for windage, right and left. The Garand has that. So in that respect those sights are all right.

But I found out that men's eyes are different. You can take the best trained riflemen in the world, and they don't look through the sights the same. I took two riflemen at the Winchester plant during the War, Captain Chesly and Captain Richard, who did nothing but shoot for the Winchester Co., that was their business, they couldn't be better trained riflemen than they were, took 4 rifles. We took the 200-yard indoor range; and there was nothing to bother us. The sights were set at the 200 yard graduation. First Captain Chesly fired 10 shots at 200 yards, a nice little group. Then Captain Richard took the same rifle with the same sight setting, same range, same conditions, every thing, and he fired 10 shots, and they hit in a nice little group about 8 inches below. We went through the whole 4 rifles and no 2 of the rifles put the shots the same place, although we used the 200-

yard sight setting for all of them. Some were up 400, some down to 100. But through all 4 rifles those 2 men shot about that 8 inches difference in the elevation and some lateral difference.

When I went into the Camp Perry school I recalled that incident and instructed my instructors that they should not attempt to zero a rifle for anybody. Each man must zero his own rifle.

Captain Crossman of California challenged my claim that it was the difference in the eyes. He said it was the difference in the hold of the rifle or some stuff of that kind. I said, we will find out right now. We had a triangle sighting range that extended the regulations from 50 feet to a hundred yards. Here is what a triangle sighting thing is. You put up a rifle in a fixed rest, you sight through it at a bull's eye that a man holds against a background of white paper, we will say. And he moves this bull's-eye, right, left, up, and down, as you signal him until it is centered. And there is a hole in the center of that bull's eye and when you have it just right you have him put a pencil through that hole and make a dot on the paper behind. He then moves the bull's-eye and you repeat the same thing twice more. This gives you three dots.

Well, they never could get back to the same dot again. They get close to it if they are good sighters. And then they draw the three dots together and that makes a triangle. They each sighted three triangles. Captain Crossman sighted his, three nice little triangles all woven together. Captain Chesly sighted his and they were $5\frac{1}{2}$ inches higher and over to the left. And that was at only 100 yards. Then Captain Richard sighted his and they were an inch and a half up and $3\frac{1}{2}$ inches to the right. These triangles were all sighted through the same sights on a rifle in a fixed rest. These wide differences in the eyes of the greatest experts settled the eye question at Perry and at Benning. So I want an adjustable plate on my sight so each man can move his plate to the zero for his own eyes. It is a little simple thing to do but it is the very starting point and a valuable thing in training.

It is valuable to have men in training figuring out eyes and zeros and elevations. If you can get them to figure it out then you have them interested in the shooting and you have them interested so they will take training seriously and when they get in action this training guides them.

So I would like to see both those sights changed.

We were in agreement on what the sights should be, there wasn't any disagreement at Benning on that, and the Garand has two of the points out of the three in it. (Since making the above statement Captain Brown has explained that the Garand has an adjustable plate for zero windage.)

Now I believe that is all I recall that I want to say at this time. But I would be glad to answer any questions that anybody wants to ask me.

The CHAIRMAN. Yes. Your judgment is that for practical Army purposes this Johnson is an acceptable weapon?

Senator BROOKHART. I think the Johnson meets the semiautomatic requirements quite fully. If the Garand is going to gum up with carbon fouling and if it is going to climb around over targets as it heats up, and if the gas cylinder will dent with any reasonable bump I would put it clear out of the Army. I wouldn't use it as a rifle at all. That is my personal judgment. I am not speaking for Captain Johnson or anybody else on that.

The CHAIRMAN. Well, Senator, we certainly appreciate having you here. Thank you for giving your testimony.

Do you have anybody else?

Mr. JOHNSON. If the Chairman please, I would like to make a statement just as a matter of record. I don't think I need to make any comment about Senator Brookhart or his ability to testify before this committee on which he used to serve in the Senate, but I do want it understood that he isn't representing this company and any statements he has made here are his own statements. I don't want to have any misunderstanding about that. I have the highest regard for Senator Brookhart and I now state that, whether I or others agree with everything that he says or not, for there are always matters of opinion, it has been most inspiring to me to find a man who is as patriotic as Senator Brookhart, who is as public-spirited.

Senator BROOKHART. I sent a memorandum to Senator Sheppard and Chairman May, without any communication or consultation with Captain Johnson. I sent it after I had been to Quantico and checked up and found out very definitely that the Johnson was superior and was considered to be by every shooter who was able to use it, and that is when I wrote you and Chairman May of the House committee and that is why I am here. I was interested in starting development of the semiautomatic rifle but it must not let down on accuracy. I am against any rifle that will not keep up with the Springfield in accuracy. The Chief of Ordnance himself admitted in his statement to the House that at a thousand yards the Garand wouldn't shoot with the Springfield. Well if it will not shoot accurately at a thousand yards it is less accurate at 600 or any other.

Now so far as this shooting at Fort Belvoir on a 600-yard target at 300 yards is concerned you could shoot at one of them all day without getting any idea of how accurate the rifles were. Why, even Senator Lundeen without any practice at all made perfect bull's-eyes with both rifles. The only test was at 600 yards rapid fire and Captain Brown's Garand rifle went down in the dump for the last 24 shots. This is fatal to the rifle.

The CHAIRMAN. Senator, we appreciate testimony of the kind you have given.

Senator BROOKHART. I am not a manufacturing expert upon firearms, but I have made a considerable study of the mechanism of rifles and pistols and the mechanical principles involved. The Johnson rifle has a simpler and stronger mechanism than the Garand. It would be easier to teach to recruits and it would be more certain to function in zero weather or in mud, dirt, and sand. Its barrel is standard and can be produced at once in any factory equipped to make the Springfield or the Enfield. The bearings that carry the barrel in its three-eighth-inch recoil movement should have a close tolerance for about the first one thirty-second of an inch of that movement, but these bearings are a simple circle and close tolerance is made easy by three point contacts. The tolerance on all other parts of unloading and reloading machinery is not close and the parts are easy to make interchangeable and easy to function. The gas cylinder of the Garand alone presents more difficulties than all the mechanical problems of the Johnson, and it has several others besides. This conclusion is fully borne out by the manuals of the two rifles as well as the testimony of the manufacturers.

If the Johnson rifle can be speedily produced would its adoption disrupt marksmanship training? No; it uses the same cartridge and the same clip as the Springfield and the Enfield and can use the single load of the machine gun. For several years we cannot discard the old rifles, and that means that the Garand's eight-shell clip has disrupted marksmanship training all along the line, at least until the old rifles are discarded, and even then it could not use the machine-gun ammunition, and that would mean plenty of confusion.

If you want a bayonet on the rifle, the Johnson sword bayonet is the most ferocious I have ever seen, but I want it banished. The only reason given by the Army for keeping this ancient nuisance is that a soldier might shoot his own comrade in the dark. They have not yet found out that he would be just as likely to stab his own comrade with a bayonet. The most expert bayonet trainer I ever saw was an English captain sent over as an instructor for our Army during the World War. The most important part of his training was "butts up" or the use of the rifle butt against the bayonet. Unless it is a sword bayonet it only comes at you with the point. If the point is brushed aside his attack fails and you knock him down with the butt of your rifle. So what? If the soldier reaches a stage where his last bullet is gone he can parry a bayonet with his rifle barrel and strike down his enemy with the butt. If he is properly trained to shoot, he will never waste a bullet as an unseen or an imaginary target, and the officer who will order him to do so should be court-martialed. He will save his bullets and will never fear cold steel.

Senator Chandler took a rifle before the committee, made a forward thrust, assumed his thrust had been parried as it probably would have been, and then in a lightning flash struck down his enemy with the butt. I am sure Senator Chandler became highly expert with the bayonet. Is he expert at shooting? He may be, but if so he did not get his training in the Army during the war because we did not get started training instructors until the 10th of May 1918. Most of the soldiers went across on the theory that a poor shot gets more hits in battle than a good one and the others were not half as well trained in shooting as the Senator was with the bayonet. It became second nature with him and he does it with promptness and skill more than 20 years after the war is over. What I want is a second nature for shooting trained into the infantry soldier and I do not want it messed up with any other second-nature method of fighting. There is no objection to training him to use the butt of his rifle as in a pinch he would do that naturally anyhow, but all the time he must think of that bullet and how to aim it for a hit.

At one time during the war a memorandum came to us stating a soldier had chased an enemy a half block and jabbed his bayonet into him so hard he was obliged to fire the rifle to release the bayonet. The instruction was to save the last cartridge for that purpose. Well, I am for saving the last cartridge and all the other cartridges but not to release bayonets. Any cartridge will catch up with an enemy quicker than you can chase him down, if you know how to shoot. If Senator Chandler, expert with the bayonet, would reason this out and bring in a bill to drive the bayonet out of the Army, he would rid the Infantry of its greatest nuisance. When I left Benning they were still using

three times as much time jabbing bayonets into dummies as in training men to shoot.

Captain Brown is so obsessed as to the perfection of the Garand rifle that he is totally blind as to its defects. He tells you its recoil is reduced 45 percent below the Springfield—so low he can shoot it without limit on a broken collarbone. At Fort Belvoir the officer who made the Aberdeen tests told me it was reduced only $1\frac{1}{4}$ pounds, or about 12 percent. He also said the Johnson recoil was one-half pound less than the Garand. This result tallies with the mechanical reasons. The initial recoil of the Springfield and the Garand are exactly the same until after the bullet passes the gas vent. Then some of the pressure is transferred to the piston and thence to the unloading machinery. The initial recoil of the Johnson is less since the barrel moves back one sixty-fourth of an inch before the bullet is out. This at once relieves the recoil shock by the inertia of the barrel and the small movement which accounts for the one-half pound difference. From then on the relief is practically the same.

Captain Brown's explanation of his own scores is an amazing riddle to me. He shoots 55 straight bull's-eyes at 1,000 yards, passing all known service rifle records. At Fort Belvoir in the presence of all of us he dropped the last 24 shots of a 160 string into the dump at 600 yards and said it was his own fault and not the fault of the heated rifle. This is certainly "magical, ragical, tragical" shooting.

But what disturbs me most is, that I asked Captain Brown if after Belvoir he did not go to Quantico with one of the improved Garand rifles for a test of its creeping around as it heated up and he found that it did creep. This he denied in toto. Since then I have investigated and find that he did go to Quantico; that he did take one of the improved rifles; that he did start a creeping test; that it did start creeping; and that he did leave rather abruptly. There is almost as much mechanical reason for this improved rifle creeping as for the old one. The removal of the gas cap from the muzzle and taking the gas direct from the barrel might help a little, but the gas cylinder is still attached to the barrel; the piston and operating rod still run back along the barrel; the barrel is still housed all around with wood, and the barrel is reduced in thickness and weight. All of these things mean buckling with heat, and that means inaccuracy.

The Ordnance Department has announced that it is going back to the 150 grain square based bullet. This is a distinct abandonment of the idea of accuracy in order to support the functioning of the Garand rifle. The 172 grain boat-tailed or streamlined bullet was adopted after the most thorough trials and complete approval of the rifleman. To abandon it puts the Army back where it formerly stood for poor shooting. Besides, the constant demand of war is for heavier and more powerful ammunition rather than for lighter and weaker.

The combat target as described by Captain Brown is also a long step backward toward the "poor shot gets more hits" theory. It is a line of targets visible, partly visible, and invisible which are fired upon collectively. No individual soldier knows whether he hits anything or not. The score is determined by the scatteration fire of the whole company. Such training is a waste of ammunition. It is just as valuable with simulated fire as with good and always precious ammunition. I doubt if any army will ever get enough good ammunition to train its individual riflemen as efficiently as they ought to be trained.

The individual training is distinctly first and until that is accomplished no ammunition should be wasted on collective firing.

I especially want to call attention of the committee to the final statement of Colonel Edson on page 196. I asked him why the Marine Corps had not adopted the Garand. His answer shows they made extensive field tests of the rifle, and it functioned so badly they would rather keep the Springfield. This bad functioning cannot be corrected by removal of the muzzle cap. The functioning parts all remain just the same. It makes no difference whether the gas comes out through a hole in the cap or a hole an inch or two down in the barrel. It hits the piston head just the same way and must have the same power to operate the unloading machinery. In contrast with this the super-severe ordnance test of the Johnson by the Ordnance Department at Aberdeen proves it will function reliably under all field conditions.

The accuracy tests of Captain Van Orden show the Johnson rifle is superior to the Garand by an average of 9.9 percent in efficiency. These were fair and efficient tests by competent riflemen. They were not extensive, but they are entitled to great respect.

In view of all these facts I strongly recommend the Johnson rifle as a service weapon. In view of the present urgency, the ease of manufacture and the desire of the Marine Corps and the National Guard, I suggest that the Congress immediately authorize the production of 40,000 or 50,000 of the Johnson rifles for tests and use in all the services.

Mr. JOHNSON. We have no purpose here as far as my company and myself are concerned, we have not under consideration here as I understand it any other rifle than the Johnson rifle.

There have been some comparisons made here with the Garand M1 Springfield, and Enfield rifles.

Speaking for my company, we are not here to make any comparisons with any rifle other than to point out certain features in our rifle and say why we think the Johnson rifle should be considered.

The CHAIRMAN. I may say this to Captain Johnson: it wasn't at your instance that this bill was introduced. The Appropriations Committee sent your bill up and asked us to look into it further because they were not authorized to submit legislation on an appropriation bill and this committee have jurisdiction over military matters and they asked us to look into it and to report to them the result of our investigations.

Mr. JOHNSON. We appreciate that point very much.

The CHAIRMAN. Some of the officers have their say with other persons. We asked them to come also. Col. Albert Brown is here and we will be glad to have him make any observations he wishes to make.

Colonel BROWN. Mr. Chairman, I am representing the War Department. We have seven witnesses.

The CHAIRMAN. We will go through with them.

Colonel BROWN. We will introduce first Capt. Rothwell Brown, now in the Twenty-ninth Infantry at Fort Benning, Ga., a former member of the Department of Experiment and the Infantry Board, Fort Benning, Ga., who has worked with the Garand rifle.

The CHAIRMAN. This was Col. Albert E. Brown of the General Staff. Now, Capt. Rothwell Brown.

STATEMENT OF CAPT. ROTHWELL H. BROWN, TWENTY-NINTH INFANTRY, FORT BENNING, GA.

The CHAIRMAN. Captain, we are glad to have you with us and would be glad to have any comments you would care to make on the Johnson rifle.

Captain BROWN. Well I will try to make them as brief as I can.

The CHAIRMAN. Make them as extensive as you please consistent with the proper presentation of the matter.

Captain BROWN. Well since most of the people have stated their experience before they have said anything I will give you mine.

The CHAIRMAN. Yes; we would like to have your background.

Captain BROWN. I have been firing small arms for 20 years, and I have been firing this Garand rifle since 1925. And I have personally fired more than a hundred thousand rounds of ammunition.

The CHAIRMAN. Has this Garand rifle been in use since 1925?

Captain BROWN. 1935.

The CHAIRMAN. 1935. And you have been firing it since that time?

Captain BROWN. Yes, sir.

The CHAIRMAN. Very well.

Captain BROWN. And I have superintended the firing of over half a million rounds of ammunition through the Garand rifle. I have trained more than 5,000 soldiers and civilians to fire the Garand rifle.

Now, there has been a great deal said here this afternoon and from my viewpoint I am not particularly interested in whether Mr. Johnson's rifle is easier of manufacture. I am in the using service, and what I am interested in, in a rifle, is can we use it under combat conditions.

And I have not only been testing the M1 rifle but for the last 5 years I have been testing all types of small arms and even up to the anti-tank gun, and I have seen a great deal of tool-maker's guns, and I saw the M1 develop from a tool-maker's gun, and I have been more impressed with the difficulties that arise after production is started than I have been impressed with the superiority that can be built into any tool-maker's model.

That is a very simple thing to do. We know that the initial M1's that were made, the tool-maker's models, were extremely accurate. The first 80 rifles were accurate. Then after they were into production we found the soldiers did things to those rifles that no test work could ever do to them.

Too bad that Captain Van Orden and Mr. Ness went to such extreme labor to find out something that through the use of the M1 rifle we have found out several years ago. We knew the particular type of gas take-off which had been successful in the original model and had been entirely successful in 80 models, had not been successful when we issued it to soldiers. Today that defect has been entirely corrected.

The inaccuracy which developed in those rifles came not from any bending of the barrel, and I can see how it came up that that might have caused that inaccuracy. As a matter of fact, I doubt if anyone knows what caused it; we simply changed the front-end assembly and eliminated the defect. But we did find that the particular type of plug which we were sealing our gas in would be distorted, would be distorted by the soldier knocking it up against something. Many of them were distorted that way. At times we found the center of im-

pact of a shot group would go down and to the left when it had been distorted to the left, and some would go to the right.

We, therefore, have an entirely different rifle being produced today, than the rifle that these gentlemen have been talking to you about this afternoon.

What I am going to say is based upon what I know of the rifle that is now being produced. It isn't the rifle they have been talking about. We know the defects, and they have been eliminated. The M1 rifle that is now being produced is equal to or better in accuracy than a Springfield. I have seen not one but many of those rifles come right off the assembly line and proof-fired, and they were far more accurate.

Now as to the distortion of heat, we have two of these rifles that were fired at Benning. They were fired for 5,000 rounds and at 30 shots a minute, which is extremely fast. There was no distortion of those barrels; the guns were exactly as accurate at the end as they were at the beginning of that firing.

It is a matter of record that during 10,000 rounds of firing we had two parts that broke and we had four malfunctions; we had two failures to eject the case out and two failures to feed. That is a very remarkable performance for any self-loading weapon. It is superior to anything we have ever seen any other weapon do, sir. The accuracy of those rifles is remarkable. It is far more accurate than anybody I have ever seen could shoot it. I have fired it at a thousand yards, and I was able to make 55 straight bulls-eyes at a thousand yards. Now, of the original types which went out, as far as I can tell, we only had a small percentage that were bad. That was 5 percent, as far as I can determine. But there was no difficulty for us to get the Ordnance to change that design. The M1 rifle has gone through nearly 20 years of development. It has been tested from the tool-maker's model, tested by the Infantry and Cavalry; it has been put in production, and we now know everything that was wrong with it. At Fort Benning, Ga., not only this M1, but all types of weapons that are new, are tested.

The tool-maker's model looks fine; well, initial models invariably will have trouble they do not conceive of. Any attempt, in my opinion, to short-circuit from a tool-maker's model of any piece of ordnance into a production schedule is extremely dangerous. I have never seen any weapon that could be successfully transposed from tool-maker's models into production.

There are tolerances and other things in any piece of ordnance that you cannot show in drawings. They have to go out in the hands of soldiers who do things that nobody else can do, and until that procedure is gone through, you will never know what is wrong with the weapon.

The M1 has gone through that. We have now the finest type in the world. I don't want to get into discussion on gas operation and recoil as a matter of discussion. All of the really accurate shoulder small arms that have been successful have been gas operated. We think Mr. Browning in this country was probably the finest inventor we ever had. And when he went to a shoulder weapon, he went to gas operation.

Today the Winchester Corporation is developing a self-loading gas-operated weapon.

We have had many types of recoil weapons. This is not new. It goes back many years. But no country in the world has ever adopted

a shoulder recoil-operated weapon. There are many disadvantages to it.

I cannot agree with Senator Brookhart on the bayonet, we are still going to have to fight at night. At night you can't afford to shoot your own personnel. You must have a bayonet. A bayonet on a recoil gun is a very dangerous thing. It gives very clumsy operation with any bayonet.

While we have a choice of two bayonets on this recoil-operated gun, I don't think either would be satisfactory. The Government tested bayonets for years. It had a case of picking one out. They got the best bayonet they could. We must have on our shoulder weapon a bayonet of similar characteristics.

Now, there have been a lot of small points brought up; I am very grateful to Mr. Brookhart to find out where we got the fine sights. They are the finest military sights that have ever been put on a weapon, and they do fulfill every requirement Senator Brookhart suggested.

Every man can zero that rifle for his own particular use, and he sets 200 on his sight, and 300 when he wants to fire at 300. I think we are very grateful to Senator Brookhart for developing that sight. It can't be beat, sir.

Now, there has been brought up the question of carbon from a gas-operated gun. On this 5,000-round test that I was speaking about a minute ago, those guns were not cleaned or lubricated until the end of it, and there was no carbon deposit at the end of 5,000 rounds.

We have fired guns for 6 and 8 months at a time and never touched them, and at the end of that period there was no carbon to do any harm.

I think the Ordnance was worried about carbon formation when they went to the original design on the original M1 rifle. That hasn't proved out; we have no difficulty with carbon at all.

Now with the M1, I have seen it develop from a rifle which would show the test of 150 rounds, that is all anybody expected a self-loading rifle to do back in 1927 and 1928, all they asked them to do was 150 rounds.

Then as they started coming out, we found that they would go about 250 rounds. As the manufacture proceeded, they got better and they got up to 400 and 500 rounds, continuous rounds, without any cleaning or servicing being required. And today they have developed the manufacture of this gun so that almost any one you pick out will do 5,000 rounds straight through at a reasonable rate of fire. I don't mean you can just bang, bang, bang, but with a reasonable rate of fire they will do 5,000 rounds.

And it has taken years of intensive study by the Ordnance Department working with the Infantry and letting us when we found something suggest modifications and they have built it from 150 rounds to a 5,000-round rifle.

Now, they have made quite a point that Mr. Johnson's barrel is exposed to the air. Any gun is a compromise. We would like to have the barrel exposed to the air with wood around it. But we can't do that. We find it a necessity to have wood on it. The soldier must be able to grip that rifle every time. You can't with the Johnson rifle. The Johnson rifle barrel gets extremely hot. To shoot on a target range, it is fine, but there are greater requirements than

target-range shooting with a military weapon. There is no army in the world today that doesn't put wood on the barrel of its weapon for the simple reason that a soldier must be able to grip it and hold it. You can't do it with just your hand back here. You must grab it here where you can use it. You may swing it as a club. But what the military man has got to be able to do is to get hold of that weapon.

I don't want to take up any more of the time of the chairman than is necessary. I assure you that there is no bending of the barrel of this new M1 rifle. That has been definitely proved. There was a slight distortion of the muzzle plug, we got a physical deflection of the bullet and it took us a year and a half or 2 years to determine exactly what was causing that.

With a rifle coming up which is for your infantry and which you are going to make in quantities of millions, not just a few thousand, it is essential that you go very slowly and that you be definitely sure when you make a change that it is the correct change.

Now then it has been suggested here that we need special lubrication for the M1 rifle. We don't, sir. Two rifles have fired 5,000 rounds straight through with no lubrication but a light coat of oil when they started that firing. With the M1 and with the M2 we have adopted a jelly solution because we find it protects the metal against dirt and grit. And we are going to recommend its use in all our weapons. It stays on the metal while oil runs away. And that is the only reason we have developed those things. The graphite may not be perfect but we do want a heavy base lubricant. You are going to get grit and sand. Oil flows away. A heavy coat protects it.

You use oil in your car, but the M1 will run bone dry for 5,000 rounds if you want to do that. It would be a cruel and unusual punishment but it will do it. The reserve is there.

Now I have a few notes on accuracy—we have fired, sir, not just 3 or 4 guns. We have taken out whole companies and fired 150 or 200 men with the Springfield rifle and with the M1 rifle, so on those figures we can discard that 5 percent.

The CHAIRMAN. Have you fired the Johnson rifle?

Captain BROWN. I have, sir.

The CHAIRMAN. I mean in the quantity?

Captain BROWN. We have not. I have fired it myself. But we have never had enough Johnson rifles. We have never tested it out.

The CHAIRMAN. Why is this Garand rifle called the Garand rifle?

Captain BROWN. Mr. Garand was an employee of the Bureau of Standards, when he started developing the rifle about 1920. His development at the Bureau of Standards looked so promising that the Ordnance Department employed him to continue development of his semiautomatic rifle and sent him to Springfield arsenal. During the period 1920 to 1926 he developed a very fine rifle, in the .276 caliber. From that he went to this rifle. That rifle was really a very, very remarkable rifle. It was fine.

The CHAIRMAN. However, it wasn't exactly the present rifle?

Captain BROWN. Not exactly. It was made for a smaller caliber, the intentions were then to change to a small caliber from our present .30 caliber. But it was determined that such a change would result in two types of ammunition.

The CHAIRMAN. Isn't the War Department working along on a new rifle?

Captain BROWN. No, sir; we are absolutely satisfied with the M1.

The CHAIRMAN. Not working with the Winchester?

Captain BROWN. The Winchester has independently developed that.

The CHAIRMAN. Doesn't the War Department intend to try that out?

Captain BROWN. If the Winchester people submit it. They will test anything anybody submits.

The CHAIRMAN. Have you made an official test of this Johnson rifle?

Captain BROWN. An official test was made by the Ordnance Department at Aberdeen and Major Schlieker has the full report of the tests over there.

The CHAIRMAN. Proceed.

Captain BROWN. I was talking about accuracy in comparison with the Springfield in all of the firing that was done with the Springfield against the M1 at Benning. There was a difference of 0.2 percent in the score. And that is a very small difference in accuracy.

The only reason I want to bring that up, on the Springfield rifle, which is this one here, sir, we have a very, very small peep sight in the rear sight and a very fine front blade. Now with that very small peep aperture and a small blade we can get on a paper target much better definition that you can with the sight of the M1 rifle. But the sights of that rifle were placed on that rifle as a result of the experience of all of the people who had seen the rifle fired during the war, who were down at Benning and developed these sights; and they determined the large aperture back at the eye gave you the most accurate sight for combat firing. I am not particularly interested in what we can do on a paper target. I am a company commander and I am interested in what I can train 150 men to do on a combat target in the shortest space of time and I have fired hundreds and hundreds and hundreds of men on combat targets.

The CHAIRMAN. What is a combat target?

Captain BROWN. We drop them into the bushes, into the grass where you can just see a shadow. We have fired the rifle in smoke, fog, rain, where with the Springfield you could only about see the sights.

The CHAIRMAN. Was the Johnson tested on a combat target?

Captain BROWN. No, sir; we never have on a combat target.

The CHAIRMAN. Well you haven't completely tested it?

Captain BROWN. It has only had an engineering test at Aberdeen. It has never been submitted for a service test.

The CHAIRMAN. Go ahead.

Captain BROWN. I think I have—unless there are some questions, sir.

The CHAIRMAN. We certainly thank you for your testimony.

Senator BROOKHART. I would like to ask some questions.

The CHAIRMAN. Very well.

Senator BROOKHART. What change—what was done to change it from this condition that Captain Van Orden and Mr. Ness found to this perfect condition you have described?

Captain BROWN. Well I can draw it for you. What we were doing before, we were taking off the gas on a dove-tail. We had a plug

fitted in these dove-tails back here extended back like this [indicating]. What is happening is the dove-tail is opening up one side or the other. It might open this way or that way.

Senator BROOKHART. That is in the plug?

Captain BROWN. It is. And this wobbles. That dropped that way. You will find most of them the top or bottom of the plug has been almost cut through.

Senator BROOKHART. You took the plug off?

Captain BROWN. It has been entirely eliminated. It was an unfortunate choice. It was one of those things that takes a lot to find out what is wrong.

Senator BROOKHART. Is the vent enlarged?

Captain BROWN. The vent is much larger up here. And there is no carbon cutting or gas coming up there [indicating].

Senator BROOKHART. Was it one of these new rifles that you used that headed down in the dump out there at Belvoir?

Captain BROWN. Senator, I put them there.

Senator BROOKHART. I knew you did. But I figured from the way you were trying to hold them up—

Captain BROWN. I was just sliding in those holes exactly the way I told you. I was trying to time them.

Senator BROOKHART. But they hit 4 or 5 feet below where you had it set.

Captain BROWN. A couple of times my elbows dropped about 4 or 5 feet below.

Senator BROOKHART. Didn't you have one of those rifles out at Quantico since then and didn't it creep?

Captain BROWN. No, sir. They won't creep. They have been fired and fired and fired and we found no change.

Senator BROOKHART. I thought you convinced me pretty fully out there at Belvoir that they had.

Captain BROWN. No, sir. You misunderstood me, sir. That was entirely due to my arm.

Senator BROOKHART. You said when you struck the white below the bull's eye you let it go.

Captain BROWN. The gun goes slightly up and when it came down I started to squeeze. Frequently I split into those holes.

Senator BROOKHART. Those were consistently the last shots after the rifle was heated up.

Captain BROWN. No, sir. The last three clips were right around the bull.

The CHAIRMAN. All right.

STATEMENT OF MAJ. GRANT A. SCHLIEKER, INFANTRY, LIAISON OFFICER, ABERDEEN PROVING GROUND, MD.

Major SCHLIEKER. Since the Ordnance Department are charged with the development and testing of all Infantry weapons it is essential that the Chief of Infantry keep a representative at Aberdeen where those things are tested to keep his office informed of tests that are carried on.

In that capacity I was present at a test conducted of the Johnson semiautomatic rifle, caliber .30, made from December 19 to 30, inclusive, 1939, by the Ordnance Department at that station.

My primary interest in witnessing this test was to determine how the subject weapon met the essential military characteristics laid down by the Infantry as necessary in a semiautomatic rifle for combat fire rather than for target practice. I consider that the Johnson rifle satisfactorily fulfilled a number of the essential requirements, but the following analysis shows that there were a number of very necessary characteristics which the subject weapon did not meet. We found it was reasonably accurate—but the rifle was a tool-maker model rather than production model.

ESSENTIAL MILITARY REQUIREMENTS (CHARACTERISTICS)

Requirement A: The rifle must be simple, strong, and compact, and adapted to function with the standard caliber .30 ammunition. Weights should be well balanced and so placed that the essential strength is give to components requiring it.

The Johnson rifle meets this requirement, except that it is not compact and over-all weights are not well balanced. This is due to the very long receiver inherent in the design.

Requirement B: The mechanism must be well protected from the entrance of sand, rain, or dirt, and should not be liable to derangements due to accidents, long wear and tear, exposure to dampness, sand, and so forth.

The rifle meets this requirement, except that the magazine and butt stock are not sufficiently strong to withstand blows likely to be received in service.

Requirement C: The rifle must be so designed that the magazine may be fed from clips or chargers without the possibility of breaking clips or chargers under the pressure of loading them into the magazine.

The Johnson rifle contains a magazine which may be fed from clips or chargers but due to abnormally high pressure necessary to force ammunition from clips into magazine the clips are often broken, spilling ammunition onto the ground. This difficulty increases materially under dust and mud conditions, and, due to pressure necessary to load the second clip, men's hands become tired.

Requirement D: The trigger pull, measured at the middle point of the bow of the trigger, should be not less than 3 nor more than 5 pounds. The trigger action should be similar to that of the present service rifles, that is, it should have a light first pull, after which there should be no appreciable backward motion until the sear is released.

The rifle does not meet this requirement, having a single instead of a double pull.

Requirement E: An efficient safety or locking device must be provided, permitting the gun to be carried cocked and with cartridge in chamber without danger. The rifle should remain cocked and ready for firing when the safety device is unlocked.

The rifle does not satisfactorily meet this requirement, because the safety, as constructed, does not permit ready determination in the dark of its setting.

Requirement F: The weight of the rifle, with magazine empty and without bayonet or sling, should be a minimum consistent with proper functioning and in no case should exceed 9.5 pounds.

The rifle does not meet this requirement, the mean weight of the two samples submitted being slightly over 10.1 pounds and would be more if proper hand guards were installed.

Requirement G: The rifle must be so designed as to give good balance and be adapted to shoulder firing.

The rifle does not meet this requirement satisfactorily, because it is inherently poorly balanced and because its recoil effect on the firer is unpleasant. Recoil should be the minimum obtainable. This is an important factor in training the soldier against flinching. This rifle has a kick against the shoulder equal to the 1903 rifle.

Requirement H: The rifle should be capable of being used as a hand functioning arm in case the self-loading feature is disabled. The bayonet should be so attached as not to interfere with the proper operation of the piece under any conditions that may normally be expected.

The rifle meets the first part of this requirement. It does not meet the second part of the requirement because—

(1) The functioning of the piece is not reliable when the service bayonet which has been proven as the most efficient in the world is attached, due to the fact that the recoiling parts must carry this additional weight to the rear, slowing up the action.

(2) Even with the small Johnson bayonet attached and using the powerful M1 ammunition which is now substitute standard, it does not function reliably when fired at depression angles.

(3) It is possible to strike a hard object with the bayonet with sufficient force to unload the piece.

(4) There is no secure grasp for the left hand above the metal hand guard, only the slender barrel being available. Firing soon makes this too hot to grasp, and a moderate amount of firing makes even the hand guard too hot to grasp.

Due to absence of hand guard, the rifle is unsuited for use as a support for the bayonet; and since the bayonet is the principal infantry weapon utilized in night fighting, this one point precludes this rifle's use as a military weapon.

In conclusion I desire to state that: While the Johnson semi-automatic rifle satisfactorily performed as a machine, it did not fulfill all necessary military requirements and did not have any advantages over the present standard rifle which might make it necessary to consider it as a substitute for that weapon.

The CHAIRMAN. It isn't offered as a substitute.

Major SCHLIEKER. Well, accept my phraseology, sir, I don't know how it is offered.

The CHAIRMAN. It says as a standard arm of the service.

Major SCHLIEKER. Well we already have one that is entirely satisfactory.

The CHAIRMAN. Do you ever have more than two types of one arm?

Major SCHLIEKER. We don't if we can help it, sir. If we have more than one type it means the question of supply, it means the question of spare parts for two things. The Army, in this respect is exactly like a trucking company. No big trucking company owns two kinds of trucks to do the same job. They may own light trucks and heavy trucks, but for the same job they use the same equipment in order to have the same supplies. And even beyond that, sir, the Johnson rifle does not fulfill the requirements of the fighting soldiers.

The CHAIRMAN. Do you know anything about the new type of rifle the Winchester Arms has developed?

Major SCHLIEKER. I have seen it, sir. It has been submitted to the Ordnance for consideration. I fired it last week. I saw the rifle,

it is a very compact, very military looking rifle. As far as its functioning, it went beautifully for the little time we fired it. But I don't know what it will do on a test. It is a gas, not recoil operated weapon.

Senator CHANDLER. Would you state your opinion of the Garand?

Major SCHLIEKER. I think the Garand is the finest semiautomatic rifle there is in the world.

Senator BROOKHART. I would like to ask a question or two, if you have no objection.

The CHAIRMAN. Go ahead.

Senator CHANDLER. How long have we used the Garand?

Major SCHLIEKER. It was standardized in '36.

The CHAIRMAN. I understand some improvements have been made.

Major SCHLIEKER. Yes.

Senator BROOKHART. My question is in regard to the recoil and the trigger.

Lt. Col. ALBERT E. BROWN, Infantry. I have a letter prepared in the War Department which shows the development procedure followed in the adoption of the Garand semiautomatic rifle an extract from which I would like to introduce into the record at this time:

The development of the Garand rifle, of the design represented by the M1 rifle, was started in November 1927 as a caliber .276 semiautomatic rifle. A pilot model of the caliber .276 was entered in the competitive tests at Aberdeen Proving Ground in August 1929. Of all the weapons entered in that test, the board considered that the Garand and Pederson offered the best promise of success. Consequently, instructions were given for the manufacture of 24 Garands for a service test. Upon completion of a comparative service test between the Garand and Pederson, the Garand was found to be the most satisfactory. In the meantime, in the fall of 1929, instructions were given for the development of a caliber .30 semiautomatic rifle to be of the same basic design as the Garand caliber .276. Until this time, no caliber .30 semiautomatic rifle suitable for military purposes and within the prescribed weight limits had been produced. The Garand design offered promise of producing a satisfactory semiautomatic rifle caliber .30 within the desired weight limits. Development of this caliber .30 Garand rifle was carried along concurrently with the further development of the caliber .276 until the early part of 1932 when the Chief of Staff directed that the semiautomatic rifle must be of caliber .30, at which time further work on the caliber .276 was abandoned. After frequent tests and modifications by the Ordnance Department 75 caliber .30 rifles were issued to the Infantry and Cavalry Boards for test in 1934. As a result of these tests, certain components of the rifles were redesigned and submitted to test in May 1935, and the rifle was finally adopted for issue as a standard item of equipment in January 1936. Further tests were made at Fort Benning in 1936 and recommended improvements embodied in the design and on June 25, 1937, the commandant of the Infantry School recommended that the production of the rifle be expedited. Thus it is seen that the rifle was subjected to extended tests and many modifications over an extended period of time.

Senator CHANDLER. Approximately how many have you?

Lt. Col. GUY H. DREWRY. Approximately 41,000 Garand rifles have been produced.

Senator CHANDLER. And distributed to the Army?

Colonel DREWRY. That's right.

Senator CHANDLER. How many have you on order?

Colonel DREWRY. We have a total on order of 169,000.

Senator CHANDLER. Now will you answer me one more question, what is the rate of production at the present time?

Colonel DREWRY. At the present time the Springfield Armory is producing 200 per day on one shift. They are doubling the shift now and will be up to 400 per day within the next 3 or 4 months.

Senator CHANDLER. Is that the only place we are making them?

Colonel DREWRY. No; the Winchester Co. have a contract for 65,000 and they expect by November to have an average production rate of 3,000 per month.

Senator CHANDLER. What will that give us when that contract is being performed? How many per day will that give us?

Colonel DREWRY. We will have a production from the Winchester Co., that is, assuming they don't go on a second shift, of 3,250 per month. At the Springfield Armory we now have a production of 4,000 per month which we expect to increase by late fall to 8,000 per month, with existing facilities.

Senator CHANDLER. Thank you very much.

Colonel DREWRY. I might also say this, Senator, the requirements for semiautomatic rifles are very much less than they are for an Army that is equipped entirely with bolt-action rifles.

Senator CHANDLER. Now is there a new Garand and an old Garand and is there any difference in them?

Colonel DREWRY. The initial Garand production was of a certain design. Of course after those Garands got in the hands of troops certain minor defects developed, as with all new equipment, and we have made minor changes without destroying the interchangeability of the parts in those weapons. The major change has been in the front end. Instead of having the detachable muzzle plug we now have resorted to a one-piece construction to get away from this plug which is removable and which the gentlemen have explained caused some difficulties in accuracy.

Senator CHANDLER. Yes. Now how many of the ones that have not been changed are in that approximately 40,000, did you say?

Colonel DREWRY. We have approximately 40,000, Senator. All of the present production are of that type—we had a lot of components in production when this change was made and which had to be completed. We expect by the middle of June all the rifles coming out of Springfield will be of the new type. All of the rifles manufactured by the Winchester Co. will be of the new type. We don't feel that it is necessary to recall all of the rifles that have been made because only a small percentage of them cause difficulty. When the barrels wear out, these rifles will be returned to the arsenals for overhaul, and we will at that time put the new type in. Therefore the only cost due to the modification is the cost of the gas cylinder itself. If we wanted to convert all of those rifles right now it would cost us about \$8 or \$9 per rifle for this approximately 40,000 rifles.

Senator BROOKHART. About this recoil proposition, it is your claim that the Johnson had a sharp initial recoil?

Major SCHLIEKER. Yes, sir.

Senator BROOKHART. Now the initial recoil comes from the explosion in the cartridge, does it not, and the explosion has the same pressure in all directions, doesn't it?

Major SCHLIEKER. Yes, sir.

Senator BROOKHART. And in the Garand rifle that explosion, that pressure isn't affected until the bullet gets up into the vent?

Major SCHLIEKER. That is true.

Senator BROOKHART. Then the initial explosion in the Garand and in the Springfield would be exactly the same, would they not?

Major SCHLIEKER. No, sir.

Senator BROOKHART. What is there happens in there that would change that in the Garand, that isn't in the Springfield?

Major SCHLIEKER. I stated that I was an Infantry officer. I am not an Ordnance expert, I am an Infantry officer at Aberdeen.

Colonel DREWRY. I can answer that.

Major SCHLIEKER. May I just—I am there to keep my Chief informed of what the Ordnance is doing with things that pertain to the Infantry.

Senator BROOKHART. Well I just wanted to know what happened in that rifle that changed the recoil then.

STATEMENT OF LT. COL. G. H. DREWRY, ORDNANCE OFFICE CHIEF OF ORDNANCE

Colonel DREWRY. The recoil of a barrel isn't in any way connected with pressure. It is momentum which causes recoil. Momentum is the product of mass and velocity.

Senator BROOKHART. I was asking the comparison of the Springfield and the Garand.

Colonel DREWRY. I can explain that, too. The reason you get less recoil with the Garand against your shoulder than you do with the Springfield is this; when the gas enters the gas post at the front end of that barrel. it acts in all directions.

Senator BROOKHART. I am talking about the gas when it first explodes.

Colonel DREWRY. You don't get any recoil at that time. It is later on that you get it. But as soon as the gas gets in this cylinder it acts in all directions. That part of it which is acting on the forward part of the cylinder tends to push the rifle away from you.

Senator BROOKHART. Well, now, the movement of the two in this, the Springfield and the Garand are exactly the same until the bullet gets up to that vent?

Colonel DREWRY. If you put the two rifles on a ballistic pendulum you find that the work done is the same but the rate of application or a man's shoulder is different in each case.

Senator BROOKHART. Well on the recoil-operated rifle the picture shows that before the bullet gets out of the barrel the barrel has moved back one sixty-fourth of an inch. So that the initial recoil is reduced by whatever that barrel took off.

Colonel DREWRY. The reason, sir, that the barrel moves before the bullet is out is due to the reaction from the column of air that is ahead of the bullet.

Senator BROOKHART. That is a part of the pressure then?

Colonel DREWRY. It isn't part of the gas pressure.

Senator BROOKHART. How about the trigger? You reject this rifle because the trigger only has one movement. Now I am for the double-squeeze trigger, I always called that taking command of the trigger, but that is a simple little matter, is it not?

Major SCHLIEKER. Yes, sir. I was impartial in reporting where this gun does not fulfill military characteristics.

Senator BROOKHART. But that is such a small item that it could be fixed and fulfill that completely, couldn't it?

Major SCHLIEKER. Yes, sir. Without any trouble.

Colonel DREWRY. I want to state, Mr. Chairman, the position of the Ordnance Department.

We are a supply agency. The fighting branches tell us what they want and we go out and get it.

In the case of rifles, as in any other item, it is entirely up to them in the end as to what they have.

As far as the M1 rifle is concerned the characteristics which Major Schlieker read here were decided upon by the Chiefs of the fighting branches and for many years we tried to get a rifle that would meet them.

Finally after many tests by ourselves as well as the fighting organizations they stated that this rifle (the Garand) met their needs.

Then we started in production. But before we started production the using services insisted upon making, as they always do, a service test of a sufficiently large quantity to determine whether or not the weapon was satisfactory.

I have never known of anything that was sent out to the using services in which we didn't have to make changes, however, perfect we thought they were. And the M1 rifle was no exception. We have made many minor changes, and as far as I know at the present time, no further changes are contemplated.

The rifle is in satisfactory production at the rate of 200 per day and no problems are unsolved. The rifle is more completely interchangeable as to parts than any small arms weapon I know of. We do less hand fitting than we ever had to do on the old '03 rifle and fitting has been practically eliminated.

As far as interchangeability is concerned we periodically take 10 rifles off the production line, strip them down to the last pin, mix the parts and put the rifles back together. Such a test was conducted about 2 or 3 weeks ago. The 10 rifles were put together without any selection of parts whatsoever and they functioned perfectly and passed the prescribed tests.

As far as production is concerned the tools, jigs, fixtures, and gages have been proven. Someone has said that we have to look to the past to see what the future holds, and I realize the fact that there have been great strides in production work in the last 15 or 20 years, but during the last war in one case the British placed a contract for the Lee Enfield rifle, which is a simpler weapon to make than any automatic that I know of, with the Winchester Repeating Arms Co. That contract was placed in November 1914, and the first rifle was delivered 14 months later. They reached the maximum production rate which they contemplated when they started, in 2 years and 4 months after the order was placed.

Now those people are experienced gun manufacturers. They know the game, going and coming.

The CHAIRMAN. It wouldn't take that long now, would it?

Colonel DREWRY. It may not. But I do not think that any company would get into production these days on a complete rifle in less than 16 or 18 months. That is, in any sizable quantity. And I do not believe the maximum production could be obtained in probably less than 2 years. That is my personal opinion and is based on past experience in such things.

The CHAIRMAN. Any further observations?

Colonel DREWRY. No, sir; if there are any questions anyone would like to ask I would be glad to answer.

The CHAIRMAN. We certainly appreciate your being here.

Colonel BROWN. The next witness is Mr. Frank Jervey who is in the Small Arms Section of the Chief of Ordnance Office.

**STATEMENT OF FRANK JERVEY, OFFICE, CHIEF OF ORDNANCE,
WASHINGTON, D. C.**

The CHAIRMAN. You have heard this testimony this afternoon?

Mr. JERVEY. Yes, sir.

The CHAIRMAN. Give us your reaction to it.

Mr. JERVEY. Well I might say first that I am a civilian employee in the office of the Chief of Ordnance and a retired captain and during the war commanded a rifle company.

The CHAIRMAN. Oh, yes.

Mr. JERVEY. I have followed this rifle (the Garand) since its inception and I feel that it is the finest rifle of its type that I have ever had any experience with.

We have had difficulties with it and as the gentlemen from the War Department explained, that is something that I think you are bound to have with any new piece of mechanism of this type.

I haven't anything else unless I could be of any service to you, sir.

The CHAIRMAN. Very well. Thank you for being here.

**STATEMENT OF COL. EDWIN BUTCHER, DIRECTOR OF THE
INFANTRY BOARD**

The CHAIRMAN. Proceed in your own way to discuss the matter before us.

Colonel BUTCHER. I wish to give a history of the development of the semiautomatic shoulder rifle, M1.

Prior to 1919, the Ordnance Department had been conducting experiments with a semiautomatic shoulder rifle for the Infantry for some time, but until after the World War no marked progress had been made.

In 1919 the Infantry and Cavalry equipment boards recommended that the Ordnance Department continue its efforts in this direction and The Adjutant General, May 4, 1920, instructed the Ordnance Department to undertake the development work on semiautomatic rifles—referring specifically to the Garand and the Bang rifles. These rifles were caliber .30.

In June 1920 the Ordnance tested the Garand rifle, the Bang rifle, the Colt automatic (Thompson) and the Barthier, and as a result, recommended the development work be continued on the Garand and the Bang rifles.

In 1921 the Bang and Garand rifles were tested and a board of officers, appointed by the commanding officer, Springfield Armory, recommended the continuation of the development of the Garand rifle.

The two most promising types of rifles at this time were the Garand and the Thompson rifles.

In 1923, 24 Garand and 20 Thompson automatic rifles were ordered manufactured.

Ten of each were sent to the Infantry board for test in May 1925.

In 1923 the Ordnance Department initiated the design and manufacture, with the concurrence of the Infantry and Cavalry, of a pilot

model semiautomatic rifle, caliber .276 to simplify the problem of designing a self-operated weapon within the weight limits required (8.5 pounds) and the use of a smaller cartridge to enable the soldier to carry a greater number of rounds.

In 1927 the Chief of Infantry wrote to The Adjutant General that the development of the semiautomatic rifle had progressed to a point where it is assured that such a weapon, satisfactory to service, can be produced. Conclusion had also been definitely reached that a satisfactory semiautomatic shoulder rifle of approximately the weight of the Springfield rifles, 8 pounds 8 ounces, cannot be produced in a caliber .30. (The Garand weighed 9 pounds 9 ounces, the Thompson weighed 9 pounds 10 ounces.)

In the meantime, the Pederson caliber .276 semiautomatic shoulder rifle had been produced by Mr. Pedersen.

In 1927 the Ordnance had 20 .276 caliber rifles in production for test against the 40 caliber .30 semiautomatic rifles.

In May 1927 The Adjutant General acted on a recommendation:

That the present type Springfield rifle be replaced by a semiautomatic rifle as soon as practicable after a satisfactory type has been developed and tested.

Action:

Approved in principle, present development plans and tests for obtaining a suitable arm to continue.

In May 1928 the Chief of Infantry wrote The Adjutant General that the report of test of the .276 Pederson semiautomatic rifle has shown conclusively that it is entirely suitable but it is believed inadvisable to adopt this weapon until other designers have an opportunity to submit for test semiautomatic rifles.

In the summer of 1928 a War Department board was appointed for the purpose of recommending a specific caliber for the semiautomatic shoulder rifle.

On October 16, 1928, the War Department board of officers recommended that the caliber .276 be adopted as standard for the semiautomatic shoulder rifle to replace present rifle caliber .30 M1903.

This was approved by The Adjutant General.

In 1929 War Department new board of officers appointed. Tested at Aberdeen Proving Ground the Colt, Garand, Czech, Pedersen, and Thompson semiautomatic shoulder rifles.

Further tests were made and the Garand semiautomatic rifle, caliber .276 appeared to show the most promise and was further developed. Twenty were made for service test in 1931 and the Garand, caliber .276 was recommended for standardization on November 28, 1931.

The development of the Garand, caliber .30 was also being continued.

On February 25, 1932, letter from the Secretary of War to the War Department caliber board directed that the further development of the caliber .276 semiautomatic shoulder rifle be discontinued and that every effort be made to produce a satisfactory caliber .30 rifle.

As a result of this directive, the Garand, .30 caliber semiautomatic shoulder rifle, pilot model, was produced and tested in February 1932.

Eighty of these rifles were manufactured and sent to service boards for tests in July 1934.

After further modifications, another test was made in the summer of 1935 and as a result of this test the Garand, caliber .30, semiautomatic shoulder rifle was standardized on January 9, 1936.

Since that date, further improvements were made in 1937, 1938, 1939, and 1940.

From the above it is clear that the semiautomatic shoulder rifle, M1 is the result of 20 years of experiment, development, and test.

At the present time this Garand rifle, designated as the M1, is considered to be the best military rifle in the world and fulfills all of the requirements of the service.

The CHAIRMAN. In other words, there are some things in it that were not put in there by Mr. Garand?

Colonel BURCHER. Yes. Well of course he is still up there, he is still working, he went to work and created them. I think he is still working for Ordnance.

We have that trouble with everything, the soldier finds things nobody else has found. We have to make things foolproof for a soldier. He can do anything to anything.

Senator CHANDLER. He talks pretty rough about them.

Colonel BUTCHER. Yes, sir; I know. If we want to find out what can happen to it, we give it to the soldier.

I think that's all.

Senator CHANDLER. You are satisfied with the service that the Army gets from the Garand rifle?

Colonel BUTCHER. Yes, sir.

Senator CHANDLER. The way you have got it now.

Colonel BUTCHER. Yes, sir. Accuracy and functioning and everything.

Senator CHANDLER. You don't believe that by adopting the Johnson rifle you could make it better than the Garand?

Colonel BUTCHER. That is for the technical experts.

Senator CHANDLER. Have you made a test of it?

Colonel BUTCHER. No, sir. I never saw it until I saw it on the table here today. I have never tested it down there in the field.

The CHAIRMAN. Thank you very much.

STATEMENT OF MAJ. GEN. G. A. LYNCH, CHIEF OF INFANTRY

The CHAIRMAN. General, in your own way give us your reaction to this proposition.

General LYNCH. Mr. Chairman, you have heard the experience and opinion of the officers on whom I rely to form my decisions and recommendations. I may say to start with that I am not an expert on armaments. There are too many types of armaments these days to be expert on all of them. If I had the time to do it I couldn't equal the judgment of the men who have nothing else to do. And as you have heard the technical side of this, you practically have in your possession all the information I have when I make my recommendations.

I may say to start with, it has been the policy of my office to push the development of the Garand rifle. When it became evident several years ago in view of the world situation that the time factor in getting our Infantry ready for action was a very important matter, we had to push things as fast as we could. And to give some picture, right

at the beginning, of the problem with which we were faced, and also to give an idea of the accomplishments of the Ordnance Department in the past 3 years, I may say there isn't a single item of armament of the Infantry regiment today that isn't a complete revolution either in respect to new design, modification, or tactical employment.

The Ordnance Department has not only produced this rifle, they have modified the automatic rifle that Senator Brookhart referred to a while ago as being an inaccurate weapon, which it was. It is now probably the most accurate weapon in our possession.

The CHAIRMAN. Your present rifle?

General LYNCH. Present automatic rifle, the gas-operated Browning automatic rifle.

They have also produced for us a light machine gun; that is to say, tripod gun capable of keeping pace with the advance of attacking troops and giving them the close support which we formerly expected of the heavy machine gun and which the heavy gun was unable to accomplish.

We have the antitank gun which is probably the best antitank gun of that caliber in the world in its class.

Senator CHANDLER. How do you designate that antitank gun?

General LYNCH. As 37 millimeter. It is much more powerful than any of the weapons that have been used in Europe except the 75. But it will take out most of the tanks in the world.

Senator CHANDLER. Well, General, let me ask you another question. Will it take out one of those 80-ton tanks?

General LYNCH. No, sir; it will not.

Senator CHANDLER. What will we do?

General LYNCH. You have to have 75 millimeter-caliber for that—armor-piercing 75. The ordinary 75 shell won't do the work either.

The CHAIRMAN. Did I understand you to say the Browning rifle?

General LYNCH. The Browning automatic rifle.

The CHAIRMAN. That isn't the same as the Garand?

General LYNCH. No. That is the weapon Senator Brookhart referred to. It is full automatic.

The CHAIRMAN. That is the Browning.

General LYNCH. The Browning is full automatic.

The CHAIRMAN. The Garand is the semiautomatic?

General LYNCH. Yes.

The CHAIRMAN. Do you have both?

General LYNCH. We have both. We use an automatic weapon as the platoon weapon, not the individual weapon. The Garand is the individual weapon of the Infantry soldier. I want to say I think we have armament in the Infantry regiments today in design equal to that of any army in the world, and in many respects superior.

The CHAIRMAN. That is very reassuring.

General LYNCH. Now the great feature of this semiautomatic rifle in my opinion, the Garand, is the increased accuracy of rapid fire. We have had comparisons here of the Springfield, the Johnson, and the Garand. They all have their special characteristics. But in the hands of the ordinary soldier the semiautomatic rifle is much more effective in rapid fire than any bolt-action rifle. It is true the expert with the finer sights and long training with the Springfield rifle can probably make a better showing, but the training in manipulating the bolt in rapid fire is a matter of much time and patience. You elimi-

nate that at once with the semiautomatic rifle. I estimate that the training time with the Garand rifle will not be 50 percent of that required with the Springfield.

The chief difficulty in training the rifle shot with the Springfield rifle is the flinching with the resulting derangement of the aim. The great majority of soldiers flinch more or less. And it is only the expert shot that as a rule consistently overcomes the flinching habit and sometimes even he flinches.

The recoil of the Garand is so slight as to be inappreciable. The fatigue of firing is very much reduced. And it is in that very direction of increased accuracy of fire that I find this weapon most important to us. I think it is, for battle fire, the most accurate shoulder weapon in the World that I know anything about.

Now in comparing any other semiautomatic rifle now available in this country with the Garand it must be remembered that you are comparing a totally untried weapon in the hands of troops with one that has been through two target seasons, one that has fired hundreds of thousands of rounds, that has had unanimous approval from every rank in the service from the private to the general. And I have had members in my office interrogate enlisted men just to find out how they feel about it. There is no question about it. The man feels confidence in this weapon.

I think the fact has been sufficiently developed that any new rifle coming under consideration would have to pass through a long series of tests before it could be accepted as standard.

Senator CHANDLER. General, let me ask you a question: You are certain the men in the Army of the United States have confidence in the Garand?

General LYNCH. I am. I made that point.

Senator CHANDLER. That means a great deal. I want you to make it again.

General LYNCH. I think it is a most important point.

Senator CHANDLER. I had one in 1917 and 1918 I didn't have any confidence in. I had some very bad guns. These fellows know it.

General LYNCH. In reference to adopting this as a standard weapon—

The CHAIRMAN. It isn't offered as a substitute but as a standard weapon.

General LYNCH. I know of no precedent of that kind. We always have a standard and a substitute. That is, one weapon is bound to be better than another. And that is your standard. We have for instance at present the Garand which is the standard, the substitute standard is the Springfield and the Lee Enfield.

The CHAIRMAN. Is the Enfield a substitute also?

General LYNCH. That is a secondary substitute.

The CHAIRMAN. Secondary substitute.

General LYNCH. Yes. Have you any further questions?

Senator CHANDLER. Except to stress the point that personally you rate the Garand first and the Springfield second and the Enfield third.

General LYNCH. Yes, sir.

Senator CHANDLER. And if you do not have available in emergency a sufficient number of Garands you would supply Springfields first and then Enfields?

General LYNCH. Yes.

Senator CHANDLER. I just wanted to get that in the record that way if that is your opinion.

General LYNCH. Yes.

The CHAIRMAN. We thank you very much. Anyone else now?

STATEMENT OF BRIG. GEN. R. C. MOORE, ASSISTANT CHIEF OF STAFF OF SUPPLIES

General MOORE. Senator, the chief of staff asked me to represent him at this hearing.

The CHAIRMAN. Very well. Very glad to have you.

General MOORE. During the hearings before the House Appropriations Committee the question of the efficiency of Garand rifle arose. Considerable discussion took place at that time. As a result of that discussion a report was rendered to the chairman of the Appropriations Committee of the House concerning the Garand rifle. Also, copies of the various requests received from the field giving their opinion were submitted with that report. A complete copy of that report was submitted to the chairman of this committee, to you, Senator, and while part of it has been published in the Congressional Record I think that complete report should be made a part of this record.

The CHAIRMAN. Have you the report with you?

General MOORE. Yes, sir; I have a copy of it here and there is a copy in the file of the Military Affairs Committee also.

The CHAIRMAN. You mean in this committee?

General MOORE. Yes, sir.

The CHAIRMAN. Very well. We will make it a part of the record.

General MOORE. That is the War Department report on the whole question, and a report from each division commander in the United States whose troops had recently had experience with the rifle at target practice. I can read that report if you desire.

The CHAIRMAN. It won't be necessary.

General MOORE. In general the policy of the War Department concerning the Johnson rifle is expressed in a letter sent to Captain Johnson on the date of May 22, 1940.

Capt. MELVIN M. JOHNSON.

DEAR CAPTAIN JOHNSON: The points raised in your letter have been given very careful consideration by me and previously both by the Ordnance Department and the combat branches which are armed with rifles.

Your own military background will provide the reasons why the War Department should not adopt a certain type of semiautomatic rifle in the absence of demonstrated superiority over the Garand. Two types of rifles would multiply training problems, increase the costs, multiply problems of manufacture, replacement, and field maintenance.

Our urgent requirement at the moment is to speed up production of the Garand. The combat departments are greatly pleased with the Garand and the War Department feels the rifle has been supported by both exhaustive tests and by the reactions of the officers and men concerned. They have the conviction the criticisms of the Garand are not supported by the facts.

While unwilling to accept the Johnson rifle as a weapon, the War Department does not question the value of that gun. We find the Garand a very satisfactory weapon, and the adoption of another type of semiautomatic rifle at this time could not be based on sound logic.

Faithfully yours,

G. C. MARSHALL, *Chief of Staff.*

General MOORE. I would like to have in the record the views of all the division commanders.

The CHAIRMAN. Very well. We will accept the paper that you have presented and the accompanying papers.

General MOORE. Yes, sir; they are all in here, I think.

The CHAIRMAN. This is what you want in?

General MOORE. Yes.

(The papers referred to follow:)

APRIL 26, 1940.

HON. ANDREW J. MAY,
*Chairman, Committee on Military Affairs,
House of Representatives.*

DEAR MR. MAY: With further reference to my letter of April 11, 1940, on the subject of the M1 semiautomatic rifle (Garand), there is transmitted herewith copy of a letter to the chairman, Appropriations Committee, House of Representatives, together with enclosures thereto which include a full report of investigation by the General Staff on this subject.

It is believed that the contents of the attached papers, together with those previously furnished, fully justify the action of the War Department on this subject. In addition, it is hoped that they will remove any further apprehension on the part of Members of Congress as to the efficiency of the Garand semiautomatic rifle.

Sincerely yours,

HARRY H. WOODRING,
Secretary of War.

APRIL 26, 1940.

HON. EDWARD T. TAYLOR,
*Chairman, Appropriations Committee,
House of Representatives.*

DEAR MR. TAYLOR: Referring to my letter of April 9, 1940, on the subject of the M1 semiautomatic rifle, and responsive to the expressed desires of the Appropriations Committee, I am pleased to forward herewith a full report of investigation by the General Staff on this same subject.

This report, which has my unqualified approval, is based on a thorough study of War Department records and on the full reports of all divisions now in the field. I also include copies of reports received from the commanding generals of the First, Third, Fifth, and Sixth Divisions submitting their opinions on the Garand rifle. These reports had not been received in the War Department at the time that my letter of April 9 was dispatched.

I trust that the accompanying papers together with those previously furnished will completely satisfy the Appropriations Committee as to the soundness of the War Department's position on this important subject and will definitely remove any apprehension on the part of members of your committee regarding the comparative effectiveness of the M1 semiautomatic rifle.

Sincerely yours,

HARRY H. WOODRING.

APRIL 23, 1940.

Memorandum for the Secretary of War.

Subject: Investigation of the General Staff concerning the M1 semiautomatic rifle (Garand).

1. Report No. 1912 of the House Military Appropriations Committee, Seventy-sixth Congress, third session, on the Military Establishment appropriation bill, fiscal year 1941, page 21, contained the following statement with reference to the Garand semiautomatic rifle:

"The accuracy, range, and type of ammunition remain as the chief controversial issues, and it is the sense of the committee that these should have prompt and thorough investigation by the General Staff."

In consonance with the above-expressed opinion there is submitted below a full report based upon official War Department records and recent reports from the divisions now in the field.

2. The War Department is primarily interested in the efficiency of equipment for combat purposes. With this in view, certain steps involving a considerable

period of time are prescribed before any item of equipment is finally adopted for issue as standard equipment to the combat arms. The combat arm, in consideration of new developments at home or in foreign countries, specifies certain characteristics which it desires to have developed by the supply service. After consideration by the General Staff of the purpose, cost, production facilities, etc., authorization is given for its development as an experimental model by the developing arm and the combat arm and suggestions for improvement are embodied in further development. In case of an important item of equipment, such as the rifle, it is then issued in limited quantities and extended tests are conducted. If the combat arm recommends adoption as an item of standard issue, the Chief of Staff, after consideration by a technical committee which includes all the interested arms and services, then recommends to the Assistant Secretary of War that the supply service take the necessary measures to procure the required quantities for issue to the troops. This procedure has been frequently criticized due to the length of time involved before a new weapon or other item of equipment is placed in the hands of the troops.

3. However, War Department records show that such a procedure was followed in the case of the M1 semiautomatic rifle and assertions that the rifle was adopted too quickly are not confirmed by the following facts extracted from the records. The development of the Garand rifle, of the design represented by the M1 rifle, was started in November 1927 as a caliber .276 semiautomatic rifle. A pilot model of the caliber .276 was entered in the competitive tests at Aberdeen Proving Ground in August 1929. Of all the weapons entered in that test, the board considered that the Garand and Pedersen offered the best promise of success. Consequently, instructions were given for the manufacture of 24 Garands for a service test. Upon completion of a comparative service test between the Garand and Pedersen, the Garand was found to be the most satisfactory. In the meantime, in the fall of 1929, instructions were given for the development of a caliber .30 semiautomatic rifle to be of the same basic design as the Garand caliber .276. Until this time no caliber .30 semiautomatic rifle suitable for military purposes, and within the prescribed weight limits, had been produced. The Garand design offered promise of producing a satisfactory semiautomatic rifle caliber .30 within the desired weight limits. Development of this caliber .30 Garand rifle was carried along concurrently with the further development of the caliber .276 until the early part of 1932 when the Chief of Staff directed that the semiautomatic rifle must be of caliber .30, at which time further work on the caliber .276 was abandoned. After frequent tests and modifications by the Ordnance Department 75 caliber .30 rifles were issued to the Infantry and Cavalry boards for test in 1934. As a result of these tests certain components of the rifles were redesigned and submitted to test in May 1935, and the rifle was finally adopted for issue as a standard item of equipment in January 1936. Further tests were made at Fort Benning in 1936 and recommended improvements embodied in the design and, on June 25, 1937, the commandant of the Infantry school recommended that the production of the rifle be expedited. Thus it is seen that the rifle was subjected to extended tests and many modifications over an extended period of time.

4. The records in the War Department show that caliber .30 M1 ammunition (maximum range 5,500 yards) was developed primarily to produce long-range machine-gun ammunition. It was finally adopted as standard for the 1903 rifle on the principle that rifle and machine-gun ammunition should be identical in order to simplify the supply problem. After the adoption of the M1 ammunition it was discovered that the range was so great that it was difficult to obtain target ranges of sufficient area to permit its use with safety to neighboring communities. Consequently, in April 1937, decision was reached to resume manufacture of a limited quantity of caliber .30 ammunition similar to the M1906 to be used on those ranges that were not safe for use of the M1 ammunition. As a result of this decision certain improvements were made in the M1906 ammunition and the new ammunition was designated as M2 (maximum range 3,450 yards).

In the meantime, the Garand semiautomatic rifle was designed, developed, and tested for use with M1 ammunition. Its performance in the tests with that ammunition was very satisfactory. It was adopted as the standard rifle in January 1936.

In December 1937 the Chief of Infantry recommended that the M2 ammunition be adopted as standard for all rifles and the Browning automatic rifle in both peace and war. In using the M1 ammunition, the Infantry had found that the power developed by this cartridge resulted in undesirable recoil when used in shoulder weapons, and undue wear and tear on barrels and parts of all .30-caliber weapons.

In view of this recommendation, the General Staff in March 1938 requested a report from the Chief of Ordnance as to whether the M2 ammunition could be used in the new semiautomatic rifle. In reply he recommended that caliber .30 (1906 type) ball ammunition, now known as M2 ball ammunition, be adopted for use in all rifles and light machine guns. This recommendation was approved by the Chief of Staff on July 19, 1938.

With the advent of the Infantry 81-millimeter mortar the question arose as to whether long-range machine gun fire was necessary. Consequently in March 1939 the Infantry Board conducted tests at Fort Benning with the 81-millimeter mortar and machine guns firing both the M1 ammunition and the M2 ammunition.

The board reported that "Adoption of M2 ammunition will reduce the effectiveness of machine guns in the following:

"(a) Ability to penetrate.

"(b) Ability to effectively fire on targets over 2,400 yards."

It would permit:

"(a) Longer life of barrel and parts.

"(b) Searching of more area on reverse slopes.

"(c) The use of one type of caliber .30 ball cartridges in all Infantry weapons.

"(d) More latitude in selecting firing positions."

A statement was made that there will be rare occasions for machine guns at distant ranges and that M2 ammunition is sufficiently good in range and penetration to do the normal expected work on the battlefield.

It was recommended that caliber .30 M2 ammunition be classified as standard ammunition for all caliber .30 Infantry weapons both in peace and war. This recommendation was approved by the Chief of Infantry, concurred in by the Chief of Cavalry, and put into effect by the War Department on December 19, 1939.

From the above sequence of events extracted from the records of the War Department, it is evident that the statement "that M1 ammunition is not suitable for use with the Garand rifle, the pressures being too great, thereby making it necessary for the Department to manufacture M2 ammunition," has no basis in fact. Each M1 rifle manufactured is required to function satisfactorily with both M1 and M2 ammunition before it is accepted.

5. The reports from the field submitted to the committee involve forces employing approximately 18,000 rifles, most of which have been used in known range and combat practice. These reports confirm the statements of the Chief of Infantry in his letter to the Chief of Ordnance dated April 2, 1940.

Briefly, these are as follows, with confirmation noted:

(a) Due to increased rate of fire it can take advantage of the fleeting targets which present themselves in battle.

Confirmed by combat practice in divisions.

(b) The battle fire of the soldier is much more accurate due to the fact that the rifle can be held on the target and the aim not disturbed by reloading as is the case with the 1903 rifle.

Confirmed by combat practice in divisions.

(c) The fatigue of firing is very much reduced.

Confirmed by all reports.

(d) The more rapid rate of fire and the ability to hold the piece continually on the target greatly increase the efficiency of antiaircraft fire.

This is a matter of opinion not yet based on actual target practice but confirmed by opinions by First Division and Sixth Divisions. It is a reasonable assumption, as everyone knows, that it is better to fire at a duck with a shotgun than a rifle.

(e) The reduced recoil and elimination of bolt manipulation in rapid fire greatly reduce the training time (about 50 percent) required to produce an efficient rifleman.

Confirmed by experience in all divisions. Offset to a minor degree in that more time is apparently needed for instruction in care and cleaning.

(f) The ballistic accuracy is the same as that of the 1903 rifle but with the larger peep sight for battlefield effect its target-range accuracy may not equal that of the 1903 rifle.

Reports indicate that target range accuracy is the same up to 500 yards but that hits in combat practice are very much greater with the semiautomatic rifle.

(g) The M1 rifle has been favorably received throughout the service.

This is confirmed by all reports to the effect that this rifle is definitely superior in its combat efficiency to the M1903 rifle.

6. It also appears from these reports that all division commanders would prefer to have their troops in action equipped with the M1 rifle rather than the M1903

Springfield rifle. As one division commander states: "The psychological effect of increased fire power is of great combat value." Another states the "U. S. infantryman would as soon think of going back to muzzle loaders. He is now the best-armed soldier in the world."

7. In general, the records show that the present sight was deliberately adopted as a combat sight in preference to a target range sight. The objections to the front end have been removed. The question of lubrication and cleaning is one that can be easily solved by proper instruction and these difficulties have been removed by experience in a short period of time in the field. The accuracy is very satisfactory for combat purposes. The range depends upon the type of ammunition which was adopted after full consideration by the using arms that superior range of the M1 cartridge was not needed on the battlefield, and was more compensated for in the M2 cartridge by the following advantages: viz, reduced recoil, increased number of rounds that can be carried by the soldier, a more curved trajectory permitting fire over troops supported and against targets on reverse slopes.

8. The Chief of Staff agrees with his commanders in the field that the adoption of the M1 caliber .30 semiautomatic rifle as a standard shoulder weapon to replace the M1903 Springfield rifle has been fully justified.

G. C. MARSHALL,
Chief of Staff.

HEADQUARTERS THIRD DIVISION,
OFFICE OF THE COMMANDING GENERAL,
Camp Ord, Calif., April 9, 1940.

Subject: Rifle, caliber .30, M1.

To: The Adjutant General, War Department, Washington, D. C.

1. Reference radiogram, War Department, April 3, 1940, concerning views on rifle, caliber .30, M1, the following report is submitted:

(a) It is the concensus of opinion of myself, the Chief of the Infantry Section, and commanders of the Fourth, Seventh, and Fifteenth Infantry Regiments, that the rifle, caliber .30, M1, is greatly superior in combat efficiency to the rifle, caliber .30, model 1903, and is a highly satisfactory infantry weapon.

(b) The Third Division has had a brief experience of 2 months with the rifle, caliber .30, M1. During this time 3,000 men—three infantry regiments—fired record courses and combat firing and the following statistical data has been obtained which it will be observed fully substantiates the views expressed above.

(1) The repairs and replacements of parts in the case of the rifle, caliber .30, M1, have not exceeded the repairs and replacements of parts characteristic of equal quantity and variety of firing with the rifle, caliber .30, M1903.

(2) While firing on the target range, failures to complete strings of rapid fire, common with the rifle, caliber .30, M1903, due to broken clips, did not occur with the rifle, caliber .30, M1.

(3) The rifle, caliber .30, M1, is more effective in combat than the rifle, caliber .30, M1903, because the firer can lie motionless whereas the firer of the rifle, caliber .30, M1903, has to operate the bolt, thereby moving his arm and tending to disturb his position and disclose himself to the enemy. The firer of the rifle, caliber .30, M1903, even though well trained, often removes his eye from the target while operating the bolt, thereby losing time and often completely losing the target.

(4) With the rifle, caliber .30, M1, it is easier for the firer to set his rear sight accurately because he does not have to remember sight corrections for the various ranges as he does with the rifle, caliber .30, M1903.

(5) With the rifle, caliber .30, M1, lack of recoil results in less flinching and consequent increase of accuracy of fire under combat conditions.

(6) Due to greater capacity of the clips, greater ease of operation, and greater rapidity of fire, a larger volume of fire was delivered during combat practice with the rifle, caliber .30, M1, than with the rifle, caliber .30, M1903.

(7) During combat practice a greater percentage of hits to rounds fired was attained with the rifle, caliber .30, M1, than with the rifle, caliber .30, M1903.

(8) The sights, both front and rear, of the rifle, caliber .30, M1, are superior for combat practice firing to those of the rifle, caliber .30, M1903.

(9) The following tests were conducted under identical conditions. Two regular eight-men rifle squads were selected. One was armed with the rifle, caliber .30, M1903. The targets consisted of "F" silhouettes which were moved back and forth across the front at a range of 300 yards at the speed of marching

troops. Each target continued to move until it was hit and was then withdrawn. The firing was done from a kneeling position. Results were as follows:

Rifle	Targets hit	Time	Rounds fired
Springfield M1903.....	12	1 minute 53 seconds...	100
M1.....	12	1 minute 21 seconds...	86
Springfield M1903.....	8	50 seconds.....	58
M1.....	8	49 seconds.....	56

(10) The following is a summary of results of record firing on the known-distance range of the Seventh Infantry with the M1 rifle. These results are considered satisfactory inasmuch as this regiment began its record firing within 2 weeks after the rifle was issued to it:

	Percent	
Number fired.....	765	
Number of experts.....	55	7
Number of sharpshooters.....	218	29
Number of marksmen.....	438	57
Number unqualified.....	54	7

(11) The mechanical functioning of the M1 rifle is considered satisfactory. Initially there were a few breakages of firing pins due to a considerable amount of dry firing while training for marksmanship. Modification of training procedure reduced these breakages to a very low figure.

(12) From my personal observation I find that the enlisted personnel of the division armed with the new rifle find it entirely satisfactory and are greatly pleased with the results they are obtaining with it. This applies both to enlisted men of long service and to young soldiers who have only fired the M1903 Springfield 1 or 2 years. As has been mentioned above, this new weapon has been in the hands of the division for only a short period, but I think we are all satisfied that with further opportunity to use it, the M1 will prove to be a much superior combat weapon to the old Springfield.

W. C. SWEENEY,
Major General, United States Army,
Commanding.

HEADQUARTERS FIRST DIVISION,
OFFICE OF THE DIVISION COMMANDER,
Fort Benning, Ga., April 6, 1940.

Subject: Comparison of combat efficiency of the Garand and Springfield rifles.
To: The Adjutant General, Washington, D. C.

1. Reference your radio, April 3, 1940, the following advantages and disadvantages of the rifles in question are a summary of the opinions within the division:

Advantages, Garand.—(a) The M1 rifle has rapidity of fire which is especially valuable for anti-aircraft fire, close-in aimed fire against personnel, and area fire against personnel at ranges from 500 to 1,000 yards.

(b) The recoil of the M1 rifle is so reduced that no physical injury results to the firer, and the imparting of instruction is, therefore, facilitated.

(c) The automatic ejection and reloading of the M1 rifle not only assists in maintaining a continuous aim but greatly reduces fatigue in the operation of the rifle.

(d) The additional three rounds in each clip provide 60 percent more fire for the Garand before reloading is necessary.

Advantages, Springfield, 1903.—(a) For rifle competitions the Springfield, being a point weapon, is superior, particularly at ranges over 500 yards.

(b) The clips for the Springfield are lighter and are more easily handled.

(c) There are fewer maintenance problems with the 1903 rifle.

Disadvantages, Garand.—(a) Due to the semiautomatic fire, the ammunition expenditure may be much increased.

(b) Cleaning the weapon is more difficult and damage to the breech mechanism may result unless particular training has been given.

(c) Beyond ranges of 500 yards the weapon is not as accurate.

(d) The clip holding the cartridges must be loaded by the units and is not expendable.

Disadvantages, Springfield 1903.—(a) The manipulation of the bolt of the Springfield causes fatigue and greatly reduces the accuracy of the firer.

(b) The manipulation of the bolt greatly reduces the effectiveness of the fire against aircraft and also the rate of fire for any target.

2. The general consensus in the 1st Division is that the adoption of the Garand rifle has resulted in a distinct increase in combat efficiency.

KARL TRUESDELL,
Brigadier General, United States Army,
Commanding.

[First endorsement]

HEADQUARTERS FIFTH DIVISION,
Fort McClellan, Ala., April 6, 1940.

To: Adjutant General, War Department, Washington, D. C.

1. The attached reports on the Garand rifle are forwarded in compliance with a radiogram, dated April 3, 1940, A. G. O., Washington, D. C.

2. I concur with the conclusions of the Chief of the Infantry Section and of the three regimental commanders of this division that the Garand rifle is definitely superior to the model 1903 Springfield rifle in its combat efficiency.

C. B. HODGES,
Brigadier General, United States Army,
Commanding.

HEADQUARTERS, FIFTH DIVISION,
OFFICE OF THE CHIEF OF INFANTRY SECTION,
Fort McClellan, Ala., April 6, 1940.

Subject: Garand semiautomatic rifle.

To: Commanding General, Headquarters, Fifth Division, Fort McClellan, Ala.

1. After observation of the firing of the Garand rifle, both on the known distance range and on the combat practice firing range, it is my opinion that this rifle is definitely superior to the model 1903 Springfield for combat for the following reasons:

(a) The Garand rifle has reduced the time necessary to train a satisfactory military shot approximately 50 percent.

(b) Within the ranges of ordinary military combat firing, the Garand rifle is as accurate as the 1903 Springfield.

(c) During critical phases of combat, the Garand rifle is capable of delivering three times the volume of effective fire of the bolt operated weapon.

(d) Men are much less fatigued after firing the semiautomatic rifle over long periods than they are after firing the Springfield.

2. The number of malfunctions have been negligible.

3. All infantry company officers consulted are enthusiastic about the performance of the new type rifle.

L. R. FREDENDALL,
Brigadier General, United States Army,
Chief of the Infantry Section.

HEADQUARTERS, SECOND INFANTRY,
Fort McClellan, Ala., April 5, 1940.

Subject: Views on the subject of the M1 rifle.

To: Commanding General, Fifth Division, Fort McClellan, Ala.

1. Reference radio W. D. A. G. O., dated April 3, 1940, subject: Garand rifle, the following report on the M1 rifle is based on my observation of its use in the Second Infantry since its issue January 11, 1940. During this period the regiment has completed its qualification range firing.

(a) Few mechanical faults were experienced. All which were noted were easily corrected by the ordnance repairman at the range. Company commanders report that fewer men needed for services of the ordnance repairman than had previously been required when firing the 1903 Springfield rifle. This is partly due to the fact that although the M1 rifle is semiautomatic it has 80 fewer parts than the 1903 Springfield rifle. There are 72 parts to the M1 rifle and 152 parts to the 1903 Springfield rifle.

(b) The combat efficiency against indistinct targets at ranges up to 600 yards is for the M1 rifle as 3:1 over the 1903 Springfield rifle. This is based on the following points:

- (1) The greater rate of fire of the M1 rifle, when needed, is an especial advantage.
 - (2) The type of sight on the M1 rifle facilitates indistinct targets being easily picked up or located and effectively fired upon, and further permits effective fire at fast moving targets and eliminates blurring.
 - (3) Firing can continue almost indefinitely without the loss of efficiency due to fatigue on the part of the firer. This is due primarily to the lessened recoil in the M1 rifle.
 - (4) Because the M1 firer does not have to operate the bolt by hand he can remain concealed in his firing position much better than one firing the 1903 Springfield rifle.
 - (5) Simplicity of sight settings add to the M1 rifle's combat efficiency.
 - (6) The psychological effect on the rifleman knowing the increased fire power capabilities of his M1 rifle is of great combat value.
2. The great popularity of the M1 rifle with the troops as well as the favorable reports received from rifle company commanders leads me to report that the M1 rifle is unquestionably a weapon far superior to the 1903 Springfield rifle.

F. M. ARMSTRONG,
Colonel, Second Infantry,
Commanding.

HEADQUARTERS, TENTH INFANTRY,
Fort McClellan, Ala., April 6, 1940.

Subject: Garand semiautomatic rifle.

To: Commanding General, Fifth Division, Fort McClellan, Ala.

1. In accordance with instructions from The Adjutant General and Commanding General, Fifth Division, the following views on the United States semiautomatic rifle, M1, are submitted herewith:

2. My observation of this weapon during the time it has been in use in this regiment and reports from the rifle company commanders lead me to believe that it is far superior as a military weapon to the United States rifle, model 1903.

3. My conclusions are based upon the following facts:

(a) As a self-loading shoulder weapon, it simplifies instruction of the recruit in that it eliminates the manually operated bolt.

(b) The larger aperture on the rear sight and the fact that it is closer to the eye permits a clearer vision. The wider front sight blade with guards facilitates location of target and bringing fire on it. This is a definite advantage in combat firing.

(c) The simplified loading with clip and the mechanized ejection of same saves time.

(d) From known distance firing, up to 600 yards, its accuracy has been found equal to the United States rifle, model 1903.

(e) Its increased fire power, at least three times that of the United States rifle, makes it of greater value in combat. Eliminating the manual operation of loading permits the rifleman to keep his eye on the target. The reduction of recoil combined with the elimination of manual operation reduces fatigue and confusion of the individual.

(f) The increased feeling of power and efficiency it gives the rifleman, increases his battle efficiency and morale.

4. During our recent rifle marksmanship practice no defects were found in the United States semiautomatic rifle, M1, which would seriously affect its combat efficiency.

ARTHUR R. UNDERWOOD,
Colonel, Tenth Infantry,
Commanding.

HEADQUARTERS, ELEVENTH INFANTRY,
Foxt McClelland, Ala., April 5, 1940.

Subject: Comparison of combat efficiency of Garand rifle and M-1903 Springfield rifle.

To: Adjutant General, War Department.

Through: Commanding General, Fifth Division.

1. The Garand rifle was issued to this regiment February 8, 1940. Instruction was given in mechanical training, preparatory marksmanship exercises, and instruction firing at 1,000 inches, tables I and II, BFM volume III, part I, chapter 1A. Field firing problems for squads and platoons have been conducted and the following comparisons and deductions drawn:

(a) The percentage of hits per field target per rounds fired is approximately the same with both rifles at ranges of 700 yards and less.

(b) The actual number of hits per field target in a given time fired by the Garand is from two to four times as great as with the Springfield.

(c) There were practically no mechanical malfunctions in any of the field firing problems.

2. The Garand rifle is considered superior to the Springfield in suitability for military use and combat efficiency for the following reasons:

(a) With a minimum of training with the Garand rifle men can deliver at mid-ranges, from two to four times the fire power delivered with the Springfield rifle.

(b) The physical effort to fire the Garand is greatly lessened which correspondingly increases the efficiency of the rifleman when he engages in close combat with the enemy.

(c) The time required for preparatory exercises and known distance marksmanship training is greatly lessened with the Garand, due to the automatic bolt-manipulation features.

(d) The rear sight of the Garand is much superior to the Springfield type in ease and accuracy of adjustment and in finding and keeping the eye on the indistinct target while firing.

(e) The morale of the individual rifleman is much superior when armed with the Garand semiautomatic rifle due to his realization that he can fire accurately at least two shots to one at an enemy armed with any bolt operated rifle.

C. P. HALL,
Lieutenant Colonel, Eleventh Infantry,
Commanding.

HEADQUARTERS, SIXTH DIVISION,
 OFFICE OF THE COMMANDING GENERAL,
Camp Jackson, S. C., April 5, 1940.

Subject: Report on Garand rifle.

To: Adjutant General of the Army.

Referring to your radiogram of April 3, the following report is submitted regarding the performance of the Garand rifle:

1. (a) The three Infantry regiments of this division have completed known distance firing and have conducted musketry and combat firing with the Garand rifle.

(b) The few mechanical difficulties experienced were caused by lack of proper lubrication and the newness of the rifle rather than by mechanical defects. A few failures to feed or to eject properly were due to cartridge clips being worn, warped, or bent. All of these defects were easily corrected. In no case was trouble experienced when a new clip was used.

(c) Under windy and very dusty conditions in Wyoming, the Garand rifle did not fail to fire due to sand or dust.

(d) Under the severe conditions of rapid fire the rifle suffered fewer jams than the 1903 rifle.

(e) The recoil of the Garand rifle is much less than that of the 1903 rifle, and new men can be more easily taught in its proper use without the necessity of overcoming the tendency to flinch, as is the case with the 1903 rifle.

(f) The Garand rifle is a better weapon for antiaircraft fire.

(g) There is no question but that more aimed shots can be fired within a given length of time with the Garand than with the 1903 rifle, thus permitting greater fire power.

(h) The individual soldier is capable of maintaining sustained fire with practically no evidence of fatigue.

2. The unanimous opinion of the three regimental commanders and the chief of infantry section is that the combat efficiency of the Garand rifle is much greater than that of the 1903 Springfield rifle. In this I concur.

C. A. TROTT,
Brigadier General, United States Army,
Commanding.

General MOORE. In general, the War Department holds the commanding generals in the field responsible for the success of their troops and the chiefs of arms responsible to some extent in giving them the weapons they desire. In other words, the responsibility for success in the field and responsibility for the proper weapons should rest with the War Department and its commanders in the field, and we do not think it can be divided.

That's all.

The CHAIRMAN. We thank you very much.

Colonel BROWN. That completes the War Department's testimony.

Colonel JONES. I am from the Navy Department. I have nothing to contribute but as a representative of Admiral Furlong.

The CHAIRMAN. Please state your name, and so forth, for the record.

STATEMENT BY LT. COL. B. G. JONES, UNITED STATES MARINE CORPS

Colonel JONES. Lt. Col. B. G. Jones, United States Marine Corps, Ammunition Section, Bureau of Ordnance, Navy Department.

The CHAIRMAN. You wish to make a statement?

Colonel JONES. Yes, sir.

The CHAIRMAN. Very well.

Colonel JONES. The Browning automatic rifle and the Thompson submachine gun are the semiautomatic weapons which have been included in the weapons furnished naval landing forces as standard equipment for those forces. If the requirement for another semiautomatic weapon becomes apparent, in conformity with long-standing policy the Navy will procure the standard weapon of the type from the Ordnance Department, United States Army.

The CHAIRMAN. Thank you very much.

We have had a very interesting hearing.

Now, Mr. Johnson opened up this meeting. If you want to say a few brief words in conclusion we will make it a day.

Mr. JOHNSON. Thank you, Mr. Chairman. In reference to the letter which was read by General Moore from the Chief of Staff, I have here my reply to that letter.

The CHAIRMAN. You wish that inserted in the record?

Mr. JOHNSON. It is in accordance with the general statement I made this morning.

(The letter referred to follows:)

JOHNSON AUTOMATICS, INC.,
Boston, Mass., May 27, 1940.

Gen. GEORGE C. MARSHALL,
The Chief of Staff, War Department, Washington, D. C.

DEAR GENERAL MARSHALL: I am deeply honored by the personal attention which you have so graciously given to Dean Melvin M. Johnson, my father, and myself with reference to the question of the Johnson semiautomatic rifle.

It is only because I am sincerely convinced that our service faces a very serious problem with respect to rifles that I have ventured to proceed so far in this matter.

With reference to the points made in your very kind letter of May 22, I feel sure that I shall not only not lose but rather gain your respect by making a reply to you.

During 1 year and a half of the World War this country produced caliber .30 rifles at the rate of 2,300,000 approximately per annum. We began the war with about 600,000 Springfields. It required the facilities of Springfield, Rock Island, Winchester, Remington, and Eddystone to produce sufficient rifles. Even so some units commenced preliminary drill with Spanish War and other models.

The maximum capacity of Springfield Armory on 3 shifts to produce M1 Garand rifles is about 500 per day or about 10,000 per month, approximately. Thus, Springfield's maximum potential production is about 120,000 Garand rifles per year. By the end of 1940 Winchester will make approximately 3,000 Garands per month, but on 3 shifts could probably make approximately not over 100,000 rifles per annum. Bearing in mind the difficulties encountered in going into 3 shifts, and the efficiency loss which has been repeatedly indicated by the Chief of Ordnance in congressional testimony, the maximum potential production of Garand rifles in emergency would not exceed a figure slightly in excess of 200,000 rifles per annum.

The Chief of Infantry has very definitely stated that it is not believed that the semiautomatic rifle necessarily reduces the number of rifles needed in Infantry organizations, pointing to the parallel of the repeating rifle which replaced the single-shot rifle and yet which did not result in a reduction in the number of rifles required.

You have stated that production is the problem of the day. I respectfully call attention to the fact that the Garand rifle is notoriously a difficult weapon to produce in quantity manufacture. This is clearly borne out by the record of its production, and representatives of the Ordnance Department have stated that the weapon is not easy to manufacture.

I am entirely in accord with the proposition that production is the problem of the day, and I sincerely believe, as do many other persons, that the Johnson rifle is so much easier to manufacture in quantity production than the Garand that in view of the approaching emergency it might be quite advisable to initiate production of this rifle, at least in order to obtain a comparison, as well as to have the second string to the bow, so to speak. The War Department has never seen fit to enter into any consideration of that question not to obtain any comparative data. I believe such comparisons as to manufacturing are much more important than those which relate to field use, although there has not as yet been any thorough comparative consideration given both rifles side by side.

Believe me, I deeply and sincerely regret that circumstances have repeatedly forced me to be put in the position of criticizing the M1 rifle. The fact remains that a number of reasonably well respected authorities have criticized the Garand rifle seriously, and a number of their criticisms have certainly not been denied, nor have they been subjected to any test designed to prove or disprove the truth of those criticisms. The most serious criticism of all is the one which has been least mentioned but which relates to the point mentioned in your letter, namely, its manufacturability, for that is the problem of the day.

With reference to the point of having two types of semiautomatic rifles, and thereby multiplying training problems, replacement, and field maintenance, I must respectfully call attention to the fact that we do not now have one type of rifle in the service but instead we have three, namely the models M1, M1903, M1917. It is understood that the service has well over a million M1903 and M1917 rifles, and it will be some time, in fact a number of years, before we will have an equal number of Garand rifles, even at a greatly accelerated rate. The service is therefore faced with the problems outlined in your letter which result from having several types of rifles, and must face that problem, such as it may be, for some time to come.

I cannot impose upon your courtesy to me any further. My own military background, such as it is, prompts me to feel deeply concerned over the question of adequacy of rifles rather than number of types. It is my opinion that the Army would be much less embarrassed by more than an adequate number of rifles of four or five different types, than by a serious lack of sufficient rifles of any one type. Being a democracy we cannot have the ideal type of army which the Nazis were able to build, yet even they have acquired different models from several nations, especially including the Czechs and Poles.

Circumstances inevitably force me to take a position along the above lines. In my natural efforts to sustain this position I am sure that you in particular will know that I am only doing what I conceive to be my duty.

Again thanking you for your courtesy and consideration, and hoping that on some occasion I may have the opportunity to be of service, I am

Very respectfully yours,

MELVIN M. JOHNSON, Jr.,
Captain, United States Marine Corps Reserves.

Mr. JOHNSON. Now there have been interesting statements made here by various members of the War Department about certain characteristics of the Johnson rifle which I would just run through very fast.

The CHAIRMAN. Very well.

Mr. JOHNSON. There was some reference made to recoil- and gas-operated weapons.

To the best of my knowledge the German Army is using a recoil-operated 24-pound light machine gun which has a shoulder stock, is capable of being fired with the butt stock on shoulder. That is known as the M34. A picture of a Nazi parachute soldier with this gun recently appeared in Life magazine.

I am always ready to stand corrected, but so far as I can discover, except for certain weapons which have been acquired in the last few weeks, the German Army isn't using any gas-operated weapons. They may have acquired some from Czechoslovakia. They are using a bolt action Mauser rifle; the German Krieghof, Walther, and Mauser gas-operated rifles have not appeared in the Nazi army. There is the Bren machine gun. That is a gas-operated weapon weighing 21 pounds, and is fired from the shoulder. That has an attachment which is designed to scrape the carbon out of the cylinder of that gun, designed by the British War Office. I only mention that because some reference was made by Captain Brown in this connection which I feel I must clarify.

Also the German Army in 1914 according to the Encyclopedia Britannica tried a gas-operated shoulder weapon, the Mondragon, and that gun was discarded. The Standard failed in 1911 in America, also gas operated. That has no particular significance except the reference was made to gas-operated guns here. I must also point out the fouling and erosion which the muzzle blast makes on the Johnson bayonets. This effect is equally unavoidable but more serious in a gas cylinder.

Senator CHANDLER. Let me ask you this question. The Captain after he made his short jab grabbed this gun here. How would you make the short jab without grabbing it here?

Mr. JOHNSON. Now the short jab consists of holding here and here. That is for the short jab. [Indicating.] The distance from this hand—pointing to the hand nearest to the muzzle—to the point of the model 1905 U. S. bayonet is approximately 21½ to 22 inches. I have no ruler here to prove the point but that would be approximately it.

Senator CHANDLER. Mr. Chairman, in the old days it was a stick, then a hit with the butt; they might have changed it; then a drop to catch it here. I am trying to find out here. You couldn't use that—

Mr. JOHNSON. The distance from the hand at the lower band or the equivalent on the Johnson rifle radiator guard to the point of the dagger-type bayonet which has an 8-inch blade is 23 inches. In other words if I grasp the Johnson rifle using the dagger bayonet with

8-inch blade at this point, that is, back of the lower band, I am only $1\frac{1}{2}$ inches further from the point than if I grab the Springfield rifle below the upper band here. So far as making the short jab is concerned with the Johnson sword bayonet that is made equally well by its protruding 8 inches from the muzzle of the Johnson rifle. Thus the distance from the point of this Johnson bayonet would be only $1\frac{1}{2}$ inches farther from the point than the hand on the Springfield. [Indicating.]

The short 8-inch blade at the muzzle is regarded as advantageous by many bayonet experts. I have shown here that the criticism of the Johnson rifle for the short jab is not well founded. I thank the Senator for raising this point.

Now, there is always a reason for whatever we may do. We try to have sound reasons for the design of this rifle. I have no desire to engage in arguments back and forth about one small point and another. I do want to say this, although it is quite obvious, if you have a rifle, particularly a semiautomatic which is cocked with the breech closed, as all semiautomatics are supposed to be—and this one and the Garand rifle which has been mentioned both cock with the breech closed—if you leave a cartridge in the chamber during such interval as you may not be firing although you may be in combat—you will see that the reason we did not cover this Johnson rifle up with wood is because if the gun were fired and were heated up and it were covered with wood it would accentuate the temperature, it would raise the temperature and that would result in several things which are very obvious. In the first place we have been talking considerably about combat. Say a soldier in combat has fired and is moving on. His rifle is hot. The temperature is raised in the chamber, perhaps to such an extent that the cartridge may fire accidentally by what is called preignition.

Another difficulty which I think is impossible to correct except by improving the cooling condition is that you raise the pressure of the cartridge so that when it fires the pressure may be very high and that may cause some functional difficulty.

Now, I am a Reserve captain—I am probably a very poor one—but be that as it may, I have read the Garand Manual and I have read in the Garand Manual the soldier is cautioned not to leave a bullet in the chamber when the gun is very hot; which is a very wise precaution. The Garand is wood-covered. I am merely pointing to that in the manual. The Johnson was deliberately and intentionally air-cooled to eliminate those two serious difficulties. I think the one of preignition is reasonably serious. Some machine guns are cocked with the bolt closed. The British told me last year they had trouble with their Browning aircraft gun because even in airplanes the chamber got so hot they had preignition. That, of course, is a machine gun, but everybody here I think is familiar with airplane machine guns. They only fire for short periods. We made tests with our air-cooled light machine gun firing full automatic and using five shot loads and after several hundred rounds at 50 or 60 shots per minute the cartridge left in the chamber for 12 or 15 seconds was susceptible of preignition.

The reason why this Johnson has been designed without hand guards—now, these things are questions of opinion, and I don't wish to bore anyone but I may state that I have found many military

authorities including at least one or two authorities abroad who were not in favor of putting hand guards on this rifle, although we showed a model with wooden hand guards. And you may guess that it was the British who wanted to know if we had "the bloody wood around the barrel to keep the heat in."

Senator CHANDLER. What do you say about the criticism the Captain made about dirt and water and everything else getting in here? After it went to the field? Could you arrange that so it wouldn't happen? Isn't that a valid objection to this?

Mr. JOHNSON. If I may reply to the Senator's question directly, I say it is not because no critical mechanism is affected there and experience has proven the Johnson rifle is not easily affected by sand or dust. Captain Van Orden was at the Proving Ground at the time when this gun was sand-tested—and that sand test is included in the record which Major Schlieker has mentioned, and it is stated in the conclusion that the weapon functioned notwithstanding the sand and dust and so on.

Senator CHANDLER. Did it function just as well?

Mr. JOHNSON. Substantially. If you put sand in here in the radiator sleeve and you want to take it out you turn the piece over and rap it and blow it.

Senator CHANDLER. And it will come out?

Mr. JOHNSON. Yes, sir. We made a demonstration at Camp Sims the other day; Mr. Ness was present, incidentally. Some photographs were taken by a news picture outfit, and they showed this gun being completely buried under the contents of a large bag of sand until there was nothing shown but the muzzle, the muzzle of the Johnson rifle. The weapon was then taken out and shaken and it functioned perfectly. There is no place that sand can go except in here between those bushings [pointing to the bushings which are on the barrel]. The sand has no appreciable effect there. I shall later include some specific reports in this record on the point, if the Chairman please.

Senator CHANDLER. What about the durability when it is dropped? He said it was dropped four feet to a board.

Mr. JOHNSON. Two answers to that if I may present them. In the first place the magazine now has two ribs. The magazine is made from a die and when you go into production on this magazine the die will have extra strengthening ribs which will, when the magazine is stamped out, give the magazine considerable extra strength. No other change is needed. Possibly we may use a plastic magazine body. Airplanes are being made of plastics.

Senator CHANDLER. Do you agree it is a present defect?

Mr. JOHNSON. It is a defect depending upon the degree of force in striking the magazine. It is perfectly possible to break parts on all rifles. I can start and do a job on the Garand cylinder. I can do a job on the Springfield rifle if you want to start breaking rifles.

Senator BROOKHART. You can bump that cylinder on the Garand on that and put the rifle clear out of commission.

Captain BROWN. What cylinder do you speak of, Senator?

Senator BROOKHART. That cylinder where the piston works.

Captain BROWN. Well they have taken that gas plug off now and the barrel goes clear through.

Mr. JOHNSON. Well, for the sake of the record there is still a gas cylinder on the Garand. The location of the gas port is the only change brought out here in the latest Garand.

Senator BROOKHART. You still have a cylinder outside and if you bend that cylinder the rifle is clear out of commission.

Mr. JOHNSON. I must confine my remarks to the Johnson rifle if possible. It is possible to dent this magazine [pointing to magazine on the model] it is our contention, which I don't think anyone would deny, that the magazine will be strengthened by increasing the number of ribs when you put the magazine into production. Some reference to that point is also included in the full Aberdeen report. The magazine is removable, it is quickly detached by pulling off the butt stock. That has been demonstrated many times, and answers a comment by Captain Van Orden.

Senator BROOKHART. What do you say, Captain Johnson, about the objection mentioned about loading that you have to sort of pull it instead of being able to clamp it, clamp down on it [indicating]?

Mr. JOHNSON. Well, the rifle may be easily rotated over and the clip inserted in the clip seat. The thumb is pushed down on the cartridges and into the aperture. I can't see any particular disadvantage to this type of clip loading, either the Springfield or the Johnson rifle. I am going to ask if the officers of the Marine Corps will express their view on the clip loading because Captain Van Orden has already testified he has loaded clips in this rifle. One feature is it more firmly positions the clip than does the Springfield. Another thing is when the soldier has been given some training with it, and I have had some myself, the clip ejects itself, providing the clip hasn't been bent [illustrating]. I hold no brief for those clips except we have an awful lot of them and an awful lot of rifles for them. They are cheap, light, plentiful, and familiar.

Now the question of heat on the hand guards was mentioned—

Senator CHANDLER. Before you leave there, do you agree it is easier to clamp down on it or easier to push them in from the side?

Mr. JOHNSON. Well I certainly don't wish to disagree with Major Schlieker.

Senator CHANDLER. Well you certainly have a right to if you want to.

Mr. JOHNSON. Well I still have a slight tinge of R. O. T. C. training, sir. I can't see any particular reason why this magazine is hard to load. If you put two clips into the magazine where the Springfield holds one, you will encounter slight additional spring tension as you will with any magazine that holds more cartridges. Off the record—

(There followed remarks off the record.)

Mr. JOHNSON. I am not selling the Springfield clip. Here it is. And that is that. It is now made so that it is stiff and binds the cartridges more than formerly.

Now the question of the safety device—I guess I am back on the record. This safety device is located in front of the trigger guard. If the Senator would be good enough—this is off the record now.

(There followed a discussion and demonstration off the record.)

Mr. JOHNSON. Pointing to the Springfield rifle, the Springfield safety when it is to the right it is safe, to the left it is off. Our rifle is the same. The Senator just proved that the Johnson safety does not have the alleged defect.

Senator CHANDLER. Where is the safety?

Mr. JOHNSON. It is up top side on this M1903, but if you are in the dark you still have to feel for any safety whether it is around the cocking piece as on the M1903 or some other place. So that I must

respectfully dissent on that point made by Major Schlieker, as well as other points which I am answering.

Now, the question of the buttstock. We will have to take that up with the walnut people, but this stock was put through, as Major Schlieker pointed out, some rather severe tests and was thrown around on the floor and so forth and the stock did split. It was also noted however that it did not change the impact. With the stock split under unusual condition it did not affect the center of impact.

Senator CHANDLER. What do you say about when he said if you hold it over it won't reload, you would exhaust your one shot and wouldn't get another back in?

Mr. JOHNSON. If you hold it loosely like this without any support instead of firmly and with dagger bayonet it is possible it may not do it. When the gun was held loosely by the test officer it was noted it failed to eject the shell. That was with the dagger bayonet. That wouldn't be true of the sword bayonet, for that type of bayonet is attached to the receiver—not the barrel—and cannot affect the automatic operation.

Senator CHANDLER. Suppose you had your dagger on?

Mr. JOHNSON. Well after one shot the next thing I would do would be to get into the trench. If the gun were held in that program of diving into the trench you might possibly hold it a little more firmly. You may want to shoot it around corners like they did at Aberdeen, a 220-pound man jumped on the gun at the center of the barrel. It can be seen by the committee that Captain Van Orden isn't a featherweight. That test caused the Winchester barrel that was used to bend, shooting around corners. It did not distort or injure the Johnson receiver frame. That was, if I may say so, an unusually severe test.

Paragraph (c) from the Aberdeen Proving Ground report relative to the dagger bayonet which was there tested stated that with the Johnson dagger bayonet attached it will not function reliably unless firmly supported at the shoulder or hip or in some other way. I don't know what other way that would be but if it is held here or against the shoulder, we haven't encountered that difficulty. But the sword type was designed to eliminate any question on that.

Now I said at the outset this morning I have no point to make for any bayonets or how they should be used, if it is desired to have bayonets fixed or not. I said this morning I recommended the sword bayonet. However, this dagger bayonet can be attached after the ammunition supply of the soldier is exhausted and this dagger bayonet is light; if the sword is allowed to protrude no more than 8 inches beyond the muzzle it will be no longer than the '05 bayonet or possibly half an inch or an inch longer if the blade were to protrude no further beyond the muzzle of the rifle. I know, however, that Colonel Edson prefers the dagger bayonet. I copied its blade from a new British type with their permission.

I don't know whether the authors of this bayonet will be present much longer to defend it but this sword type is a copy of the French bayonet and has the T-shape blade design. The gentleman mentioned it is not fully stuck out at the muzzle. We put it back here on the theory that it does present this edge below the barrel. I would rather be struck by the barrel than I would by the sharp edge of any instrument. I cannot believe the infantry considers such

points too seriously. Our standard M1905 bayonet is hardly of recent design.

Now, the question of the kick was mentioned. All I can say about the kick is that we have had a great many people fire the Johnson rifle and we have had a lot of opinions expressed and there have been one or two that thought it kicked as much as the Springfield but a great majority thought it kicked a great deal less. Some of them are on public record, including Mr. F. C. Ness.

Now so far as a man being able to fire it, I know we are all here for the purpose of finding out true facts and I am sure Captain Brown will forgive me and bear with me in reading a report which he signed at Fort Benning on the Johnson rifle in 1938. He states that he fired a total of 2,400 continuous rapid-fire rounds—I quote: "all of the firing from the one thousand six hundredth round up to the two thousand four hundredth round was fired by the test officer—the one thousand six hundredth to two thousandth were fired at about 40 to 48 rounds per minute. The two thousandth to two thousand four hundredth were fired as fast as magazines could be placed in the receiver and trigger pulled without respect to target." This report is of the 29th of June to July 6, 1938 signed by Capt. R. H. Brown, Infantry.

Captain BROWN. May I state something on that. I fired that with a shooting coat on and I think it is only fair to say that without a shooting coat that rifle does kick much more than the Garand and all of us found it necessary to fire it with a shooting coat on, that is a pad on the shoulder.

On the 1st of February 1939 I broke my collarbone and I fired the Garand rifle with a broken collarbone 8 months without that shooting coat. We find the kick of the Garand is 45 percent less than the Johnson rifle. I have measured that with a special test and taken it round after round after round. My collarbone didn't knit but I kept on firing for 8 months with a broken collarbone.

Mr. JOHNSON. Well I am sorry to get into that little detail. I cannot agree from my recollection that Captain Brown had a shooting coat on, because I recall he had plain dungarees on. Captain Brown has not tested the Johnson recoil mechanically—I state that if this Johnson rifle is held and fired, as it is recommended to be fired, there is no reason for anyone to suffer any disabilities as far as the kick of the gun is concerned. I would like to try Captain Brown's recoil machine. Of course I have fired this Johnson rifle a great deal over 80,000 rounds, and perhaps I would not know whether it kicked or not, but we have had a great many people who feel it kicks less than the Springfield. One man who fired at Fort Belvoir told me the Johnson kicked him less than the Garand. Perhaps this, too, is a matter of individual opinion. An Aberdeen test firer repeatedly refused to accept my shooting coat last fall. His name was Getsell.

If Captain Van Orden has any views as to whether this Johnson rifle kicks less or more than the Springfield rifle, based upon firing it—

Captain VAN ORDEN. Out of about 15 of 22 men who fired the rifle all of them said without exception that they thought it was much less than the Springfield.

Captain BROWN. Were there pads on their shoulders?

Captain VAN ORDEN. Some did and some did not.

Mr. JOHNSON. It has been a surprise to me to find out that the question of the kick of this rifle has been so much a question of minor controversy, but of course I am under a duty to Johnson Automatics, Inc., as well as to this committee.

When this rifle is held tightly on the shoulder with a grip of force it is our experience, and we too have fired our rifle considerably, that if the gun is held very tight on the shoulder, you will experience slightly more kick than if you hold the rifle normally and firmly but not very tightly against the shoulder.

This gun recoils, the bolt unlocks. The recoil is retarded materially by the work of unlocking that bolt. That unlocking of the bolt slows down the recoil of the barrel. If it did not, it would pound the gun all to pieces which is not the case. There has to be some decelerating means and that is provided in the Johnson unlocking action. Such kick, as there is, consists of the striking of that barrel against the stock of the receiver. Therefore, if the gun were held gently on the shoulder the bulk of the gun would absorb a great deal of that force. Whereas on the Springfield the force, I think everyone agrees, comes right straight back on the shoulder; it is direct. On the Johnson rifle it is absorbed to some extent in the receiver and stopped. That has been our experience and we have mentioned it to various people who have fired the rifle and they have had the same reaction. If a man holds it in the recommended manner it needn't bother him.

Captain BROWN. When you push the barrel back you unlock the bolt and you can't fire the rifle?

Mr. JOHNSON. That is correct.

Captain BROWN. If a man pushes up against the barrel or bayonet and unlocks the bolt, you can't fire the rifle.

Mr. JOHNSON. That is true. He would have to push pretty hard.

Captain BROWN. That is the reason the police won't use these automatics.

Mr. JOHNSON. I must say, sir, I can't quite conceive just how that could develop. I am sure I wouldn't want to volunteer myself to take my chances that much, this gun pushing me—

Captain BROWN. You would do it quick enough if he had it against you.

Mr. JOHNSON. I am afraid I should probably change my politics. I am sorry, sir; I can't agree that is a worth-while consideration in a shoulder rifle. I have heard that people do grasp at a pistol but I don't believe that this average soldier that we have been talking so much about here is going to be given much instruction or have much of a desire to do that sort of thing. Of course, as for gripping the barrel, we have all agreed that that barrel gets hot and you can't grab hold of it so they wouldn't be likely to grasp the barrel. The soldier should not grab the hot barrel or look into the muzzle, if the rifle is loaded.

Now there is one point here which I wish to make and that is this: There has been much talk here about toolroom models and gunsmith models.

This machine gun, an early model machine gun, is a toolroom whittled model. That is I think what the gentlemen have referred to in talking about the difficulties that arise when you put a rifle in the field which worked all right in the gunsmith category, but when put in production you have a lot of trouble.

Now I want to emphasize that this rifle was production-engineered as far as humanly possible to make anything until you actually set

up the machinery to put it in production. That is the first point. The Johnson tested at Aberdeen in 1939 was a production model, not a "tool maker's model."

And the second point is that I will take the liberty of stating that that hasn't been done before with rifles or machine guns in normal practice. And what the gentlemen from the Infantry board and Captain Brown have said is absolutely true in other cases, but we have substantially avoided that difficulty by having these rifle models which are shown here. The drawings were used for Johnson-production models and there hasn't been any whittling or changing around. It is true and everybody knows you do make changes in production. But that is a question of degree as to the change that becomes necessary because in most of the cases where the gun hasn't been production-engineered, and worked out in advance as to the tolerances and parts, you are naturally going to get changes when you go into production. Mr. Gardner testified this morning that Taft-Peirce made maximum, minimum, and medium models to prove the drawings and then we made production models which I have shown and fired a number of them. When we went from the proof models to the production models, yes, we made some slight changes. When we went from the old original whittled guns we made some material changes. But that production-model procedure hasn't been followed in the arms business and I am quite sure it hasn't been done with any other rifle of this type.

This is the one thing we tried to do, the thing we were urged to do by the Ordnance officers. They insisted that that procedure should be followed. It has been followed in other industries, but hasn't been followed in the arms business. We have done it, and that is the reason I cannot accede to the proposition that we are going to have a terrible time working out all sorts of bugs. That is the thing we have covered. I think it is perfectly obvious, that has been demonstrated here, and I want to emphasize that as strongly as I can. As a matter of fact it was sufficiently unusual that Machinery Magazine published an article in the January issue of 1940 on the advantages derived from studying and analyzing and working out production drawings for any mechanism, particularly that of a rifle.

I will be glad to submit a copy of that article for the record if the chairman please.

The CHAIRMAN. Very well.

Mr. JOHNSON. As to the point that has been made a great deal of here this afternoon—

The CHAIRMAN. Indicate where the article is and let the reporter have it. You can do that later though.

Mr. JOHNSON. I have taken a great deal of the chairman's time and the committee's time. I naturally appreciate very much the time that has been taken on this subject.

The CHAIRMAN. Any vital points you have that have not been covered, go ahead, we are giving everybody a chance here.

Mr. JOHNSON. Our manager, Mr. Howard, has submitted to me an analysis which he prepared with respect to certain points in this rifle which we believe are superior to other rifles.

The CHAIRMAN. Let it be inserted.

Mr. JOHNSON. If there is no objection, that has been—I think copies of that have been distributed to members of the committee.



The CHAIRMAN. Give it to the reporter.
(The analysis referred to follows:)

JOHNSON AUTOMATICS, INC.,
New York City.

JOHNSON SEMIAUTOMATIC RIFLE

GENERAL COMMENT

In the 4 years since the Garand semiautomatic rifle was adopted by the United States Army in January 1936, there has been invented and fully developed for mass production a better, more powerful, more accurate, and longer-ranged rifle—the Johnson semiautomatic.

This rifle was invented by Melvin M. Johnson, Jr., of Boston, captain, United States Marine Corps Reserve, lawyer, military author, firearms expert, and inventor also of the Johnson light machine gun.

Of interest to the American taxpayer.

Of interest to the United States national defense.

Of interest to American riflemen who may have to shoot accurately in the next war at enemy troops more than 300 to 600 yards distant.

Of interest to the American machine gunners who are hereafter to be supplied with the 45-percent shorter-ranged and less powerful .30-'06 cartridge—known as M2 ammunition—to keep the ammunition-supply problem in common with the Garand rifle.

Of interest to those who want the United States fighting forces equipped not only with the "world's finest rifle" but with the "world's most powerful and longest-ranged semiautomatic rifle."

In short, of interest to all Americans is the now much discussed Johnson semiautomatic rifle—it shoots the longer-ranged and more powerful M1 cartridge with the streamlined bullet.

Accordingly, we present herewith facts and our opinions concerning why the Johnson semiautomatic rifle is superior to Garand semiautomatic rifle.

JOHNSON SEMIAUTOMATIC RIFLE IS SUPERIOR TO GARAND SEMIAUTOMATIC RIFLE

1. *Johnson accuracy not impaired by barrel heat.*—Johnson rifle accuracy is not appreciably affected, if at all, by rapidly changing barrel temperatures resulting from sustained or intermittent rapid fire.

This is a serious problem with the Garand rifle.

2. *Johnson more accurate at longer ranges.*—Johnson rifle accuracy is superior at all ranges from 300 to 1,000 yards or more.

The Garand rifle has been recently officially described as a "combat rifle" because of its admittedly poor accuracy at ranges beyond 600 yards.

3. *Johnson greater endurance more efficient.*—Johnson rifle endurance and efficiency is not adversely affected by sustained rapid fire.

The Garand rifle efficiency and endurance is adversely affected by excessive sustained rapid fire.

4. *Johnson more powerful, longer-ranged—does not handicap machine gunner and rifleman.*—Johnson rifle functions efficiently during sustained rapid fire of 1,000 rounds or more with the recently abandoned and greatly superior high-powered, long-ranged M1 ammunition (maximum range 5,500 to 5,900 yards, effective range 4,200 to 4,500 yards for machine-gun-barrage purposes). The Johnson rifle also functions efficiently during sustained rapid fire of 1,000 rounds or more of the now standard and 45-percent shorter-ranged M2 ammunition (maximum range 3,000 to 3,300 yards, effective range only 2,200 yards for machine-gun-barrage purposes).

The Garand rifle obviously functions better during sustained rapid fire with the lower powered M2 cartridges than with the high powered M1 cartridges, otherwise there would be no point in handicapping the United States machine gunners as well as riflemen with this short ranged cartridge which was recently made "standard" for all weapons calibered in .30-'06.

Johnson no increase in weight burden for M1 ammunition in Springfield clips over M2 ammunition in Garand clips.—The claim that the lower-powered, shorter-ranged M2 ammunition saves the Garand rifleman weight over the same number of rounds of M1 is grossly misleading. For example, while 40 rounds of M2 ammunition alone weigh less than 40 rounds of M1 alone, the 40 rounds of M2 for the Garand rifle must be held in packages of 8 in special steel charger clips. These 40 rounds of M2 plus the 5 Garand charger clips weigh more than 40 rounds

of M1 ammunition when held in brass Springfield clips. In other words, the soldier equipped with a Springfield, Enfield or Johnson rifle using the Springfield type ammunition clip can still enjoy all the advantages of the higher-powered, longer-ranged M1 cartridge, whereas the Garand charger clip increases the weight of the soldier's Garand ammunition supply to such an extent that he has to be given the shorter-ranged, less powerful, and lighter-weight M2 cartridge.

5. *Johnson eliminates lubrication and cleaning problems.*—Johnson rifle cleaning or lubrication is unnecessary during 1,000 rounds of sustained or intermittent rapid fire.

Garand rifle cleaning and lubrication is necessary at least every several hundred rounds, and it is doubtful if it would function efficiently under such sustained rapid fire.

6. *Johnson barrel fully air-cooled.*—Johnson rifle barrel is fully air-cooled. The ventilated metal hand guard prolongs the life of the barrel, eliminates charring of conventional wooden handguards and of wooden forestock during sustained rapid fire—hence, eliminates the vision-obscuring smoke and greatly reduces the hazard of accidental discharge of a live cartridge in the chamber due to preignition from an overheated barrel.

The Garand rifle barrel is fully woodcovered. This insulation prevents rapid cooling and renders the danger of such preignition very great.

7. *Johnson barrel instantly detachable and replaceable.*—Johnson rifle barrel is instantly removable by the soldier in the field for cleaning or for replacement, if worn or damaged, without the use of tools or the services of an armorer.

The Garand rifle barrel is not removable. It is permanently welded to the receiver frame. Hence, renewing the barrel is a job for the factory and costs a great deal more, not to mention the serious handicap to the field services in time of war.

8. *Johnson adapted to use of any standard .30-'06 barrel.*—Johnson rifle construction permits the adaptation, at no appreciable difference in cost, of any standard .30-'06 calibered barrel, including the Springfield and Enfield barrels, or such commercial barrels as are manufactured by Winchester, Remington, Savage, etc.

The Garand rifle cannot utilize any of these barrels due to the required lighter weight and special necessary dimensions.

9. *Johnson barrel permits standard cleaning methods.*—Johnson rifle barrels may be cleaned from the breech end, as has been standard practice in the service for 30 years or more. This reduces wear at the muzzle, the control point of accuracy.

The Garand rifle requirements specify that it must be cleaned from the muzzle end.

10. *Johnson mechanism is simpler—no gas piston, no cylinder, no muzzle cap.*—Johnson rifle has no gas cylinder, no piston, and no piston rod nor operating rod to get out of order or to require cleaning or lubrication.

These problems exist in the Garand rifle.

11. *Johnson eliminates carbon cleaning problem.*—Johnson rifle has no carbon cleaning problem.

The Garand rifle has this problem.

12. *Johnson eliminates graphite and other lubrication problems.*—Johnson rifle requires no special lubricants. Any ordinary rifle oil will do, but in severe cold weather all oil can be dispensed with—it is not essential for the efficient functioning of a Johnson rifle.

The Garand rifle requires Dixon's No. 3 graphite plus aircraft machine gun lubricating oil (see Garand rifle instruction manual) for efficient functioning—this is a great handicap especially in zero weather, as borne out by the experiences of the Finnish Army with their automatic weapons.

13. *Johnson utilizes standard Springfield clip—simplifies ammunition supply problem.*—Johnson rifles can be loaded with ammunition in standard Springfield clips, thus keeping the ammunition supply problem in common with the Springfield and Enfield rifles with which our Army would at first be forced to equip most of its troops in any immediate emergency that might arise out of the current world crisis. As pointed out below, the Garand cannot be manufactured quickly in the necessary large quantities for such an emergency, whereas the Johnson can.

The Garand rifle requires a "mongrel" type of "package" clip to hold eight cartridges. This would be useless to the operator of the Springfield or Enfield rifle, just as the standard Springfield type clip is useless to the operator of the Garand rifle.

14. *Johnson magazine loading system has unique advantages of vital importance.*—Johnson rifle magazine can be efficiently loaded with cartridges in Springfield-type clips or with single cartridges at any time while the breech bolt is open, or while

the breech bolt is closed on an empty chamber, or while the breech bolt is closed on a live round in the chamber with the gun cocked and ready to fire, so that the soldier will not be defenseless while loading as is the case with the Garand, the Springfield or the Enfield rifles. The Johnson rifle method of loading the magazine with single rounds would permit the soldier to utilize cartridges taken from a machine gunner's belt, a Garand rifle "package" clip, or from any loose ammunition supply box. Johnson rifle magazine can be replenished with ammunition at any time with the bolt open or closed regardless of the number of rounds remaining in the magazine.

The Garand rifle cannot be loaded under any circumstances with the breech bolt in the closed position. Therefore, the soldier will always be defenseless with this weapon while reloading the magazine. The Garand rifle magazine cannot be efficiently loaded at any time with single rounds. Thus, it is impracticable to replenish the Garand magazine until all eight rounds have been fired or until the remaining unused rounds have been removed from the magazine to permit the insertion of a fresh "package" clip of eight rounds. It is generally conceded by many competent military authorities that the Garand loading system will inevitably result in considerable waste of good ammunition in battle, for the soldier will neither wait until he has fired all eight rounds before reloading his rifle nor will he stop to save the ejected remaining good ammunition as it falls to the ground when the magazine is cleared for reloading.

15. *Johnson magazine capacity 25 percent greater.*—The Johnson rifle has a capacity of 10 cartridges in the magazine plus 1 cartridge in the barrel chamber making a total of 11 rounds.

Garand rifle has a total capacity of only eight rounds.

16. *Johnson breech lock stronger—anticipates development of more powerful ammunition.*—Johnson rifle breech lock is unusually strong. The load is evenly distributed circumferentially around the head of a rotary bolt by eight locking lugs. Only 20 degrees of rotation from the unlocked to the locked position is required. This strong Johnson breech mechanism anticipates the development of much higher powered ammunition than has yet been developed for military rifles.

The Garand rifle distributes its load over only two small lugs on a bolt having only 25 degrees of rotation from the unlocked to the locked position. Thus the Johnson breech lock is much stronger and safer than that of the Garand rifle.

17. *Johnson construction safeguards soldier's eyes and face.*—Johnson rifle receiver frame is so constructed as to fully cover the rear end of the breech bolt and thereby protect the eyes and face of the soldier against powder burns or other injuries that might be caused by defective ammunition.

The Garand rifle has an exposed breech bolt close to the operator's eyes. Reports have been heard from various Garand rifle operators that smoke and powder leaks from the breech irritating their eyes and this interfering with accurate shooting.

18. *Johnson extractor instantly removable.*—Johnson rifle extractor can be easily and quickly removed and replaced, if defective, without removing the breech bolt by simply sliding the bolt handle off and on.

On the Garand rifle, to replace a defective extractor it is necessary to remove completely the trigger unit, the wooden stock, and the breech bolt unit from the receiver frame. Broken extractors are fairly common with all rifles now in the service.

19. *Johnson firing pin easily removable, extremely durable.*—Johnson rifle firing pin can be easily and quickly removed and replaced, if defective, by sliding out the lock plate, the bolt handle, and the bolt nut. The three-piece bolt unit disassembles and assembles in less than 5 seconds. Thus the firing pin can be replaced in the bolt unit and assembled in the rifle in a small fraction of a minute and without tools or special effort. In the history of tens of thousands of rounds of firing of production-designed Johnson rifles, there has never been a case of a single broken firing pin.

The Garand rifle firing pin is actually much more difficult to remove and replace than in the case of the Johnson, although a technical description might not disclose much difference. Considerable breakage of Garand rifle firing pins has resulted to date, yet the soldier is instructed not to disassemble the Garand breech bolt unit containing the extractor and firing pin. Actually, this is a tricky job to accomplish.

20. *John design facilitates large scale production.*—The manufacturing tolerances and the design of the Johnson rifle parts are such as to facilitate large scale low cost production. Thus, only standard commercial-type production machinery is required.

The Garand rifle requires some custom-built production precision machinery for normal production.

21. *Johnson utilizes standard grades of commercial steels.*—Johnson rifles require only standard grades of commercially available steel.

The Garand rifle requires certain specially made high-grade alloy steels according to various published records.

22. *Johnson "combat" sights simple and rugged, also suited for sniping and fine target work.*—Johnson rear sight has quickly removable elevation slide with 100-yard adjustments up to 1,000 yards, adjustable vernier peep apertures permitting adjustments in minutes of angle, and peep aperture selection for various light conditions.

The Garand rifle rear sight is said to render the rifle suitable only for "combat" purposes because the accuracy is allegedly impaired by the large peep aperture.

23. *Johnson design permits ideal top position for telescope sight—eliminates blind view of side-mounted telescope.*—The Johnson rifle receiver frame, with its side loading magazine and with its side ejection port, makes it ideally suited to the mounting of a telescope sight on the top or left side. The top mount permits a full and unobstructed view, especially of all fast moving targets.

The Garand rifle top loading and top ejection port interferes with the proper use of a telescope sight in the standard and most efficient manner.

24. *Johnson offers two types of bayonets—more modern and more deadly than the Springfield bayonet.*—The Johnson rifle may be equipped with one of two optional types of the most modern bayonets (a) the Johnson dagger bayonet, weight one-half pound, mounted at the muzzle of barrel; the $\frac{3}{8}$ -inch recoil travel of the barrel increases the penetration of the bayonet blade in combat; the rifle equipped with this bayonet will function efficiently as a semiautomatic weapon when held in any position—including pointing downward, if held with a normal and reasonably firm grip; (b) the Johnson sword bayonet, weight nine-tenths of a pound, is ruggedly mounted at the head of the barrel sleeve and does not recoil with the barrel. This is a more powerful and deadly type of weapon than the Garand or Springfield bayonet.

The Garand rifle utilizes the Springfield bayonet, weight 1 pound. This bayonet is in no way superior for combat purposes to the Johnson bayonets. However, it might save the Government some duplication of expense in equipping Garands, if large Springfield bayonet stores are on hand.

Johnson permits salvage of Springfield and Enfield barrels—avoids complicating ammunition supply with "mongrel" type Garand clip.—Johnson rifle, as an offset to this saving, can utilize (a) the Springfield barrels in store, a far more expensive item of material; (b) any serviceable barrels salvaged from Springfield rifles as these might be replaced with Johnson semiautomatic rifles; (c) any serviceable barrels salvaged from United States Enfield rifles as these might be replaced with Johnson semiautomatic rifles; (d) the standard ammunition now packed in vast quantities with the Springfield-type clip attached.

25. *Johnson manufacturing tolerances facilitate quantity production, assuring 100 percent interchangeability of parts, eliminate hand-filed fitting of parts.*—Johnson rifles have been so engineered and designed as to facilitate large scale quantity production and to eliminate hand-filed fitting of the parts. All production manufacturing tolerances have been proved in to assure 100 percent interchangeability of the parts. This is essential for economical production and for low cost field service.

Garand rifles involve considerable hand-filed fitting of parts, do not permit 100 percent interchangeability in the field without the services of an armorer and have proven expensive to maintain. The barrels cannot be renewed in the field. The cost of modernizing the existing 35,000 Garand rifles with the one-piece barrel and muzzle cap will exceed many times the mere cost of the barrel itself.

26. *Johnson facilitates "procurement planned" production under war-time emergency conditions.*—We have been assured by reputable manufacturing authorities that the Johnson rifle can be quickly produced in practically any desired quantity.

Experience indicates that the Garand cannot be quickly produced in the quantities which would be necessary in an emergency.

CONCLUSION

Johnson rifles simplifies problem of modernization of Army rifle equipment.—The Johnson issue can scarcely center around the statement of The Adjutant General that "it would be impracticable to procure and maintain two types of rifles." As in the case of 1917-18, if the United States should enter a war this year, its troops would necessarily have to be equipped very largely with the Springfield

and the Enfield rifles irrespective of Garands now available or on order. Furthermore, special ammunition supplies for the Garand would have to be provided because of its required "mongrel" type of "package" clip—a problem the Johnson rifle eliminates.

Johnson favored by impartial observers.—Accordingly, we feel certain that any impartial consideration of the foregoing points of superiority which we claim for the Johnson rifle over the Garand rifle will establish their absolutely irrefutability.

Johnson deserves unbiased consideration of United States Government in face of current world crisis.—Inasmuch as less than 35,000 Garand rifles have been produced to date, notwithstanding the lapse of 4 years of effort and the expenditure of millions of dollars of the taxpayers money, and inasmuch as your Committee on Appropriations has already been advised by several competent persons that the Garand rifle still leaves much to be desired from every standpoint—manufacturability, functioning, accuracy, and ease of maintenance, we submit that the Johnson semiautomatic rifle deserves this most thorough and unbiased consideration by the United States Government in this time of emergency.

Johnson versus Garand involves but one issue: "Which is the better rifle?"—Stripped of all prejudice, of all selfish motives, of all pride of authorship and design, of all misleading statements of half truth, of all trivial and petty quibbling over this feature or that characteristic, of all hair-splitting and "buck"-passing language, there is really one and only one issue that vitally concerns the United States national defense in the Johnson versus the Garand rifle controversy:

"Is the Johnson semiautomatic a better rifle than the Garand from soldier's point of view, from the manufacturer's point of view, from an unbiased procurement planning point of view?"

Johnson challenge to prove superiority over Garand ignored.—We repeat our challenge often made to the Ordnance Department to disprove before any unbiased group of mechanical engineers, any unbiased military group of experts, and any unbiased civilian rifleman that the Johnson rifle is not equal or superior to the Garand rifle on every major count.

FURTHER COMMENT

1. *Johnson weight compares with United States rifles used during World War in 1917-18.*—Johnson rifle weight averages $9\frac{1}{2}$ to 10 pounds. United States Springfield rifles average $9\frac{1}{4}$ to $9\frac{3}{4}$ pounds, and United States Enfield rifles average $9\frac{1}{4}$ to $10\frac{1}{4}$ pounds, official handbook specifications to the contrary notwithstanding.

Weight of any given rifle is never identical with another, except by chance, due to variation in density of wooden stocks and the porosity of the wood which controls the volume of linseed oil absorbed in the finishing of the same.

Garand rifles weight average $9\frac{1}{2}$ to 10 pounds.

2. *Johnson safety switch foolproof.*—Johnson safety device is absolutely positive and absolutely foolproof. There is no need to read any "on" and "off" labels. The safety lever is just forward of the trigger guard. Reached with the tip of the right forefinger, it is "on" or in the "safe" position only if the lever can be readily felt in the right-hand position. If the finger can reach around the forward edge of the trigger guard, the safety lever is obviously in the "off" or "firing" position. In a word, the safety switch is "off" when thrown to the "left" position and "on" when thrown to the "right" position. Confusion over which is the "safe" or firing would be no more likely with a Johnson rifle than with a Garand, Springfield, or Enfield rifle.

3. *Johnson bayonet superior to Springfield bayonet used with Garand.*—The Johnson rifle may be equipped with one of two optional types of the most modern bayonets, (a) the Johnson dagger bayonet, weight one-half pound, mounted at the muzzle of barrel; the $\frac{3}{8}$ -inch recoil travel of the barrel increases the penetration of the bayonet blade in combat; the rifle equipped with this bayonet will function efficiently as a semiautomatic weapon when held in any position, including pointing downward, if held with a normal and reasonably firm grip; (b) the Johnson sword bayonet, weight nine-tenth pound, is ruggedly mounted at the head of the barrel sleeve and does not recoil with the barrel. This is a more powerful and deadly type of weapon than the Garand or Springfield bayonet.

4. *Johnson functioning under sand, mud, or dust conditions superior to Garand.*—Johnson rifle tests prove "It can endure considerable sand and dust without failure

to fire and then reload automatically." The force required to load a clip of cartridges into the magazine under adverse conditions is no greater than that required to load a Springfield or Enfield under the same conditions.

5. *Johnson buttstock is strong and rugged.*—Johnson walnut buttstock is equal if not greater, in strength to the stock of a Springfield, Enfield, or Garand rifle. The thickness and depth of the wood is greater. The strength of any walnut stock varies with the character of the wood grain. Some are more brittle than others.

6. *Johnson magazine is strong and rugged.*—Johnson magazine will withstand severe blows from abuse or accident. Dents do not necessarily impair loading or automatic feeding. A Johnson rifle dropped from a height of 4 feet and at right angles onto the edge of a ¼-inch board supported by a concrete floor failed to put the magazine out of action. The blow merely dented the magazine body in three-sixteenths of an inch and reduced the rifle capacity to 5 rounds plus 1 round in the chamber. If damage should ever put the magazine fully out of action, it can be completely removed in a few seconds and the rifle can then continue to operate as a single-shot loader or the damaged magazine may remain on the rifle without impairing this single-shot method of operation.

7. *Johnson continuous trigger pull best for semiautomatic rifles.*—Johnson continuous trigger pull facilitates training of riflemen. Reduces "flinching" of beginners. It is popular with all those who have extensively fired Johnson rifles. However, Johnson rifles are provided with the conventional "slack and take-up" trigger pull at the buyer's option.

8. *Johnson recoil against the shoulder is lighter and pleasanter than the Springfield rifle.*—Johnson recoil produces 10 percent fewer foot-pounds of energy than the Springfield, according to Aberdeen Proving Ground, December 1939, test. Of the several hundred persons who have fired the Johnson rifle, over 90 percent exclaim that the recoil shock is very much less than that of the Springfield. A very few have indicated that they thought it was as great as the Springfield. Less than five persons have ever expressed the view that the kick felt any greater than the Springfield. The difference of opinion varies according to peculiarities of holding by, and the sensitiveness of, the particular shooter. This is true regardless of the make of rifle in a given caliber firing identical ammunition.

9. *Johnson world's longest-ranged, most powerful semiautomatic rifle.*—Johnson efficiency, endurance, and power surpasses that of any rifle in the world. This claim has never been successfully challenged. A production model Johnson rifle is at least equal in accuracy to a standard service production model Springfield or Enfield rifle. At ranges of 300 to 1,000 yards or more the Johnson is more accurate than the Garand rifle.

"JOHNSON AUTOMATICS" PROVEN BY TESTS WORLD'S MOST POWERFUL LONG-RANGED SEMIAUTOMATIC RIFLE—SIMPLE, RUGGED, RELIABLE, ACCURATE, SHORT-RECOIL OPERATED

Can deliver sustained or intermittent rapid fire over long periods without need of lubrication, cleaning, or other attention and without barrel overheating or accuracy being impaired by fluctuating temperature of barrel.

Standard weight.—About 9½ pounds.

Rotary magazine.—Capacity 11 cartridges, 10 in magazine plus 1 in chamber. Loads with cartridges singly or in Springfield clips while breech is opened or closed ready for firing and regardless of whether magazine is partially or entirely empty.

Barrel.—Fully air-cooled, instantly removable for cleaning or replacement and interchangeable with Johnson light machine gun or other Johnson rifles.

Bayonet.—Sword type ruggedly mounted at head of barrel sleeve, or powerful dagger type mounted at muzzle. Automatic operation and accuracy unimpaired by either of these instantly detachable bayonets.

Caliber and ammunition.—All Johnson rifles and Johnson light machine guns are available in American or foreign military calibers and operate with chamber pressures ranging from 36,000 to 68,000 pounds per square inch. The Johnson rifle is especially adapted for the world's finest, most powerful and accurate, and longest-ranged, streamlined-bullet ammunition; the caliber .30 M1 cartridge, or for use with the 45-percent shorter-ranged and less powerful M2 cartridge.

Mr. JOHNSON. And this is the magazine article on manufacture. (The article follows:)

[Reprinted from Machinery, January 1940]

CAREFUL ANALYSIS OF PROPOSED PRODUCTS SIMPLIFIES INTERCHANGEABLE MANUFACTURE

(By C. B. Gardiner, assistant secretary, Taft-Peirce Mfg. Co., Woonsocket, R. I.)

AN OUTLINE OF THE PROCEDURE FOLLOWED IN PLANNING FOR QUANTITY PRODUCTION OF JOHNSON SEMI-AUTOMATIC HIGH-POWERED RIFLES

Invention of a device is only the first step in making it a practicality. Successful marketing of the article generally necessitates refinements in the design to permit economical manufacture, and refinements for this purpose often bring important improvements in the functioning and appearance of the device.

Economical manufacture usually requires a preliminary careful analysis of the invention to determine the preferable methods of production and the proper dimensional tolerances of working parts. Without this preliminary analysis, tolerances closer than necessary may be specified, with a resultant high production cost. On the other hand, it may be learned, after fixtures, jigs, and other special equipment have been provided, that the tolerances are too wide to insure satisfactory functioning of the product and that this condition can be remedied only by extensive changes in the manufacturing routine. It may also be learned, after it is too late, that slight modifications in the original design would have permitted much simpler manufacturing practices than those adopted. If the proposed device is at all complicated, the expenditure of funds in a preliminary study of manufacturing procedure will be well repaid.

Melvin Maynard Johnson, Jr., captain, U. S. Marine Corps Reserve, the inventor of a semi-automatic short-recoil high-powered rifle which shoots 10 bullets in rapid succession with 1 loading, and which has established sensational performance records both in this country and abroad, fully understood the fundamental principles here outlined, and brought his original rifle models to the Taft-Peirce Manufacturing Co. for complete planning of a manufacturing program. It was decided to develop methods based on the production of 50 rifles a day, which would be applicable in the average well-equipped machine shop, so that in case of an emergency, a large number of shops could be placed in production on rifle parts with little delay.

Of prime importance was another requirement believed to be unique in rifle manufacture—that the methods decided upon must insure 100 percent interchangeability of all parts, so as to completely eliminate hand fitting in assembly operations. In other words, the job was to be “engineered” from the standpoint of an average machine shop.

The first step taken by the Taft-Peirce Manufacturing Co. was to make a complete set of pencil detail and assembly drawings on bond paper of all parts, with the exception of the barrel, as the rifle is designed to use either Springfield, Remington, or Winchester barrels of .27 or .30 caliber. In making these drawings, the tolerances specified were as wide as possible consistent with good workmanship, in order to keep down manufacturing costs and facilitate assembly, but close enough to insure rifles of high quality. A few tolerances on the receiver were as close as plus or minus 0.001 inch, and others as close as plus or minus 0.003 inch, but the tolerances on most dimensions were between plus or minus 0.005 inch and plus or minus 0.010 inch. In establishing these tolerances, good machine-shop practice was followed, and it was constantly kept in mind that each extra zero after a decimal point would mean a more expensive gun.

Concurrently with the making of the pencil drawings, manufacturing processes were planned and a study was made of all machine tools, jigs, fixtures, special tools, working and inspection gages, etc., required for manufacturing parts on the basis of 50 rifles per day. More than 500 operation sheets were drawn up listing all details of operations. These sheets show sketches of the work, list the machines and tooling to be used, and indicate the cuts to be taken by each tool. Feeds and speeds are given, as well as the estimated time for each operation. Fifty-five different types of standard machines are necessary, and for a production of 50 rifles a day, 174 standard machines are used. Incidentally, the receiver, which is the most difficult part, must undergo 123 machining operations.

Upon the completion of these preliminary steps in planning the manufacturing methods, three rifles were made to prove the correctness of the drawings. One of the rifles was made to all of the dimensional high limits, another to all the low

limits, and a third to the median limits. Only in this way could it be definitely determined before actual manufacture was started that a gun made to the closest fits or to the widest fits would function to complete satisfaction.

All parts for these models were made in the toolroom and checked in a constant-temperature room to insure accuracy of dimensions. It was extremely gratifying that these rifles met the most severe tests satisfactorily. They prove the practicability of the specified tolerances and the planned manufacturing procedure. Whereas few of the parts on the original model made by the inventor were susceptible of production by ordinary machine-shop methods, every part on the "engineered" rifle can be made by such methods. In addition, the "engineered" rifle is stronger than the original model, much simpler, and has a neater appearance.

All together, there are 103 parts to the rifle, including every piece made on a machine, such as small pins used for assembly purposes. The simplicity of the rifle has greatly impressed arms experts, as it is possible to change rifle barrels in a few seconds and to disassemble a rifle completely, and reassemble it ready for firing in 2 minutes. The weight of the rifle is about 9 pounds. It has the accuracy and power of the well-known Springfield rifle.

A quantity of rifles have now been manufactured according to the methods developed in the study here described, and it is of interest to note typical performance records of some of these guns in impartial tests conducted by different persons in various places. They have been subjected to the most severe conditions, including excessively extended firing and operation with defective ammunition, abnormally loose barrels, and intentionally careless assembly. One rifle, for example, fired 300 rounds of wartime ammunition without a single failure. Another fired 247 consecutive rounds of excessively soft brass-cased ammunition. In a rather spectacular performance, a third rifle fired 2,400 consecutive rounds of ammunition in 1½ hours at the rate of from 30 to 100 shots per minute after the mechanism had been previously fouled by firing 500 rounds of ammunition. During this entire performance, there was no cleaning, oiling, or cooling of the weapon.

The work of "engineering" this rifle, including the making of all drawings, operation sheets, and the model rifles, took less than a year, a creditable performance, considering the work involved.

Captain BROWN. Mr. Chairman, may I say a word in regard to production? Colonel Drewry wants to call your attention to a matter.

The CHAIRMAN. Very well.

Colonel DREWRY. I just want to say a word about the design of tools, jigs, fixtures, and gages, and then manufacturing them and putting them to production. We have been through that experience many times and our tools, jigs, and fixtures were designed by designers whom we hired from the civil-service list and who have been trained for a long time.

I have never seen a case where after you start using newly designed jigs and fixtures on the production line that it didn't become necessary to make changes in them due to the machines on which placed not working satisfactorily, or as you expected them to work, with that particular fixture or gage, and there are many times when we have to go back and make minor changes in fixtures and jigs and gages before we get in to production.

The CHAIRMAN. Anything further, Mr. Johnson?

Mr. JOHNSON. There was a great deal of discussion here about trigger pulls. We can of course put in the slack and take-up which are mentioned here as being important; you pull the trigger up, then it releases in our light machine gun. It is quite possible to put the double pull in our rifle, it isn't different from any other as far as that point is concerned.

With regard to the question of tools in manufacture, I understand that Mr. Sparks would have a word on that if the chairman please.

The CHAIRMAN. We will hear from you.

Mr. SPARKS. Colonel Drewry, all you say about tools and dies and fixtures is correct, that is part of the manufacturer's problem which is occurring and has been with us for 40 years. It always will be with us. It is no different problem than it was a great many years ago. I took that into consideration as we always do in considering any job in our plants.

Colonel DREWRY. And the point I was trying to bring out was this: If you design your tools, jigs, and fixtures and then put them into the production shop they don't work 100 percent.

Mr. SPARKS. Never will. Never will.

Colonel DREWRY. That is what I was trying to bring out.

Mr. SPARKS. You didn't find that in the M1.

Mr. JOHNSON. Well, it means, if the chairman please, that the only way we can find out anything is to do it. We can conjecture and conjecture and have discussion of what might be done, what has happened, and what might happen. All I can say is that we have done everything that is humanly possible, I think, to do in preparation for production without the actual production itself. But there have been questions raised about the suitability of this rifle for service use.

I would like before leaving here to ask the representatives of the Marine Corps once more if they think this rifle is at least reasonably suited for military use with certain reservations such as the trigger bolt. Would Colonel Edson and Captain Van Orden be good enough to give me a word on that?

Colonel EDSON. In the early part of my statement before the committee, I said that the Marine Corps had not yet adopted any semi-automatic rifle and that we would not adopt one until we had ourselves tested it and determined that it was suitable for our requirements. We cannot make the statement that the Johnson rifle would be suitable for military use until it has been put in production or a certain number made and the rifle turned over for field test. It would have to be submitted to a field test by the soldier, as Major Schlieker said, before we could find out whether the rifle would work or not. As I said before it has certain features which we are inclined to think are desirable; it cleans easily, the barrel can be taken out and cleaned easily which removes a great deal of the possibility that the chamber may become pitted and rusted in the field, resulting in extraction difficulties. I think the piece will fire reasonably well without lubrication or with very little lubrication. The other things I think I mentioned before, sir. However, a field test would undoubtedly disclose certain desirable modifications in the rifle as exhibited before this committee, some of which have been mentioned in the previous testimony of other witnesses.

The CHAIRMAN. Mr. Johnson, when you look over your remarks you can add any further points that you think ought to be emphasized.

Mr. JOHNSON. I thank you, sir; and I thank Colonel Edson. The point is: The Johnson rifle is believed worthy of issue to troops for tests.

Senator CHANDLER. Mr. Chairman, may I say one word before we go. I have appreciated very much the opportunity to hear the Army men discuss these features and I appreciate very much their attitude toward this rifle Captain Johnson has explained.

I haven't been here very long but I have noticed a feeling—I hope it doesn't exist—that the officers and men in the War Department are not inclined to take propositions that are submitted other than creations of somebody in the Department.

Gentlemen, I would like to say it exists, and I hope it isn't true to any great extent. They do complain, and I think probably have a right to complain that if some fellow works very hard on something that he thinks might be of value to the defense of the country that it ought at least to have a fair chance, and I am just urging in every instance—the chairman of our Military Affairs Committee is always so very careful to give everybody a chance to demonstrate, and he gives it, all the time. And I have observed that, and that is the reason I am anxious whenever I can to help take it off him, but he will agree with me there is a feeling they are not inclined to give them much consideration.

The CHAIRMAN. Some people say so, but I have always found the Army officers to be very considerate.

Senator CHANDLER. My own experience is you are, but I hope you will continue to be. It is hard work, and it is long hours, but in the long run the people of the United States ought to be encouraged, and you can't encourage them if when they come here you just say "No, we haven't got time."

Captain BROWN. I don't think we do that. We have given Captain Johnson several opportunities. And not only that, we are looking for a new rifle all the time. I just tested a new Browning semi-automatic last week at Aberdeen, and we are encouraging them to go ahead with that test because it seems from the looks of the rifle it may be better than either one of these, and we are giving them ample opportunities to go ahead and develop that rifle, and we are just in the same position on every one.

(There followed a discussion off the record.)

Colonel DREWRY. Mr. Chairman, may I say one word. Of all the small-arms weapons that we have in the service today not a single one of them was designed by an Ordnance officer or Ordnance personnel. Mr. Garand was hired as a civilian employee. All our automatic weapons were designed by Mr. Browning.

Senator CHANDLER. Is Mr. Browning an employee of the Government?

Colonel DREWRY. No, sir.

Senator CHANDLER. Is he an outside man?

Colonel DREWRY. He was an outside man. He is now deceased. Even the Springfield rifle wasn't a development of ours. We copied it from the Mauser, and we paid royalties on it.

Senator CHANDLER. I have no objection if you can make a better one than they can make.

Captain BROWN. Off the record.

(There followed a discussion off the record.)

Senator BROOKHART. I would like to ask why the Marine Corps hasn't adopted the M1.

Colonel EDSON. We have tested the M1 rifle and, at the present status of its development, we have decided not to adopt the M1 at this time. I might qualify that, the decision was reached not only on the accuracy of the present piece which we tried and which does

not have the new front end, but also because of the functional difficulties which we encountered in the field.

The CHAIRMAN. In other words, it was put out in the field with combat conditions and did not function, that is, the piece without the new front end?

Colonel EDSON. Yes. It would not function sufficiently well under conditions encountered in landing operations to warrant its adoption at this time as a satisfactory replacement for the Springfield rifle.

We will furnish you a copy of a restricted report entitled "Report on U. S. Rifle, Caliber .30, M1 (Garand Semiautomatic), Covering the Target Year 1939."

The CHAIRMAN. All right.

(The report referred to follows:)

HEADQUARTERS U. S. MARINE CORPS,
Washington, May 30, 1940.

Hon. MORRIS SHEPPARD.
United States Senate.

MY DEAR SENATOR SHEPPARD: In compliance with your written request of this date, there is furnished herewith a copy of a restricted report entitled "Report on U. S. Rifle, Caliber .30, M1 (Garand Semiautomatic) Covering the Target Year 1939."

Sincerely yours,

MERRITT A. EDSON,
Lieutenant Colonel, U. S. M. C.
for T. HOLCOMP,
Major General Commandant.

2000-40-50
AR-268-jc

ADJUTANT AND INSPECTOR'S DEPARTMENT,
May 9, 1940.

MEMORANDUM FOR THE MAJOR GENERAL COMMANDANT

Subject: Report on U. S. Caliber .30, M1 (Garand Semiautomatic) covering the target year 1939.

- References: (a) DP&P memo 6487, approved by MGC, dated 19 Nov. 38.
(b) Ltr MGC 2000-40-50, "Rifles, U. S. Cal. .30, M1, etc.", to CG, FMF, dated 28 Dec. 38.
(c) Annex "A", "Consolidated reports received from the service on the performance of U. S. Rifle, Cal. .30, M1, for the target year 1939."
(d) Ltr MGC 2000-40-50 AR-268-jc to CG, 2d MarBrig, FMF, dated 6 Oct. 39.

Enclosure: (1) Reference (c).

1. Reference (a) provided for the distribution of 400 rifles, U. S. caliber .30, M1, delivered to the Marine Corps in September and November, 1938, as follows:

- 300 to 2d Marine Brigade, FMF, MCB, San Diego, Calif.
- 35 to 1st Marine Brigade, FMF, MB, Quantico, Va.
- 35 to Basic School, MB, NYC, Phila., Pa.
- 10 to Marine Corps Schools, MB, Quantico, Va.
- 20 to Depot of Supplies, Phila., Pa.

2. The 300 rifles sent to the 2d Marine Brigade, FMF, were used to fully equip the rifle companies of the 1st Battalion, 6th Marines, with the U. S. rifle, caliber .30, M1, in lieu of the U. S. rifle, caliber, .30, M1903.

3. The 35 rifles issued to the 1st Marine Brigade, FMF, Quantico, were used to equip one platoon, 1st Battalion, 5th Marines.

4. The 35 rifles issued to the Basic School and the 10 rifles issued to the Marine Corps Schools were used for normal target practice of a limited number of officers attached to those organizations in lieu of the U. S. rifle, caliber .30, M1903, during the target year 1939.

5. Paragraph 8 of reference (b) directed that complete reports be made to the Major General Commandant on 30 June, 1939 and upon completion of the training year 1939, covering the results obtained in training with the M1 rifle. These reports have been briefed, paraphrased, and consolidated in Annex "A", enclosed herewith. It is believed that the following conclusions can be drawn from the various reports submitted under the following headings.

(a) *Total ammunition fired*

244,845 cartridges, ball, caliber .30, M1, were fired through the M1 rifle during the target year 1939. This total does not include ammunition expended in this rifle during the Culebra maneuvers participated in by the 1st Marine Brigade, FMF, during the early part of 1940 although extracts from a report submitted at the completion of such maneuvers are included in reference (c).

(b) *Rounds fired from each rifle*

353 individual rifles were fired throughout the year. The least number of rounds fired through any single rifle was 16 and the maximum 2,425, the average being 639.6 per rifle.

(c) *Class of stoppages, causes, and corrective measures for each rifle; and*

(d) *Malfunctions and broken parts for each rifle*

Because of the obvious difficulty of definitely determining the difference between a stoppage and a malfunction these two subparagraphs, included in the reports as required by reference (b), have been combined under one heading.

Throughout the reports there are repeated instances of "numerous" stoppages or malfunctions reported which were not specifically enumerated or listed to any individual rifle. One report specifically states that the stoppages and malfunctions reported therein occurred only during the record firing of 1 September, 1939, and does not include malfunctions which may have occurred during the preliminary firing. It can therefore be assumed that the stoppages and malfunctions included under reference (c) are incomplete.

There were, however, 131 stoppages, malfunctions, or broken parts definitely reported (disregarding gas cylinder plugs out of line, cracked stocks, etc.) which would result in the rifle being temporarily or permanently out of action in the field, or one (1) such stoppage or malfunction for every 1,869 rounds fired. 78 of the 353 rifles fired had some stoppage or malfunction which would have put the rifles temporarily or permanently out of action in the field. This is equivalent to 22.1 percent or one (1) out of every 4.5 rifles.

83 rifles were fired more than 1,000 rounds each. Of this number, 30 or 36.1 percent had one or more stoppages or malfunctions. Of the 270 rifles which were fired less than 1,000 rounds, 48 or 21.6 percent had one or more stoppages or malfunctions. It is impossible to determine from the reports at what point in the firing stoppages or malfunctions occurred. It would seem apparent, however, that defects in the piece may be expected to increase rather rapidly in proportion to the number of rounds fired.

In the hearings before the Subcommittee of the Committee on Appropriations, House of Representatives, on the Military Establishment Appropriation Bill for 1941, the following percentages of malfunctions with the M1 rifle were reported by an officer of the Ordnance Department, U. S. Army:

Test	Total rounds fired	Number of malfunctions	Percent malfunctions
Fort Benning, Ga. (September-November 1939), field test.	40,000	844, as follows: Failure to feed..... 651 Failure to extract..... 152 Failure to eject..... 39 Rounds jumped out..... 2 Total..... 844	2.22
Fort Riley, Kans. (November 1939), test of new front end by Cavalry Board.	7,405	53, as follows: Failure to feed..... 36 Rounds ejected with clip..... 7 Failure to extract..... 3 Defective round..... 2 Battered round (failed to feed)..... 2 Failure to feed due to foreign matter on cartridge case..... 2 Broken extractor..... 1 Total..... 53	.716
	1,440	Failure to feed..... 42	2.92

In the May 1940 issue of the American Rifleman, Mr. F. C. Ness of the National Rifle Association reported tests conducted by him on the M1 rifle during the month of April. On page 45 of that issue he reports as follows: "The total functional failures in 388 rounds of magazine fire were 28, for a malfunction percentage of 7.2 percent. We also had a number of other stoppages (23) such as refusal to accept clip, refusal to accept first cartridge, refusal of bolt to open, and failure to eject clips for a total of 51 in 692 rounds, or 7.3 percent."

Reports covered by reference (c) are favorable, therefore, as compared to the above reports. It is believed, however, that the ratio of malfunctions reported in reference (c) is extremely high for any rifle which is to be adopted as the standard infantry weapon. Attention is also invited to the fact that, with a single exception, all of the tests reported have been conducted under more or less ideal conditions, that is, on rifle or combat ranges in the continental limits of the United States where adequate facilities are available for care and cleaning and where the piece has not been subjected to the continued exposure to the elements and rough treatment which may be expected under combat conditions.

All reports stress the necessity for constant care, cleaning, and lubrication if the M1 rifle is to function properly. In some cases, rifles had to be cleaned and lubricated before the completion of a day's firing of the qualification course (90 rounds) because of malfunction. This is a distinct disadvantage for use in combat.

(e) Injuries caused by rifles, if any, to personnel

It may be concluded that with proper training injuries to personnel will occur no more frequently with the M1 rifle than with the M1903.

(f) Tabulation of the results of firing for experts, sharpshooters, marksmen, and unqualified personnel

Original qualification firing with the M-1 rifle prescribed classification scores for expert, sharpshooter, and marksman on the same percentage basis as are in effect for the M1903 rifle. Results obtained were so far below the average standard of the Marine Corps that such qualifications were disregarded and the classification scores were lowered an average of 3.8% below the standard for the M1903 rifle. Qualification percentages obtained with the reduced classification scores compare favorably with the M1903 rifle. The highest score recorded was 416 out of a possible 440, and the average qualification score for all firing was 354.8.

Attention is invited to the fact that a majority of the men fired the M1 rifle twice for record within a period of approximately four months. In spite of this fact there was no improvement in the average score obtained although it would normally be expected that the average score would show a considerable increase had the firing been conducted with the M1903 rifle.

(g) The results of musketry and combat firing tabulated and compared with similar firings done with the M1903 rifle and the Browning Automatic Rifle

In every instance except one the M1 rifle proved superior to the M1903 rifle in musketry and combat exercises when reduced to the common basis of the number of hits scored per round per minute.

(h) Accuracy of M1 rifle as compared with M1903 rifle and Browning Automatic Rifle

All reports which have compared the accuracy of the M1 rifle to the Browning Automatic Rifle are unanimous in their opinion that it is more accurate than the latter weapon. It appears definitely proved that the M1 rifle is less accurate than the M1903 at all ranges up to 600 yards, increasing from approximately 3.0% at 200 yards to approximately 11.0% at 600 yards. The average difference in accuracy over the qualification course A is 6.4%. No firing tests have been conducted at ranges over 600 yards.

(i) Suitability for use in bayonet combat

The M1 rifle appears to be suitable for bayonet combat.

(j) Simplicity of mechanical construction

The M1 rifle is simpler mechanically than the Browning Automatic Rifle. It is more complicated and slightly more time must be devoted to instruction with it than with the M1903 rifle. The M1 is a more difficult piece to clean than the M1903.

(k) Ease and simplicity in assembling and disassembling

The M1 rifle is easier to assemble and disassemble than the Browning Automatic Rifle. Field stripping can be learned about as readily as with the M1903 rifle. It would appear that approximately four (4) hours should be the average time allotted for instruction in nomenclature, functioning, assembling, and disassembling. One report states that proper maintenance and careful lubrication can be learned only through considerable experience and use.

(l) Suitability of sights

The construction of the M1 rifle in the hands of the Marine Corps is such that the front sight acts as a key between the gas cylinder assembly and barrel assembly and is held in place by only one screw. The gas cylinder plug tends to become loose on the barrel, which results in considerable movement of the front sight itself. It is believed that this defect will be eliminated in later models. All reports are unanimous in that the front sight blade is too wide. Considerable difficulty was experienced by movement of the rear sight in elevation during firing; elevation clicks are not uniform in spacing; and the rear sight is subject to damage unless it is fully housed except when being used. The rear sight housing tends to collect moisture which results in rust and eventual malfunction. The size of the rear sight aperture is favorable for combat firing although several reports indicate that the size can be reduced slightly without affecting its practicability for this purpose.

(m) Fatigue from firing the rifle

There is considerably less fatigue from firing the M1 rifle than is experienced with the M1903 or the Browning Automatic Rifle.

(n) Recommendations, if any, for corrections of mechanical deficiencies of the rifle

Reference (c) lists numerous recommendations in detail. The following recommended changes are actually being embodied in the M1 rifles now or shortly to be manufactured:

- (1) Redesign front-end assembly.
- (2) Improve the quality of the metal in the firing pin.
- (3) Provide a well in the butt stock to carry lubricant and essential spare parts.

It is believed that the following recommendations are worthy of further consideration:

- (1) Change front sight blade to .05 or .06 in width.
- (2) Reduce size of rear sight aperture slightly.
- (3) Improve the design of the rear sight.
- (4) Provide a better quality spring metal for clip ejector.
- (5) Improve the quality of metal and the fit of trigger pin.
- (6) Change the design and material in the front hand guards to prevent cracking.
- (7) Modify method of holding receiver group in stock to eliminate play which develops due to the wear on locking lugs.
- (8) Improve the type of chamber cleaning tool.

(o) Recommendations as to spare parts that should be furnished with each rifle

From the reports submitted it is believed that the following spare parts should be issued to and carried by each man armed with the M1 rifle:

- | | |
|------------------------------|--|
| 1 Firing pin. | 1 Pin, trigger. |
| 1 Ejector, cartridge. | 1 Extractor. |
| 1 Spring, cartridge ejector. | 1 Plunger and extractor spring assembly. |

Opinions regarding the spare parts to be issued for each 100 rifles are so divergent that it is considered no action should be taken until further experience with the rifle crystallizes the necessity for increasing the allowances prescribed by the Ordnance Department, U. S. Army.

(p) *Does the M1 rifle perform satisfactorily in the capacity intended, namely, as a replacement for the M1903 bolt action rifle*

There is a serious doubt as to the suitability of the M1 rifle in its present state of development as a replacement for the M1903 rifle because of: the number of malfunctions experienced, even under the satisfactory conditions under which the majority of these tests have been conducted; the fact that the rifle requires excessive care and lubrication to insure that it function properly; and the defects reported by the First Marine Brigade, FMF, as a result of the limited field test conducted at Culebra. This is especially true when one considers the type of service of the Marine Corps as a whole in small wars and landing operations.

(q) *Any other information of pertinent nature not covered above*

(1) Effective rate of fire is apparently from 16 to 20 shots per minute.

(2) Clips must be handled carefully to prevent rust, denting, or other damage which will cause malfunction.

(3) It is believed that salvaged clips can be used only a limited length of time and that most of the ammunition for the M1 rifle should be purchased already loaded in clips to obtain the best results. The reloading of clips is a slow process.

(4) The rifle must be field stripped for cleaning, which involves protection of several working parts from loss and dirt during the process.

(5) The bolt and receiver assembly becomes loose in the stock because of wear of the locking lugs.

6. All M1 rifles numbered serially from 3400 to 4100 (93% of those in the Marine Corps) were manufactured between the dates of August 26 and September 23, 1938. During the fall of 1939 a major modification of the rifle was effected by the Ordnance Department, U. S. Army, which changed the design of the barrel, gas cylinder and gas plug assemblies. The Marine Corps has two of these modified rifles undergoing test at the Marine Corps Base, San Diego, California (reference (d)). The result of these tests has not yet been reported. Mass production of the new design will be started at Springfield Armory about May 15, 1940.

7. The new design will eliminate the eccentricity of the axis of the bore and gas plug, and should eliminate the play in the front sight base, defects which were reported in reference (c). The accuracy of the rifle should be considerably improved by these changes in design. A limited number of minor modifications have also been incorporated in the weapon to improve its functional characteristics. Just what effect these changes will have on the accuracy and suitability of the rifle as a replacement for the M1903 rifle for combat purposes can be determined only by additional tests and experience. It can be stated, however, that the M1 rifle now or shortly to be manufactured is essentially a different weapon from that manufactured 18 months ago, and that further modifications can be expected as the necessity therefor becomes apparent.

8. It is recommended that a copy of this memorandum, together with the enclosure, be sent to the Commanding Officers of those organizations which have M1 rifles assigned to them, to the Depot Quartermaster, 1100 South Board Street, Philadelphia, Pa., to the Commanding Officer, Marine Corps Rifle and Pistol Team Detachment, and to the Bureau of Ordnance, U. S. Navy, for their information.

9. It is further recommended that a copy of this report, together with the enclosure, be forwarded to the Chief of Ordnance, U. S. Army, for his information.

E. A. OSTERMANN.

(Whereupon at 6:35 p. m. the hearing was closed.)

APPENDIX

JOHNSON AUTOMATICS, INC.,
Boston, Mass., June 3, 1940.

SECRETARY, SENATE MILITARY AFFAIRS COMMITTEE,
Washington, D. C.

DEAR SIR: In accordance with permission granted by the chairman, we have taken advantage of the opportunity so graciously afforded to extend our statements on the Johnson rifle hearings. Accordingly we return herewith the stenographic copy of the hearings which was furnished us for correction, and we include the following inserts, which include, as well as our own, the extension of statements of certain other witnesses with whom we have cooperated and who have cooperated with us in the preparation of the final composite statements for the record.

Respectfully yours,

JOHN BABCOCK HOWARD
(for Melvin M. Johnson, President).

COMMENT ON AUTOMATIC ACTIONS

Mr. JOHNSON. With reference to Captain Brown's conclusions concerning gas and recoil actions, I believe the committee would be interested in more specific data. The recoil operated Maxim machine gun was first introduced in 1888, rejected in the United States, and adopted by the British. The Colt gun was gas-operated but had no cylinder. The gas-operated Benet Mercie, United States model 1909, was discarded in 1916. The famous 1917 Browning machine gun is recoil-operated. All military automatic pistols, especially the Luger, Mauser, Colt, and Walther are recoil-operated. The Germans used the Maxim and similar machine gun actions in the World War. As I have already stated the M34 Nazi light machine gun is recoil-operated. The Nazis have two types of experimental gas-operated rifles not unlike the Garand and Winchester rifles, but have not put those rifles into service. Thus, the Nazis are not using gas-operated arms other than those acquired through aggression. The British, French, and Czech light machine guns are gas-operated. The British Bren has a special carbon-scraping device. Those weapons weigh about 20 pounds. I doubt that any short-recoil residual-pressure actuated automatic or semiautomatic rifle has ever been successfully demonstrated, excepting the Johnson which the Ordnance Department states functioned satisfactorily at Aberdeen. I regret I cannot concur with Captain Brown's opinion as to the similarity of other recoil actions to the Johnson action. I concur with the remarks of the Hon. Smith W. Brookhart as to the similarity between the Lewis and Garand actions, though I consider such comparisons academic at this time.

The late Mr. White had a toggle-block type of short recoil action. There was also the Bommarito, I recall. None had the Johnson type of rotary bolt and cam system.

BALANCE OF JOHNSON RIFLE

Mr. JOHNSON. With reference to the infantry's criticism of the balance of the Johnson rifle, I wish to point out that many authorities are not in accord with the criticism of the balance. For example, I cite an article in the December American Rifleman by F. C. Ness who states, in part:

"All I can say about the balance and handling qualities of this model (Johnson) is that those samples which I tried handled like 12-gauge duck guns."

This indicates that the Johnson rifle is regarded as extremely well-balanced by at least one eminent, well-regarded and critical authority of national reputation on shoulder weapons.

[Reprinted from the American Rifleman, December 1939]

THE AMERICAN RIFLEMAN REPORTS ITS TESTS WITH THE ROTARY JOHNSON SEMIAUTOMATIC MILITARY RIFLE

DOPE BAG

Conducted by F. C. Ness

Rotary-Johnson semiautomatic military model has a 10-shot magazine which may be loaded with standard 5-round Service clips or single cartridges or both and with the chamber loaded or empty, bolt open or closed. It looked abortive to me with that tin-can belly and my eyes were not pleased by the hump it put in the forestock. However, after carrying it, conveniently and comfortably, in the Maine woods and shooting it from a canoe and on the beach, I have developed a lot of respect for that rotary magazine. In changing my mind I had to overcome an established prejudice in favor of the vertical box-magazine, especially the 3-shot clip, for sporting use. This military model had a 22-inch barrel of Winchester make with bayonet lugs under its muzzle. The wood-handle bayonet was easily removed and replaced by pressing the catch and sliding it off or on. All Johnson rifles fired with this barrel performed as well with or without the bayonet. The only difference I could appreciate was a change in impact, the groups landing from 5 to 7 inches higher at 100 yards with the bayonet attached. This required about one notch lower elevation of the rear sight at that range.

We tried a combat problem by having Bob Stein drop from his boat three 5-gallon cans on the wind-lashed lake about 600 yards offshore. These drifted to some 1,200 yards while we fired at them with two Rotary-Johnsons and F. A. 1938 M1 Service ammunition. We sank two of them and picked up the third one with the boat. It had two bullet holes, but had failed to sink. I personally fired fifty rounds at each of these cans and found I had to continually raise the sight or hold over because they drifted away rapidly in that high wind. It did not take long to fire a couple of hundred rounds of clip-loaded ammunition in that Rotary-Johnson rifle, because there were no hitches or delays.

Like many others, I suppose, I had believed the Rotary-Johnson to be as awkward in handling as it was ungainly in appearance. Direct experience soon dispelled that initial impression. All I can say about the balance and handling qualities of this model is that those samples which I tried handled like 12-gauge duck guns. I had done very little shooting on flying targets for years; none since that potato bursting at Jim Beloungy's hunting camp in the Big Smokies last fall when I used my .30-'06 Mauser on self-thrown targets. With the Rotary-Johnson on the beach of Moosehead Lake last week I made straight runs on rocks thrown by myself, and a few of these were tossed forward not much more than shoulder high as Andy Sorenson had taught me.

On this occasion Mel showed me a new stunt, in which he fired under a milk can on the water and then drilled it with his second shot as it popped up into the air. We had very few misses. I can remember only a single miss and I made up for that by firing twice at one can and hitting it both times. I think that speaks well for the handling qualities of these rifles. Mel used the 24-inch .270 Winchester barrel in one Rotary-Johnson while I used a 20-inch Springfield barrel (No. K7) in another Rotary-Johnson for this shooting.

So far I had experienced or witnessed no malfunctions or stoppages of any kind. Since this trip was in the nature of a Service test, with woods use in the rain included, no cleaning was permitted. Still those expected stoppages failed to occur. Mel gave me some F. A. 1934 ammunition (Lot 1740) which was said to be loaded in soft-brass cases, and I finally succeeded in getting one of these soft cases to cause incomplete ejection by holding the arm very loosely in my hands and firing from the hip. This was easily cleared by pulling the bolt knob back and letting it go. I used a couple bandoliers of this same lot in my aerial shooting. I also used it in hip-shooting, and fired one rapid-fire group with it on the reduced "D" target at 100 yards. This 10-shot group measured 4.25 inches with 8 shots in 2.56 inches. While on that trip I fired about 1,200 shots with different Rotary-Johnson rifles and witnessed at least 2,000 additional shots with them. That included commercial and arsenal ammunition (F. A. 1938 M1 and F. A. 1938 M2) and the only .30-'06 stoppage was that single F. A. 1934 case mentioned above.

From prone rest Mel did some shooting with and without bayonet which I witnessed. I was then satisfied there was no difference in accuracy attributable to the fixed bayonet. However, I fired it both ways to check this and found no

cause to change my opinion. I fired from an improvised table rest. All of this test was conducted with Rotary-Johnson, No. R11 and the 22-inch, bayonet barrel, No. 300. We used Remington 172-grain tapered-heel ammunition in 5-shot groups at about 100 yards. In the listed results of this test my shooting is represented by the last two lines. All bayonet-test groups which were fired follow (relative impacts with bayonet are given in inches in the third column):

Without	With	Impact
<i>Inches</i> 3.00	<i>Inches</i> 3.00	7 inches higher.
-----	2.25	
2.50	3.25	5½ inches higher.
2.75	1.75	6 inches higher.
2.38	2.62	7 inches higher.
1.31	3.25	7 inches higher.
2.88	2.75	7 inches higher.

I also tried the effect of resting the muzzle on the hard, bare, unpadding edge of a wooden ammunition box, directly underneath the front sight. The only other support was my left hand under the toe of the buttstock. The group was normal, or 3.25 inches, and the relative impact was 5 inches high. My next group was 4.50 inches with 4 in 1.38 inches. Mel's group was 4.25 inches with 4 in 2.38 inches, but his relative impact was 6¼ inches high. Resting the movable barrel on a hard boat-cushion and holding the same way, my groups were 4.38 and 2.88 inches, and the relative impact, 3½ inches high. I shot four groups with tight sling. Two with left hand extended measured 4.75 and 3.00 inches. Two with my left hand back on the magazine hump were 3.38 and 2.75 inches. The impacts were the same. Because the barrel was metal fouled I did not consider it an accuracy test. Days earlier, I fired my first two groups, without sling; one just under 2 inches, the other, 2.25 inches with 4 shots in 1.19 inches. The smaller group had 4 shots in 1.25 inches. All the shooting above was from prone position.

I also did some shooting on blank cards, getting groups of 3.25 and 3.38 inches. One with F. A. M1 1938 loads on a 13-inch "D" target measured 2.81 inches. Another with F. A. M2 1938 ammunition on the 6-inch standard full measured 2.56 inches. I also fired 10 shots with Remington loads into 3.13 inches while zeroing and moving the windage screw 3 clicks. Each click equals ½ inch at 100 yards. A group with the sling tight and the barrel rested measured 3.5 inches. We noted that the zero was the same at 100 yards for the M2 150-grain load as for the Remington 172-grain load. Mel got groups of 3.5 and 2.13 inches with the latter and of 3.13 inches with the former.

We did some shooting for elevations. With rear sight down on the receiver flat my group was 3 inches below aim (7 shots in 2.13 inches). With the sight in the little notch on the sight elevator my group was 2¼ inches higher or ¼ inch below aim (7 shots in 1.75 inches). With the sight in the first big notch my group was 5 inches above aim (7 shots in 1.95 inches). Mel continued this test, landing 5 inches above aim, as I had done, with the first big notch; 9 inches high with the second notch and 15 inches above aim with the third notch of the rear-sight elevator. His 5-shot groups were very good, being, 2.56, 2.19 and 2.81 inches, respectively.

After leaving our deer-hunting camp at Holeb we went to Camp Ogontz on Moosehead Lake, where we did all the investigative shooting already mentioned. On the first day there, I conducted an accuracy test under uniform conditions of the Rotary-Johnson No. R-14 equipped with barrel No. 19-W and combat sights. The shooting was done from an improvised table rest through a window in the main camp. Because there was snow on the ground a cold draft came through the window, introducing a very annoying mirage complication which leads me to believe I could greatly better the results on my own bench rest with better sights, etc. However, the 100-yard groups, obtained under the conditions we had to accept, were very good and for a semi-automatic combat rifle require no apology. In this shooting I used no sight blackening and fired fast from the rotary magazine to test the functioning at the same time. I aimed at 5½-inch pistol bulls and used Remington, 172-grain, tapered-heel ammunition.

I first fired two 5-shot groups from prone rest and then improvised the table rest from which I fired nine additional 5-shot groups and two 10-shot groups. The latter were 3.06 and 2.13 inches, center to center, with an average of 2.60 inches. The 5-shot groups ran in order as follows: 1.68, 1.62, 2.43, 2.62, 2.81, 0.75, 2.25, 2.00 and 1.68 inches, for an eleven-group (55-shot) average of 2 inches. The last

group duplicated the first group. The biggest group was just over 2¼ inches and the smallest, exactly ¼ inch. In comparison, I fired a 10-shot group with the Springfield Sporter and its superior sights gave me 2.13 inches, which equalled my best 10-shot group with the Rotary-Johnson. I have an idea that these .30-'06 rifles will do proportionately better at longer ranges, and I would like to try one with a scope sight from bench rest at 200 yards.

After several days of rapid-fire shooting, metallic fouling accumulated and we got the bigger groups first mentioned in this article. The same rifle and barrel used in the accuracy test was fired 100 rounds slow-fire and 250 rounds rapid-fire with 1927 F. A. M1 ammunition (Lot 1011) and thereby developed fouling at breech and muzzle. To see what this had done to its grouping ability I went back to the table rest and fired three 5-shot groups. These ran 2.62, 3.06 and 2.75 inches, for an average of 2.80 inches.

Unfortunately the .270 Winchester barrel was fired a great many times before I got a crack at it, and I found it was metal-fouled and slightly ringed at the muzzle. Mel had some good groups with it in the R-11 rifle, using several commercial hunting loads of 130-grain bullet weight. These ran 2.13 and 2.43 inches for Western Super-X, 2.43 inches for W. R. A. Super Speed and 3.32 inches for Remington Kleanbore. My own two check groups at the time were fired with Super-X and measured 2.62 and 1.88 inches. The next day I used this barrel in the R-14 rifle and fired 10-shot groups with different .270 Winchester loads. The same Kleanbore load put 9 shots in 2.25 inches and all 10 in 3.50 inches. An older lot of Kleanbore made 3.06 inches with 7 in 1.88 inches. Winchester 150-grain soft-point put its 10 shots into 2.62 inches and W. R. A. 130-grain F. M. J. made 2.75 inches for its ten shots. Under the conditions of cold, darkness, mirage and makeshift rests I think the 10-shot average of 2.98 inches was very satisfactory. The 5-shot average was 2.47 inches with all loads, or 2.30 inches without the unfavorable K-B load.

Remember these are not target rifles, varmint rifles or National Match military rifles, but military and sporting rifles intended for combat or big-game with ten quick shots at the disposal of the shooter. On the cold, dark evening of October 29, Mel gave us a rapid-fire demonstration shooting from an unlighted porch floor into a strip of moonlight on Moosehead Lake. He used the 22-inch bayonet barrel in Rotary-Johnson No. R11. Because of cold, fatigue and darkness there was some fumbling, and he failed to equal his average time in this demonstration. My own timing and my own observations are given below.

With 10 rounds in the rifle and 10 loaded clips beside him, he fired 60 aimed rounds in 70 seconds. With 10 in the magazine and starting on my signal he averaged 10 shots in 2 seconds. With 10 in the magazine and 10 rounds loaded singly he averaged 30 seconds for 20 shots. With one in the chamber and 19 rounds loaded singly, he fired 20 shots in 38½ seconds. Then he used up all odd .30-'06 cartridges remaining on the porch by firing six fast 10-shot strings without timing. We had fired 500 rounds in that rifle before evening and 350 rounds previously on this trip, all without cleaning or oiling. There were no malfunctions or stoppages. The .270 Winchester barrel was inserted after these 200 rounds had been fired, and I fired fast 10-shot strings from the hip into the water. There were no .270W malfunctions.

[From The American Rifleman, November 1939]

DOPE BAG

Conducted by F. C. Ness

Semi-Automatic Accuracy.—I was much interested in the rapid-fire shooting of the M1 (Garand) rifle by the Advanced School at Camp Perry. Judging merely from casual observation, the line of shooters rushed forward about 20 yards as the 200-yard targets appeared and then fired two 8-shot clips from prone position with M2 (150-grain) ammunition while the targets were exposed, a matter of about 70 or 75 seconds.

I notice a lot of 5's were scored on the 10-inch bull and also a few 4's and an occasional 3. However, the outside shots were usually very bad, as I saw many red flags signalling complete misses. There were a few hitches in gun operation

noticeable from my observation position, and I was unable to determine whether these were failures to feed, to extract or eject, magazine jams or malfunctions of other nature.

We also witnessed some shooting on the same 200-yard range with a pair of Johnson Semi-Automatic rifles brought to camp by G. Whitney, Jr. One was a rotary-magazine model which took standard Service clips of five cartridges or single cartridges at the loader's will and with the bolt open or closed. The other was a box-magazine model. Gunner W. Mitchell of the Coast Guard team shot both rifles rapid-fire with M1 (173-grain) ammunition. It seemed that the Johnson recoil jarred the shooter less than had the Garand recoil, previously observed, when I had noticed caps and hats falling from heads jerked by the Garand and shooters' hair lifting after each shot.

First, Mitchell fired both Johnson rifles from prone with sling and got 20 straight 5's. Then he fired both rapid fire and scored 49 x 50 with each. Watching through our R. & L. scope, I saw one group was very small, but it was placed too near the edge of the bull, at 3 o'clock, and the one shot missed the edge of the black. This was followed by some demonstration bursts, rapid fire. In all the shooting I noticed two failures to feed which were quickly cleared by slamming the bolt to closed position. One of these was the 8th shot in a 10-shot string and the other was the 3rd shot in a 5-shot string. Later I learned this rifle was known to have been assembled with a defective catch-spring which accounted for the two failures. It did not appear to be very defective to me, as I noticed no further trouble.

When we fired this same rifle we noticed it had only battle sights. The front sight was O. K. but the rear aperture was too large for fine target shooting. Also it was shooting low-left for me and I had to hold off about 6 inches. However, it was easy to stay in the bottom of that big bull once I had found just where to hold. It had a fine pull, mild recoil and was very pleasant to hold and shoot. In fact, it was one of the best .30-caliber rifles I have tried in prone position, better than the M1903 Springfield. In these Johnson Semi-Automatics we all used M1 (173-grain) ammunition exclusively.

Over longer ranges, the Johnson rifles did themselves proud at Wakefield, Mass., this year. Following the thousand-yard shooting previously mentioned in the Dope Bag, the Johnsons were put through the M. C. semi-automatic rifle course originally prepared for the M1 (Garand) rifle. This course is comprised of four 10-shot scores slow-fire, at 200, 300, 500 and 600 yards and of three 16-shot scores rapid-fire, at 200, 300, and 500 yards. The total possible is 440 points. The qualification scores were 396 for "expert," 378 for "sharpshooter," and 357-plus for "marksman." We understand that no one has qualified as expert with the Garand over this course and that the requirement has been lowered since as a consequence.

Two Marine privates (Welch and Pongonis) fired the Johnson Semi-Automatic rifles over this course. They had previously qualified as "sharpshooters" with the M1903 Springfield rifle. Now with the Johnson (Rotary No. 2) one of them made 394, missing the elusive expert-rating by 2 points. The other made 393 x 440 including a 47 x 50 at 600 yards. Lt. Fisher tried the Johnson (V-8) over this course and made 406, which is 10 points over "expert," including a possible at 600 yards with 14 straight bullseyes at that range. Captain VanOrden also tried this same Johnson and scored 408 x 440, which is 12 points above the previously unattainable "expert" requirement. Two days later the same two privates tried the course again with the Johnson rifle and both made "expert" with scores of 398 (Welch) and 401 (Pongonis). Lt. Fisher qualified as expert again, with 401 x 440 this time, and Capt. Mel Johnson, the inventor, did it also with 405 x 440 over the same course. Johnson and Welch used the No. R2 Johnson while Fisher and Pongonis used Johnson rifle No. V5. F. A., 1938, M1 (173-grain) ammunition was used.

During some rapid-fire shooting on the "D" target at 200 yards, an indication of the fine accuracy of the Johnson rifle was obtained by Corporal Charles J. Eusey, U. S. M. C. His 5 shots in 5 seconds all struck well inside the area of a spotter and were circled and measured in the pit. It proved to be an inch group. This Johnson (V-10) had a Winchester M70 barrel (No. 6). The group was low in the "head" of the "D" target. The ammunition was N. M. 1939. During the rapid-fire accuracy tests and demonstrations with various Johnson rifles, all equipped with Winchester barrels, other group sizes were obtained at 200 yards;

all with F. A. 1938 ammunition. The groups, spotted and measured by the pit-scorer, were as follows:

Shots	Time	Size	Rifle
	<i>Seconds</i>	<i>Inches</i>	
5	5	12	R-2
5	8	2	V-5
5	5	8	R-2
10	18	11	R-2
5	6	5½	V-5
5	9	5	V-5
5	9	5½	V-5
10	30	8	V-5

There was also a 6-inch 5-shot group in 10 seconds with M2 (150-grain) ammunition, and at 600 yards at 25-inch 10-shot group in 50 seconds with F. A. 1938: ammunition. This shooting was done by four different shooters.

[From the American Rifleman]

DOPE BAG

Conducted by F. C. Ness

M1 (GARAND SEMIAUTOMATIC) RIFLE

At long last we have caught up with a working sample of this generously publicized product¹ of our War Department, officially adopted way back in 1936 as our new Service rifle. About 25,000² had been made by January 1940³ and present production is said to be 4,000 per month. On the basis of 250 working days per year that is still considerably short of the daily-production goal. Simple arithmetic tells us that to arm a million men in an emergency we would have to make 4,000 rifles per day, instead of per month, and even then after a year's production at this greatly accelerated rate we would have no surplus.

The M1 is a fine combat rifle with certain shortcomings outside the serious and admitted low rate of productability as revealed by its record. The development of the Garand rifle has progressed slowly since the first Aberdeen competitive test of it was instituted back in 1929.⁴ The conception of such a semiautomatic Service rifle dates back another decade at least, well-formulated lists of the requirements for such an arm having been published by the Ordnance Department in 1921⁵ prior to the competitive tests of semiautomatic rifles scheduled for September 15, 1921. It is interesting to note that the M1 semiautomatic rifle does not conform with those earlier requirements, nor, indeed, with those of 1929. Some of these requirements, considerably modified, were reviewed by Major Drewry in the requested official story of the M1 Garand which we published in *THE AMERICAN RIFLEMAN* of August, 1938.

Development of the Garand rifle continues. The most important change recently instituted was elimination of the muzzle coupling containing the gas port. This pierced section will be an integral part of the barrel in future M1 rifles including the 65,000 now being made under contract by the Winchester Repeating Arms Co. Since none of these is as yet available, the one we tested, of course, had the muzzle coupling as a separate part. This part bears the front sight as well as the bayonet lugs. Having no bayonet we could not test that feature, or its effect on the zero of the rifle. However, we noticed some play in the front sight base which we hope will be corrected.

Being a gas-operated rifle, a port is necessary somewhere in the barrel for utilizing combustion gases. In the M1 this is at the muzzle, the port leading into a gas cylinder or tube under the muzzle where the high-velocity gas impinges smartly on the piston end of a long operating rod. This rod is offset from a straight course until its cam contacts the operating lug on the bolt and pushes it upward so that the locking lugs are rotated counterclockwise to unlock the

¹ The M1 rifle was most prominently advertised in *Colliers Weekly* and *Life* magazines among others. It was also put on display at sport shows, etc.

² On February 16 there were 28,088 Garand rifles on hand and 141,201 on order, according to Gen. Marshall as quoted in the *Washington Post* of April 7, 1940.

³ Congressional Record, January 1940.

⁴ Army Ordnance, May-June 1929.

⁵ Army Ordnance, March-April 1921.

action, after the bullet has cleared the muzzle. This delay in unlocking, or initial free travel of the operating rod, is accomplished by a straight recess, over $\frac{1}{4}$ inch long, to clear the operating lug before the cam contact is made. The rather smart smack of this sudden cam contact, mitigated somewhat by the compression of the recoil spring around the operating rod, tends to burr the camming surfaces after some little use. Also, unfortunately, the gas cylinder and long operating rod increase the vulnerability of the arm to wartime abuses.

The two locking lugs on the end of the bolt are remindful of those of the Military Model-1905, Ross, straight-pull rifle,⁶ which encountered considerable operating trouble in the trenches of World War No. 1. Unless the M1 lugs are kept lubricated they are sometimes hard to start when the action is manually opened. We had to kick it open on one occasion. However, so far⁷ it has never failed to open automatically, although this sample M1 is fairly dry as far as lubrication is concerned. The lugs and the short extractor in its slot in the head of the bolt are visible from above and exposed to water, mud spray, sand and dust and other debris which may be thrown over them by rain or wind or exploding shells, bombs and grenades. The balance of the action is incompletely covered when closed. The exposed vulnerable parts at least should be protected, by some adequate cover or redesign of the receiver.

The barrel and operating rod are almost completely covered by wood. Below the lower band the hand guard around the barrel is open on the bottom exposing the gas cylinder. The piston practically clears the end of this cylinder on its rearward stroke allowing gas to escape outside, which gas blows forward covering this part of the rifle with carbon soot. Red hot particles of carbon blow back, presumably along the operating rod and upwards through the action and so into the shooter's face when the bolt comes back. We could see these sparks when shooting from the darkened interior of our shooting house and occasionally felt them sting our chins, cheeks and foreheads.

M1 NEEDS COOLING

All the wood around the comparatively thin barrel of the M1 rifle makes it a poorly ventilated rifle for rapid-fire shooting. It can be fired nearly three times as fast as the M1903 or M1917 rifles which, paradoxically, are as well equipped for heat control. The Springfield can be fired 15 shot per minute, but when a bandolier (60 rounds) of M1 ammunition (172-grain bullet) is fired in 4 minutes, even on a bitterly cold day, the oil boils out of the hand guards and the wood becomes too hot to hold with bare hands. When we fired the M1 very slowly, loading each cartridge into the chamber by hand, the oil started to bubble out of the wood in tiny specks after 40 shots to 60 shots fired in 25 to 35 minutes. This accumulative heating effect indicates the wooden covering of the M1 rifle tends to hold in the heat generated by firing. The M1 muzzle was to our micrometer .07 inch thinner than that of the 8 $\frac{1}{4}$ -pound M1903 although the M1 rifle weighed, without sling or bayonet, 9 $\frac{1}{2}$ pounds on the same scales. Since a rate of fire of 40 shots per minute is claimed for the Garand, 160 shots could be fired in the same 4-minute period mentioned above, and some cooling device would be indicated as essential for the M1 rifle. Reasoning reminds us that a thin barrel heats quickly and that an insulated barrel cools slowly.

Last Fall we handled the thermometer during a demonstration of Artist Mole's Barrel-Cooling Device on the M1903 rifle at Camp Simms. Basically, this was a ventilating hole through the barrel, at the bullet-seat, with a fluted tension plug so controlled that as the bullet left the barrel a draft of cooling air followed it through the bore. On a 4-minute shooting test there was a registered temperature of 140 degrees at the muzzle of that rifle, while the one without benefit of Mole's device stuck the indicator at the limit of the dial which was 212 degrees. Such a barrel-cooling device might not be practicable for the Garand rifle which, however, should be better ventilated than its present wooden cover allows, or given a heavier barrel.

The M1 Garand breaks down beautifully into three major groups. Pull out the trigger-guard and hammer-group assembly, bump loose the stock assembly and the barrel-receiver-and-action assembly is left. About all this does is expose the operating rod and the hammer group for casual cleaning. The barrel cannot be removed from the receiver, these two parts being inseparable and representing about a third of the entire cost. It should be kept in mind that a barrel will wear out at least twice as fast on a semiautomatic as on a bolt-action rifle.

⁶ Both locking lugs of the M1905 Ross are bevelled and consequently they operate more smoothly and easily.

⁷ After less than 400 rounds total firing which included less than 100 clip-loaded rounds.

The barrel cannot be cleaned from the breech; nor with water without endangering the gas cylinder and action. The carbon, however, can be mechanically cleaned out of the front parts when clogged, after removing the gas-cylinder plug.

SIGHTS FINE FOR AIMING

The sights on the M1 at normal adjustment are better for aiming than those of the M1903 rifle. In fact, they are as good as those of the M1917 in this respect, and the rear sight is more conveniently and completely adjustable, that on the M1917 having no windage adjustment, but the M1917 has a longer sighting radius. The barrel of the M1917 rifle is 26 inches long; that of the M1 being just under 22½ inches with a sighting radius of about 27½ inches. Like the M1917 receiver sight, that of the M1 is on top of the receiver, near the eye, and it has a large aperture. The loose and mechanically poor rear sight of the M1 is micrometer controlled in minute-of-angle clicks for both elevation (on the left side) and windage (on the right). At elevations above 600 yards the aperture tilts backwards toward the eye until it is presented at an angle which destroys the symmetry of the aperture and handicaps aiming. The adjustment has a screw-driver lock which failed to hold for us under the recoil of rapid fire at 200 yards. At 600 yards it failed to maintain its elevation, giving vertical groups. We started at 600 yards with a normal 13-click addition to the 200-yard elevation and finished with 24 clicks, which is 200% of the normal requirement. Although the ratchet may have slipped as much as a cog we are forced to believe the M1 barrel changed its zero six feet in shooting 130 rounds.

M1 CLIP EASILY LOADED

The M1 is easily loaded with its special U-shaped, pressed-steel clip of 8 rounds. The bolt stays open, held by a notch in the right side of the receiver, when the clip is pressed, straight down through the top of the receiver opening, to the bottom of its seat. I have seen this done in three seconds, but this loading time can be beaten by the Springfield's 5-shot clip. For me the two rifles are made equal in loading time only when I use two thumbs on the M1 clip. An automatic shift in the clip bearing makes it immaterial whether the cartridges are started on the right or left side of the clip. We had but one clip and reloaded this for our magazine fire. This was easily and quickly done. A partially filled clip could be loaded into the rifle, or the clip could be partially expended of its rounds and reloaded while it remained in the rifle, but this is not recommended because it cannot be done without some little difficulty. It is practicable rather than practical.

Because we had only one clip, most of our shooting was done a la single shot. That is, we put each round directly into the chamber with our fingers and slammed the bolt home upon it. The rate of carefully aimed fire by this method was 10 shots in three to five minutes. Twice the bolt failed to close completely and, since it will not fire while the lugs are incompletely locked, two misfires resulted, which of course was no fault of the rifle. However, the one-finger hook which serves as the bolt handle did not provide sufficient purchase for the grasp to clear one of these two rounds, and this inadequate handle had to be kicked smartly (we stamped on it) to start the lugs from their seats. This, of course, can be directly charged to the design and it may be accounted for by insufficient lubrication on the lugs.

The extractor never failed to work in shooting nearly 400 rounds. This shooting included 84 rounds of commercial ammunition, 49 handloads, 236 rounds of heavy or M1 type of loads and 87 rounds of light or M2 type of ammunition. The action failed to open completely only twice, resulting in a failure to eject each time. Both failures were easily cleared. One of these failures was with our lightest hand load (about 23,000 pounds pressure) and the other with our heaviest hand load in a heated chamber (pressure probably above 60,000 pounds). We had no further failures with hand loads and none of the kind with factory-made ammunition. One of our hand loads had a 93-grain Luger pistol bullet at about 3400 f.-s. This load ejected without fail and its bullets consistently hit a 4-inch circle at 100 yards. In the short M1 barrel this load (59.0 grains of I. M. R. No. 1147) gave a terrific muzzle blast, varying from red to yellow.

After firing 394 rounds, only 96 of which were fired from the magazine, the 395th and 396th rounds failed to feed from the clip. These were easily cleared, and the next two fed and ejected. At that time the bore had been cleaned twice, but no other part had been wiped or cleaned or oiled or greased. The

action now seemed to be more sluggish than formerly and, according to the manual of operation, the rifle was due for some decarbonizing treatment. This can be done in a few minutes by removing a screw and the gas-cylinder cover at the muzzle and then scraping the accumulation free with the screw driver. We removed only loose carbon.

This M1 rifle had a fine trigger pull, and balance. From the standing position it seemed equal to the M1903 and M1917 rifles. Its accuracy was slightly better at 100 yards, its four 10-shot groups averaging 3.50 inches against 4.72 inches for three groups with the M1917 rifle and 4.21 inches for two groups with the M1903 rifle as issued. With the different hand loads at 100 yards the five groups averaged 5.00 inches in the M1 rifle. With M1 ammunition, the lone 8-shot group from the magazine measured 4.15 inches and the three 5-shot groups ran, 4.25, 1.90, and 1.87 inches at 100 yards. No M2 ammunition was fired at 100 yards in our test.

At 200 yards the M1 rifle averaged 9.10 inches with 79 shots of M1-type loads. The best 10-shot group was with F. A. 1931 ammunition, which made 6.25 inches and also one group of 7.80 inches. The next best was 8.26 inches made with R. A. 172-grain Tapered Heel Kleanbore. The poorest 10-shot groups were with R. A. 180-grain, 13.27 inches; F. A. 1939 National Match, 10.84 inches; and F. A. 1931, 9.58 inches. Only 5 shots were fired with M2 150-grain Service loads, and these made a group of 6.24 inches at 200 yards.

M1 RECOIL SEEMS MILD

The recoil of the M1 rifle with M1 loads was not severe. It seemed softer than that of the M1903 rifle with the same ammunition. It was found that the recoil did not disturb the aim unduly so that it was easy to get back on the target for the next shot. We fired six 8-shot groups rapid fire on the small-bore Decimal target (4-inch 10-ring) at 200 yards using an arbitrary zero without change for two shooters and three different loads. These loads were old 150-grain Remington, old 1922 National Match, and 1932 National Match. Our time per 8-shot string ran: 18, 19, 17½, 17, 16, and 15 seconds. Our groups were: 14.94, 12.07, 10.31, 9.10, 13.88, and 8.44 inches, for an average of 11.46 inches.

Although our zero was too high the direct scores on the Decimal target ran: 60, 64, 68, 64, 66, and 76 X 80 for a total of 396 X 480, which would have been 219 X 240 on the "A" target, or very good on the rapid-fire "D" target. Later we tried one string of 8 shots (F. A. 1937) rapid fire on the "B" target at 600 yards and got a 27-inch group which was too low in impact to score well. We also fired 8 rounds of very old W. R. A. 220-grain Soft-Point ammunition into the ground very fast from the hip. All the above rapid fire (56 rounds) functioned perfectly without any hitch whatsoever in the M1 rifle. In addition we fired a total of 40 rounds slow fire through the magazine of this same M1 rifle and had the two failures to feed already mentioned.

SLOW FIRE AT 600 YARDS

At 600 yards, on a bright, cool, windy afternoon (2-minute to 4-minute wind) the writer fired, for comparison purposes, two 9-shot groups with the same M1903 rifle which was used at 100 yards. With F. A. 1933 M1 ammunition the group measured 27.13 inches with 7 in 21.75 inches and an extreme vertical of 23.13 inches. With F. A. 1939 M2 ammunition the group measured 21.00 inches with 7 in 17.00 inches and an extreme vertical of 20.50 inches. The M1903 sight base is 5 inches shorter than that of the M1 and its poorer aperture is 3½ inches farther from the eye.

In direct comparison the M1 rifle made 10-shot groups of 27.25 and 28.75 inches with the M1 (F. A. 1933) load and extreme verticals of 26.88 and 27.25 inches. The first group had 9 in 22.00 inches and the other, 7 shots in 21.00 inches. The M2 load in the M1 rifle made a 10-shot group of 26.63 inches with 7 in 16.50 inches and an extreme vertical of 19.75 inches. The other group (9 shots) with M2 ammunition was greatly enlarged by a sudden change in the wind from the right side of the 4 ring to the left side of the bull. This group had an extreme vertical of only 19.00 inches, but a total spread of 37 inches. The mean spread was 29.91 inches for the M1 against 24.07 for the M1903.

The grand average for all eleven groups, fired with the M1 rifle at 600 yards, was 28.29 inches with 73% of all shots in an average spread of 17.36 inches. The mean of the extreme horizontals was 21.47 inches and of the extreme verticals,

22.71 inches. The smallest group was 18.00 inches which scored direct 47 X 50. The complete results follow:

600 yards (slow fire)

Load	Type	Group	Extreme Horizontal	Extreme Vertical
F. A. 1931.....	M1	27.38	26.63	11.00
Do.....	M1	34.75	20.50	34.75
N. M. 1932.....	M1	28.38	16.13	39.00
Do.....	M1	35.75	31.50	25.50
R. A. 172.....	M1	23.00	18.50	19.00
Do.....	M1	18.00	10.00	17.00
W. R. A. 180.....	S. P.	22.25	22.00	7.00
N. M. 1939.....	M1	22.25	19.25	20.63
F. A. 1939.....	M2	37.00	36.00	19.00
Do.....	M2	26.63	23.75	19.75
F. A. 1933.....	M1	27.25	18.63	26.88
Do.....	M1	28.75	15.25	27.25

¹ Are 9-shot groups.

² This one scored direct 47 X 50 with seven bulls and four V's.

³ Only 7 shots and not included in averages.

⁴ This group was enlarged by a sudden change in the wind condition in the middle of the string.

Obviously the milder M2 ammunition functions better in any semiautomatic rifle and gives lighter recoil in any rifles as compared with M1 ammunition. In the M1 rifle the M2 ammunition also is less damaging to the mechanism, particularly as regards burring of the smartly engaged cams, and it will not, of course, heat the thin and wood-insulated M1 barrel as quickly as will M1 ammunition. There is no real saving in weight between the two loads because the heavy steel clip essential to the M1 rifle more than offsets the weight saved by the lighter bullet.⁸

The adoption of the new M2 Service cartridge with its 150-grain bullet at 2660 f.-s. puts our new M1 Service rifle on a power parity with the little .300 Savage lever-action deer rifle which uses the same bullet at the same m. v. but in a shorter case which latter happens to have a favorable shape and length for semi-automatic actions. Even the ancient and comparatively weak .30-40 Krag equalled the present power of our present M2 Service cartridge in our present short-barrelled M1 Service rifle. One of the most popular hand loads in the Krag drove a .30-caliber, 150-grain bullet at 2700 f. s. m. v. The m. v. of the more powerful M1 cartridge (erstwhile Service ammunition) loses at least 50 f. s. m. v. when fired in the 22.29-inch M1 barrel as compared with the 23.79-inch Springfield barrel. Apparently we are slipping.

LIGHT M1 BARREL BUCKLES

Careful analysis of our results at 600 yards indicates that the Garand rear sight responded reasonably well to our adjustments and moved the impact about 6 inches per click or for each minute of added elevation. The obvious conclusion, then, is that the barrel itself warped or buckled as it heated from our slow-fire shooting (only 130 shots in 3 hours) and steadily changed its zero, moving its groups ever lower below the aiming point. This individual M1 rifle, at least, has the peculiarity of shooting a few inches higher during the initial warming, making the second group a few inches higher in impact (4 inches at 600 y'rds and 3½ inches at 300 yards) from which point the trend is consistently downward.

Normally, 12 to 13 minutes elevation are required for zeroing a .30-'06 rifle with M1 ammunition when moving from 200 to 600 yards. We gave the Garand sight 13 clicks and the first 10-shot group landed on aim. The next 10-shot group landed 4 inches higher, indicating a zero adjustment of 12.3 minutes for 600 yards. After that initial zero, successive 10-shot groups with M1 ammunition had their impacts progressively lower as follows: 27 inches, 28 inches, 44½ inches, 56 inches, and 72 inches, a six-foot or 12-minute change in zero from buckling. The M1 loads used in shooting these seven groups were, in the same order: F. A. 1931, F. A. 1931, N. M. 1932, N. M. 1932, N. M. 1939, F. A. 1933, and F. A. 1933.

Three groups of M1-type commercial ammunition and two groups of F. A. M2 loads were also fired during this same period which began at 2:00 P. M. and

⁸ The soldier carrying two bandollers (120 rounds) of M1 (172-grain) ammunition in 5-shot clips has a lighter load than one carrying the same number of rounds of M2 (150-grain) ammunition in 8-shot clips for the Garand rifle.

ended at 5:00 P. M., an average rate of fire of 40 shots per hour, or one shot for each 1½ minutes of the elapsed time. The average change of impact per group, or string of 10 shots, was 1.6 minutes, or about 10 inches at 600 yards. In exact agreement with this average change in zero per group, the second string of M2 ammunition also landed 10 inches lower than the first M2 group. The second load of commercial ammunition landed 7 inches lower than the first commercial-load group. The writer did the shooting, from bench rest.

Later, we explored this matter further, after obtaining 8 clips for the M1 rifle, by doing some magazine firing at 300 yards on April 4 with the same Garand rifle. This time we used only one M1 load, F. A. 1933, and only one M2 load, F. A. 1938. We fired 16-shot groups (two 8-shot clips) from prone with sling, both slow fire and rapid fire. We used as many as five targets and quickened the tempo of our shooting. By 3:30 P. M. (about 1½ hours elapsed time) we had fired five 16-shot groups, or 80 rounds of M1 ammunition. By 5:00 P. M. (the next 1½-hour period) we had fired an additional seven 16-shot groups, or a total of 192 rounds of M1 ammunition in 3 hours. Then followed four 16-shot groups with M2 ammunition and a final 16-shot group with M1 ammunition, which latter was about 6:00 P. M., or a total of 272 rounds in the total elapsed time of about 4 hours, for an average rate of less than 70 rounds per hour during the afternoon.

Again we noted the consistent downward change in zero as the light Garand barrel became heated. This time we alternated in firing, the starting or zero impact for both shooters being measured and recorded as well as all subsequent impacts. As previously noted, the second group established the zero for shooter "A" by landing on aim after the first, or barrel-warming, group had landed 3½ inches below aim at 300 yards. These first two groups were made slow fire, the subsequent strings, rapid-fire, successive impacts with M1 ammunition being below aim by 24 inches, 30 inches 32½ inches, 37 inches, and 47 inches. A change in zero of nearly 16 minutes after firing 192 shots.

Shooter "B" added 2 minutes elevation, to start with his first slow-fire group at the top of the 10-inch black, the second slow-fire group was in center and the third (rapid-fire) under the bull. In order, the successive rapid-fire impacts in relation to that of the first group were lower by 11½ inches, 18¾ inches, 16¾ inches and 31 inches with M1 ammunition; a change in zero of about 10 minutes after firing 272 shots.

With M2 ammunition the first and second rapid-fire groups had the same impact but the third group was 6 inches lower and the fourth and final group with the M2 load 13 inches lower. This latter impact was 59½ inches lower than that of the first group fired by the writer, or 60 inches below the top of the bull with the original sight adjustment, and after a total of 256 rounds had been fired. For both shooters and both loads during the four-hour period the extreme or total change in impact was greater than indicated above, the M1 zero being 6½ inches higher and the M2 impact going 28½ inches lower than the indicated high and low, respectively.

WHY THE GARAND CHANGES ZERO

When we examined the M1 rifle we found the clue to this peculiar behavior of its barrel. The drawing shows three threads on the barrel and its shallow seat in the receiver. For five inches forward of the receiver the barrel is straight and reinforced by side-ribs which probably serve as supporting shoulders or rests for other parts. At the end of this straight section the diameter is abruptly reduced, it being .086 inch smaller than that of the Springfield Service barrel about 5½ inches forward of the receiver. The hand guard of the M1 rifle is charred at this point showing the thin barrel is subjected to considerable heat. Since the operating rod beneath the barrel is fastened at the muzzle and connected to the receiver with its long coil spring under tension, it acts as a taut bow-string to make a bow of the barrel as it buckles in the middle at the point of maximum heating.

Of course, when the muzzle bends down the front sight goes with it and the marksman automatically compensates for this muzzle depression when he aims. However, he does not compensate for the angle of depression set up by the buckle or rise of the bore at the middle, which causes the forward half of the barrel to slope downward in relation to the line of aim. The front sight is not only depressed less than the rise or buckle of the bore at the middle of the barrel, but the value of its angle is less so that it falls short of compensating for the depression caused by the buckle and the net result is a continual depression of the zero as the barrel heats and it shoots lower and lower relative to the line of sight or of the aiming point.

In explanation, the front sight is about 27 inches from the rear sight on the Garand, and on this radius a depression or change of .09 inch in the relative height of the front sight would amount to about 12 minutes of angle in impact (our total change in zero at 600 yards). The buckle or barrel bend, however, occurs only 12 to 14 inches from the front sight and on this shorter radius a buckle or rise of only .045 inch is required to cause the same 12-minute change in impact. In other words, while the bore angle changes more than the counteractive front-sight depression it also operates on one-half the sighting radius and its influence on the impact is twice as great, with the net result that the impact is depressed considerably as borne out by our results on the target, already mentioned.

Personally, I think that the M1 barrel should be reinforced to overcome this defect. It could be done by integral ribs or by using a heavier barrel or both. The weight standard of the M1 rifle should be reverted to the original specification of the Ordnance Department, which was 10 pounds. The M1 rifle we used weighed 9½ pounds without sling or bayonet and a pound of additional metal in its barrel would resist heat and buckling. Apparently the present unfavorably contoured barrel was designed for the original .276-caliber bore. In .30-caliber the barrel should be heavier, reinforced at the buckling point and the hand guard should be ventilated by grills or perforation to permit escape of excessive heat, or a cooling device must be used.

RAPID FIRE AT 300 YARDS

Because the zero changed from string to string faster than we anticipated it by elevating the rear sight, many low shots missed the bottom of the target, but we managed to salvage four complete rapid-fire groups with both types of ammunition. The signal to fire was given by the timekeeper, who also noted the time required to insert the second clip of 8 rounds in each of the thirteen 16-shot strings fired. This being our first experience, we found 10 seconds was required at the beginning and 8 seconds per insertion at the end, for an average time of 8.9 seconds per clip. Starting with the chamber loaded, our time ranged from 52 seconds to 31 seconds per 16-shot string, for an average of 38.1 seconds.

For the eight complete 16-shot strings our group-size average was 25.49, the mean of the extreme verticals being 26.27 inches. With F. A. 1933 M1 ammunition the four 16-shot groups averaged 24.41 inches, and the verticals, 23.10 inches, the average time per group being 40.8 seconds. With F. A. 1938 M2 ammunition the four 16-shot groups averaged 31.56 inches, with 29.44-inch verticals and an average time of 33.8 seconds per group. Our four 16-shot slow-fire groups at 300 yards with the F. A. 1933 load ran 22.50, 16.25, 16.88, and 16.75 inches, with respective extreme verticals of 16.00, 14.25, 14.38, and 15.38 inches.

We also fired three 10-shot groups with an 8½-pound M-1903 Service rifle as issued with the same load and got 13.00, 13.25, and 12.00 inches. The writer tried ten shots standing with both rifles at 300 yards. The Springfield scored 42 X 50 on the "A" target with a 35-inch group, 8 shots in 21.25 inches. The M1 rifle scored 32 X 50 on the "D" target with a 31.25-inch group, 9 shots in 19.88 inches.

FUNCTIONING RESULTS

With this same M1 rifle, we fired (on three days) a total of 692 rounds, 388 in clips and 304 without clips. This ammunition comprised about 50 rounds of handloads, 80 rounds of commercial loads, 120 rounds of M2 ammunition and the remainder, M1.

After firing the 394th round the next two (M1) failed to feed. The following two functioned all right. Then the loose carbon was dumped from the gas cylinder. The 466th round (M1) failed to feed. The 530th, 531st, and 538th rounds (M1) failed to feed. The 546th and 547th rounds (M2) not only failed to feed, but jammed against the breech. The 658th, 666th, 667th, and 668th rounds (M1) failed to feed. All rounds, 672d through 682d (M2) failed to feed and the clip failed to eject every time from this point to the end of our test, or four times. The 683d and 684th rounds (M1) failed to extract. The 686th and 688th rounds (M2) failed to feed. The 691st round (M1) failed to extract. On the first day in which 183 rounds were fired, 80 from clips, two rounds (HL) failed to eject. The total functional failures in 388 rounds of magazine firing were 28 for a malfunction percentage of 7.2%.

We also had a number of other stoppages, (23) such as refusal to accept clip, refusal to accept first cartridge, refusal of bolt to open and failure to eject clips, for a total of 51 in 692 rounds or 7.3%.

We also checked the headspace lengths of fired cases and found the Garand to be very uniform in this respect. W. R. A. commercial cases ran from 1.9458 to

1.9471 inches; Remington commercial, 1.9441 to 1.9473 inches; R. A. handloaded cases, 1.9435 to 1.9476 inches; F. A. 1931 cases from 1.9430 to 1.9451 inches; and National Match cases of three lots from 1.9441 to 1.9472 inches.

CARBON-COVERED-INTERIOR

When we dismantled the M1 rifle we found the piston and gas cylinder coated with caked carbon and the other action parts coated including the stock and hand guards. There was evidence in support of our earlier assumption that the red-hot carbon particles we had seen and felt had followed the operating rod back through the action and so to our faces. Eventually the parts will be cleaned, lubricated, and reassembled to permit firing the rifle again.

JOHNSON DAGGER BAYONET

Mr. JOHNSON. With reference to the statement of Major Schlieker concerning the Johnson dagger bayonet, I must say that the blade was copied by permission from a recent design of the British War Office, especially constructed to facilitate withdrawal from the body of the target. Moreover, thrusting with this bayonet does not eject the cartridge, though it does unlock the bolt. It seems hardly in the interest of combat good sportsmanship or economy to thrust and shoot the enemy at the same instant. The Johnson breech bolt immediately locks itself as the bayonet is withdrawn from the enemy and the gun is then ready to be instantly fired. The standard M-1905 United States bayonet is of a type which is now obsoleted in many foreign countries. It is badly adapted for ease of withdrawal and does not inflict as fatal a wound as the T-shaped blade of the French and Johnson types or of this recent British design referred to.

RECOIL DISTANCE

Mr. JOHNSON. With further reference to Senator Chandler's question about the recoil distance of the Johnson rifle, the recoil travel of the rifle toward the shooter's shoulder and face could not possibly be any more than that of any other rifle using the same power ammunition and held in the same manner by the same shooter. As a matter of fact, moving pictures of a Johnson and Springfield rifle show graphically that the recoil shock and rearward movement of the Johnson rifle is very noticeably less than that of a Springfield rifle fired by the same shooter.

RECOIL TEST

Mr. JOHNSON. With reference to Major Schlieker's comments on recoil tests at Aberdeen, he has graciously confirmed my version of the recoil pendulum test in the Ordnance report, but indicates that the Johnson rifle kicks more than the test showed. I can only ask why the Ordnance should laboriously conduct such an elaborate yet inconsequential test. Captain Brown's test device which he mentioned for determining the kick of the Garand has not been employed to test the Johnson for a true comparison.

WOODEN HANDGUARDS

Mr. JOHNSON. I have had occasion to conduct quite extensive tests with various service rifles for comparison with the Johnson. We have found that the handguards of the average Springfield or Enfield are too hot to grasp after 60 shots, rapid fire. I cannot concur with the statement that no military rifles lack wooden guards around the barrel, for a few of the latest European types, such as an Italian repeating model, expose a substantial portion of the forward section of the barrel. In the last analysis you cannot see very well through wood and oil smoke. The cooler the barrel, the longer will be the accurate life of the barrel.

JOHNSON BARREL BEDDING

Mr. JOHNSON. With reference to a question by the committee (Senator Chandler) concerning the Johnson barrel, I wish to emphasize the fact that changes in the wooden stock as well as any thermal and atmospheric changes, can have no

influence upon the accuracy or point of impact of the Johnson rifle. No special attention is required to bed the barrel. It lies in an entirely mechanical rest, not unlike that used for the Mann test barrels, for they lie in a cradle and are free to recoil in firing. Moreover, the way in which the rifle is held does not affect that barrel since it is sliding independently in the receiver.

THE JOHNSON REAR SIGHT

Mr. JOHNSON. With reference to comments made about the Johnson sight, attention is called to these points; the Johnson sight is simple and rugged. Elevation is provided in 100-yard changes on the battle-sight elevator. A micrometer is incorporated in the peep aperture which permits elevation adjustments in minutes or half-minutes of angle. Thus, the operator can correct the sight for his purposes, bringing the center of impact to coincide with the appropriate range setting on the battle-sight elevator. The windage is adjusted in minutes or half-minutes. Moreover, the peep aperture can be turned to provide large and small aiming apertures. This sight has been very well received by many expert riflemen. It contains most of the characteristics generally desired, and includes several features not usually found in a rifle sight.

WEIGHT OF JOHNSON RIFLE

Mr. JOHNSON. With reference to Major Schlieker's remarks about the weight of the Johnson rifle, 10 pounds, I must invite attention to the fact that the original requirements for the semiautomatic rifle promulgated by the War Department in 1921 expressed the weight limit at 10 pounds. I have already called attention to this M1917 rifle which actually weighs 10 pounds, to this M1903 rifle which weighs 9 pounds 7 ounces. I have personally weighed a standard model, semi-automatic rifle (Garand) which came to exactly 9 pounds 13½ ounces without sling strap or 2½ less than this Johnson rifle R17 which has a much heavier barrel than the Garand, as I indicated this morning, the outside diameter of the Garand barrel being 0.070 inch less than the Johnson. The weight of this Garand rifle with sling strap would have been over 10¼ pounds.

SPEED OF LOADING

Mr. JOHNSON. I wish to point out that I have personally demonstrated the Johnson rifle by loading two clips in 5 seconds. Commencing with the magazine empty, I have loaded and fired 66 rapidly aimed shots, and at Peekskill, N. Y., recently I fired 38 shots in 1 minute, commencing with the rifle empty, making a 15-inch group at 200 yards. General Walter De Lamater witnessed the above firing. Mr. G. G. Whitney, Jr., of my organization equaled my loading time, 2 clips in 5 seconds in the presence of General De Lamater. Thus, it is apparent that an experienced shooter with the Johnson rifle can load two clips of 5 rounds each in less than half the time indicated by the previous testimony.

DISARMING JOHNSON OPERATOR

Mr. JOHNSON. A gentleman from the War Department took the trouble to point out what he considered a disadvantage of the Johnson rifle. He said the opponent might grasp the muzzle in such a way as to cause the bolt to be unlocked, thus preventing the operator from firing.

I must confess this point impresses me with the thoroughness of the gentleman's efforts. But I must call attention to the facts.

First, the opponent must be within a few feet of the muzzle of a loaded Johnson rifle.

Second, the Johnson operator must hold the rifle securely in order that the thrust against the muzzle by the opponent will not merely push the whole gun backward as in all probability it would.

Third, pushing the barrel back ½ inch will not prevent firing the Johnson, for it must be partly unlocked by an additional ¼-inch, or total of ¾-inch before the rifle would fail to fire.

Pulling the barrel toward the opponent might prevent ejection of a fired shell, but the opponent would probably not recover from the bullet of the first shot at a range of 2 feet.

Thrusting with the dagger bayonet unlocks the bolt during the thrust, but withdrawal of the bayonet after the thrust allows the bolt to lock and does not prevent firing a round to release the blade.

EXTRACTS FROM GARAND RIFLE INSTRUCTION MANUAL

Mr. JOHNSON. Inasmuch as it was necessary for me to make reference to certain portions of the Garand Instruction Manual during my testimony, if it please the committee, I should like to set forth certain quoted sections of that manual.

The manual in question is Standard Nomenclature List No. B21, published by the Ordnance Department and headed "Rifle, U. S., Caliber .30, M1."

OVERHEATED CARTRIDGE

With reference to my testimony concerning the advantages derived from the fully air-cooled Johnson barrel as contrasted with barrels of semiautomatic weapons which are wood covered, I wish to quote from paragraph 14 of the Garand manual, which is entitled "Safety Precautions." The following is taken from paragraph 14, subparagraph B: "When the rifle is hot from repeated firing, the cartridge must not be left in the chamber. When, for any reason, firing is suspended for any considerable time, clear the gun. Overheated cartridges produce abnormal pressures, are liable to preignition, and increase extraction effort to such extent that the rim of the cartridge case is likely to be pulled off, leaving the case in the chamber."

Attention is called to the fact that certain portions of the above-quoted subparagraph are underlined in the manual.

With reference to matters concerning care and cleaning of semiautomatic rifles, I beg leave to quote from the Garand manual, paragraph 28, entitled "Care and Cleaning Preparatory to Firing," and therefore quote the entire paragraph 28 as follows:

"28. CARE AND CLEANING PREPARATORY TO FIRING

"a. The care and cleaning of the rifle preparatory to firing differs from the procedure described in paragraph 27, in that Dixon's graphite cup grease No. 3 is substituted for aircraft machine-gun lubricating oil on many of the moving parts of the weapon. The following procedure will be followed to assure efficient functioning of the rifle: 1. Disassemble the rifle. 2. Clean and oil the bore very lightly. Do not oil the chamber. 3. Remove any carbon on the gas cylinder plug and piston head. 4. Thoroughly clean and lightly oil all metal parts. 5. Apply a thin, uniform coating of Dixon's graphite cup grease No. 3 to the parts listed below: The graphite cup grease is carried in a tube and is best applied by first rubbing a small quantity into a corner of a cleaning patch, and then applying it to the parts. Excess quantities applied at any point serve no useful purpose, and it should be avoided. a. Bolt locks (locking and operating). b. Bolt guides. c. Cocking cam on bolt. d. Compensating spring. e. Contact surfaces of barrel and operating rod. f. Operating rod cam. g. Operating rod guide groove in receiver. h. Operating rod spring. CAUTION.—Do not apply graphite cup grease to the follower slide or the under surface of the bolt, as the introduction of graphite into the chamber may lead to the generation of excessive pressures. 6. Assemble the rifle and rub all outer surfaces with a lightly oiled rag."

I now quote paragraph 30, "Care and Cleaning on the Range." I quote paragraph 37, subparagraph D, as follows: "If the rifle gives indications of lack of lubrication and excessive friction, apply additional graphite cup grease to the parts listed in paragraph 28 (a). Excessive friction exists if the empty cases are being ejected to the right rear, and graphite cup grease should be applied at the first opportunity as failure to feed and eject will occur if the condition is not corrected."

I now wish to quote from paragraph 31, entitled "Care and Cleaning in the Field." In particular I quote paragraph 31, subparagraph A, as follows: "The rifle must be kept clean and free from dirt and properly lubricated with graphite cup grease. To obtain its maximum efficiency the following points must be observed: 1. The chamber must be kept clean, using the chamber-cleaning tool for this purpose. 2. Apply additional graphite cup grease to the parts listed in paragraph 28 (a) at the first opportunity after indications of excessive friction

occur. 3. Keep a light coating of oil on all other metal parts. 4. Remove the carbon from the gas cylinder plug and the piston head when necessary. 5. In general it should not be necessary to remove any of the parts of the rifle in the field except the trigger housing group and the gas cylinder plug. However, if the mechanism becomes very dirty the rifle may be disassembled into its three main groups and the necessary cleaning and lubricating accomplished."

I now quote from paragraph 37, entitled "Immediate Action." I quote from subparagraph C (4), entitled "Fourth Phase": "If the gun fails to fire after the first three phases of immediate action have been applied, or if, at any time, the operating handle cannot be moved to the rear, check for a broken firing pin or other broken parts. Do not apply force to the operating handle. If it cannot be moved to the rear while the rifle is shaken to clear a probable broken firing pin from the path of the bolt in the receiver, turn in the rifle for examination and repair and proceed with the firing with a different rifle. Experience gained with the United States rifle, caliber .30, M1, has proved that this type of difficulty is very exceptional."

Under the heading of "Stoppages," paragraph 38, I quote subparagraph C, the second part of that paragraph under "Failure To Feed." I quote as follows: "This condition is generally caused by a break-down of the lubrication of the rifle resulting in excessive friction of the moving parts, or through insufficient gas pressure due to carbon forming in the gas port. In either case the bolt does not move far enough to the rear to permit proper functioning. If the condition exists when the last round of a clip is fired it will result in failure to eject the clip. The conditions are remedied by thoroughly removing all carbon deposits and lubricating the moving parts as described under section VI, Care and Cleaning. Infrequently this type of stoppage is caused by a faulty clip or a broken part. In these cases examination soon discloses the cause of the stoppage."

I now wish to quote from paragraph 38, subparagraph D, entitled "Failure To Extract—Detailed Explanation." I quote, "Stoppage caused by failure to extract are reduced by the first, second, or fourth phase of immediate action. Failures to extract are generally caused by—

"(a) A dirty chamber, including an excess of oil therein.

"(b) Insufficient gas pressure.

"(c) A round chambered in hot barrel.

"(2) If the chamber is dirty, or there is an excess of oil in the chamber, or a cartridge has been left in a hot barrel, the cartridge case will be expanded tightly against the chamber walls and is not extracted. If the gas pressure is low, the bolt will not open and the cartridge will not be extracted from the chamber. If the gas pressure is high or if the case is weak the extractor will rupture the cartridge case leaving the major portion of it in the chamber.

"(3) If the bolt fails to open, pull back on the operating handle, at the same time assist by pressure with a cleaning rod on the case in the chamber. If operating handle cannot be moved, check for broken firing pin. If the bolt opens and leaves the case in the chamber, remove with the combination tool or cleaning rod. In either case clean the chamber to prevent recurrence of the stoppage.

"(4) Lack of gas pressure from carbon or absorption of energy due to friction is indicated by the manner in which the cartridge cases are ejected. When sufficient gas is passing through the port and all parts are properly lubricated, cartridge cases will be ejected to the right front. As the amount of gas decreases, or the lubrication disappears, cases will be thrown to the right, and finally to the right rear."

BRIEF SUMMARY OF FIRING—UNITED STATES ORDNANCE DEPARTMENT TEST,
JOHNSON SEMIAUTOMATIC RIFLE, MILITARY ROTARY-FEED TYPE, CALIBER
.30 M-1, NO. R-17, ABERDEEN PROVING GROUND, MD., DECEMBER 19-30,
1939

Prepared by Johnson Automatic, Inc.

Total rounds fired.....	5, 775
Rounds (all M-1) fired in endurance test.....	5, 150
Miscellaneous rounds, accuracy, velocity, sand, etc.....	625
Ammunition used: United States .30 M-1 (lot 2053 M. A. 1938; also United States M-2 F. A. 1939.	

Kinds of tests:

Endurance, with ammunition, caliber .30 M1.

Velocity.

Accuracy:

Machine rest.
Prone, sitting.
Rapid fire.

Sand.

Mud, fine gravel, sand, slush.
Bayonet tests.
Functioning without any oil.
Functioning with overloads.
Functioning without relubrication.
Functioning with reduced loads.
Time to disassemble and assemble.
Time to load magazine.
Wear on breech locking parts.
Abuse, breakage tests.

Endurance test

Number of rounds of ammunition, caliber .30, M1.....	5, 150
Rate of fire: 15 to 30 shots per minute.	
Number of rounds without cooling, per series.....	150-190
Number of rounds, mechanism entirely unoled.....	208
Number of rounds without cleaning or oiling mechanism.....	1, 200

How fired: Standing, from hip, or shoulder.

Stoppages

Failure to extract due to broken extractor.....	1
Failure to feed due to improper engagement of magazine follower spring, corrected permanently during test.....	6
Failure to lock, resulting in misfire due to interference of operator's fingers, or dirt in breech, or tight cartridge case.....	12
Defective or worn bolt catch (note: This catch is an accessory, and is not essential to the loading, firing, or operation of the rifle (after failure to hold the bolt open on 29 shots, this part was replaced).....	1
Total stoppages.....	20
Number of rounds.....	5,150

NOTE.—A new extractor was replaced in 20 seconds. The misfires were corrected by pulling the handle halfway, releasing, and firing. The magazine spring was reconnected.

PARTS REPLACED DUE TO BREAKAGE OR DEFECT

Bolt catch.....	1
Extractor.....	1
Operating handle spindle spring.....	1

RECORD FOR PERFECT FUNCTIONING

The Johnson rifle fired from the 3,700 round through the 5,150 round, or 1,450 consecutive rounds without a single malfunction or stoppage of any kind, at a rate of 20 to 30 shots per minute.

VELOCITY

The Johnson with 22-inch barrel averaged 9.2 feet per second higher than the 24-inch Mann special test barrel.

ACCURACY

The accuracy in general compared favorably with the Springfield rifle as issued. Commencing with rifle empty, 10 shots were loaded and fired in 60 seconds from prone position at 500 yards, all 10 being with 22.05 inches, 8 (80 percent) in 14.2 inches. Extreme vertical 19.12 inches, extreme horizontal, 13.4 inches.

After the 5,150-round endurance test, the rifle put 16 out of 16 shots into 4.6 inches at 100 yards, with 80 percent in 3.5 inches; also 5 shots at 50 yards in 0.75 inch.

At 600 yards a mean radius for 10 shots of 7.96 inches was obtained.

SAND

The rifle, empty, was put in a sand blasting machine for several minutes. There was 1 failure to feed due to weak ejection out of 20 shots. The rifle was then loaded and again, without being cleaned, given another sand test. Twenty shots were fired. There were no malfunctions.

A clip of cartridges was placed in water and then in sand. The clip was loaded in the sand-tested rifle. The rifle fired the clip plus 2 extra rounds by hand operation. It then fired semiautomatically for 10 rounds.

MUD, GRAVEL

The rifle was capable of firing by hand operation after the test, although with some difficulty.

DAGGER-BAYONET TESTS

The rifle with bayonet was fired vertically into the air and ground, and from the shoulder and hip without malfunctioning.

The bayonet was jabbed into a wooden ammunition box.

MISCELLANEOUS

Two hundred and eight rounds were fired without difficulty with the rifle perfectly dry, without any oil.

Twelve hundred rounds were fired without any cleaning or oiling.

The rifle functioned with overloads (62,415 pounds per square inch) and reduced loads (36,360 pounds per square inch).

Field stripping required 30 seconds and assembling 50 seconds. The barrel was removed and replaced in 6 seconds, the extractor in 20 seconds.

The magazine was loaded at the rate of one clip in 2 to 3 seconds, two clips in 5 to 7 seconds.

No measurable wear was found on the breech locking parts after 5,000 rounds.

The rifle was thrown on the ground, and, with the muzzle and rear of receiver supported, a 220-pound man jumped on the barrel and radiator sleeve. The rifle was dropped so as to smash the magazine body. Results: The stock was split, the Winchester barrel was bent, the magazine was dented. No other damage was caused, and the rifle continued to shoot as a 5-shot, clip-loaded semiautomatic rifle.

REPAIRS

The above parts were removed and replaced in 11 minutes, and the rifle left the proving ground in perfect working and firing condition.

e. The rifle was stood on a 4-inch block and allowed to fall over to the side, so as to strike near the muzzle on another wood block 4 inches high. This was once repeated. Immediately before, 3 shots were fired at an "A" target, 100 yards, with a rest. Following the falls, firing at the same target was resumed. The center of impact was not changed as a result of the falls. The stock split on the third shot following the falls, but the rifle was fired 10 times more without malfunction. Size of group of the 16 shots: horizontal spread, $4\frac{1}{2}$ inches; vertical spread, $3\frac{1}{16}$ inches. The split ran from the forward end of the stock, back through the trigger guard recess and out on the left side to the rear of the trigger guard.

f. To test the strength of the magazine the rifle was dropped from a height of 4 feet so that the bottom of the empty magazine struck the edge of a $\frac{3}{4}$ -inch board. This caused a dent $\frac{3}{16}$ -inch deep in the magazine. Following this, five rounds were loaded in the magazine (it would accept no more) and one in the chamber. The six fired without malfunction.

g. The strength of the receiver was tested by placing the rifle on its left side on two blocks, one under the rear end of the receiver and one under the muzzle, and having a 220-pound man jump on it from the floor. This bent the barrel visibly and enough to change the center of the impact about $10\frac{1}{4}$ inches to the right at 50 yards. No harm to the receiver could be detected by visual inspection.

EXCERPTS FROM SECOND REPORT ON JOHNSON SEMIAUTOMATIC RIFLE, CALIBER .30, ROTARY MAGAZINE TYPE—ORDNANCE PROGRAM NO. 5082

The recoil energy as computed per supplement to this report (attached hereto) was 12.452 foot-pounds. Similar measurements made with the M1 1903 rifle indicate that that rifle has recoil energy of about 13.83 foot-pounds with M1 ammunition, or about 1.4 foot-pounds more than the Johnson rifle. However, against the shoulder the Johnson rifle may have a greater effect than the M1 1903 rifle. Note attached statement by Lieutenant Gau on this matter.

5. OBSERVATIONS AND DISCUSSION

a. The attached handbook was examined. Most of the marginal annotations therein were made by Mr. Johnson during the course of the test.

(1) Sections III to IX, inclusive, appear to be substantially correct as regards purely mechanical matters.

(2) With reference to appendix I:

(a) The claim that the rifle (item a) will operate satisfactorily with M2 ammunition was not verified. The only firing that was done with M2 ammunition during this test was from a fixed rest.

(b) The weights of two rifles which were put on the scales were 10.2 pounds and 10.017 pounds, not 9.5 pounds (item h).

(c) Hand operation (item m) when the mechanism sticks due to dirt or other causes is not comparable to the M1903 rifle, in that the operating handle on the Johnson rifle is short and can be grasped by one finger only, whereas a much better grasp can be had on the longer bolt handle of the M1903 rifle.

(3) The claims made in appendices II and III were not verified.

b. This rifle functioned reliably without any oil (parts as wiped dry of photographs) for the first 208 rounds. It was then oiled, but not because for malfunction due to lack of oil.

c. A minor deficiency noted was lack of range markings on the rear sight graduations.

d. Another deficiency noted was that the safety device was not foolproof. The safety lever which is underneath the stock and forward of the trigger guard is pushed toward one side for "safety" and toward the other to allow firing. These positions were not marked. Moreover, in the dark, unless some mechanical modification were made, no easy determination of whether the safety were "on" or "off" could be made except by attempting to pull the trigger.

e. This rifle is very poorly suited to bayonet fighting. The barrel forward of the receiver is too small in diameter to be grasped securely and after a few shots is too hot to hold. On a cold day in the shade, the hand guard is too hot to grasp at the forward end after 30 shots fired in 2 minutes, and is too hot to grasp anywhere after 90 to 100 shots fired at the rate of 15 per minute. On a hot day in the sun, the barrel and metal hand guard might well be too hot to grasp even without any shots having been fired. (See also paragraph 4 b of this section.) The fact that the bayonet is not solidly fixed but is free to move three-eighths inch to the rear along with the barrel upon meeting resistance is another deficiency.

f. The trigger is without slack—that is, there is no change in the character of the trigger pull from the time it is begun until the hammer falls. In the hands of a man experienced in shooting with a trigger having slack (such as that of the M-1903 rifle) this lack of slack tends to reduce the speed of firing aimed shots.

g. During the firings against time at standard targets, it was noted that 6 to 8 seconds elapsed from the command to commence firing until two clips had been loaded, and that 10 to 15 seconds had elapsed before the first shot was fired.

h. While the rate of aimed fire deliverable from this rifle, of course, depends on a variety of conditions, it is believed that 20 aimed shots in 60 seconds at 500 yards at a standard D target, prone, starting with an empty magazine, probably is very close to the peak attainable by a highly skilled shot. Even if he fired that many before the minute elapsed, it would require about 6 to 10 seconds to reload (a single clip only) and fire the first shot of that clip. (Captain Van Orden's best record during firing at the proving ground was 19 shots under those conditions.) In his handbook (sec. II, p. 4, item b) Mr. Johnson states that the approximate rate of aimed fire is 40 shots a minute. Upon questioning, he explained that starting with 11 cartridges in the rifle, 40 rounds had in fact been

fired in 60 seconds from the prone position at a half size D target at 100 yards with 85 percent of the shots striking in the black, and the rest in the 4 ring.

The half size "D" target at 100 yards was, of course, intended to represent a standard "D" target at 200 yards.) Firings at the proving ground lead to the belief that his explanation should be given credence. The rate of 40 per minute should not be compared to the rates attained at the proving grounds without adding at least 10 seconds for loading two clips, getting the rifle to the shoulder and aiming and firing the first shot. Thus on the basis of 70 seconds for 40 shots, starting with the magazine empty, the rate would be slightly over 34 per minute under the conditions stated.

i. This rifle appears to be reasonably accurate, although to obtain conclusive data, firing with several rifles under a variety of conditions would be necessary. In addition to the data given in paragraph 4a, it should be noted that one group of 10 shots fired by Lieutenant Gau from the shoulder prone at 500 yards in 60 seconds starting with an empty magazine, had a horizontal spread of 13.4 inches and a vertical spread of 18.12 inches (M1 ammunition).

j. The abuse tests were intended to bring out weaknesses. Mr. Johnson attributed splitting of the stock during firing after two falls as due to a slight defect arising during manufacture of the stock which was corrected by putting in a wood screw. This may have been contributory, but it should be noted that the forward end of the buttstock is unsupported by a band or other means of reinforcement (refer to photograph). This deficiency should not be difficult to correct. The magazine is not sufficiently rugged to withstand denting which is possible under field conditions, but that is a weakness which could be corrected by making the body heavier (at the expense of weight) and by corrugations. That the hand guard and receiver are sufficiently strong was well demonstrated by the fact that the barrel yielded first when the two were placed under a suddenly applied load.

V. CONCLUSIONS

1. This semiautomatic rifle has following favorable features:
 - a. As a machine its performance and endurance are satisfactory.
 - b. It is at least reasonably accurate.
 - c. It can easily and quickly be disassembled and assembled without special tools.
 - d. The barrel can be removed in a few seconds for cleaning or replacement.
 - e. With a cartridge in the chamber additional cartridges can be loaded into the magazine, thereby making it possible to keep the magazine always full, time between shots permitting.
 - f. With a cartridge in the chamber, cartridges may be withdrawn from the magazine individually, thereby making convenient the substitution of a few rounds of a different kind of ammunition.
 - g. It can endure considerable sand and dust without failure to fire and then reload automatically.
2. This semiautomatic rifle has the following disadvantages:
 - a. It weighs over 10 pounds, the prescribed limit on weapons in this category being 9.5 pounds.
 - b. It will not function 100 percent reliably with the present standard United States bayonet.
 - c. With the Johnson bayonet attached, it will not function reliably when fired at depression angles (as down into a trench) unless firmly supported against the shoulder or hip, or rigidly held in some other way.
 - d. It is very poorly suited for fighting with any bayonet, due to absence of suitable hand guards.
 - e. The safety device is not foolproof.
 - f. Under adverse dust and sand conditions, the effort required to force a clip of cartridges into the magazine may be excessive.
 - g. The magazine body is not sufficiently strong to withstand blows likely so be received in service.
 - i. The trigger pull is continuous, without the conventional "slack."
3. Against the shoulder, recoil is as great if not greater than that of the M-1903 caliber .30 rifle.
4. With this weapon a first class shot can fire about 20 well aimed shots at a standard "D" target at 500 yards, prone, starting with the magazine empty, in 1 minute.

JANUARY 2, 1940.

The CHIEF OF ORDNANCE, WAR DEPARTMENT,
Washington, D. C.

DEAR SIR: In accordance with the instructions received from your office and from the commanding officer, Aberdeen Proving Ground, Md., we were privileged to submit the Johnson semiautomatic rifle for test commencing December 19, 1939, and to be present at every single phase of the test until December 30, 1939, when all tests had been completed.

We wish to express to you our appreciation for the courtesy, consideration, and cooperation which was extended to us throughout the tests by the commanding officer, Col. W. A. Rose, and his staff. We were especially grateful for the personal interest which was shown in these tests by Colonel Rose and by Colonel Lewis, under whose supervision they were conducted, as well as for the interest shown and the care with which Capt. W. A. Niles conducted them.

We thank you and the commanding officer at Aberdeen Proving Ground for expediting this test so as to make our stay in Maryland as short as could possibly be expected in view of the thoroughness of the test. We were especially grateful to Captain Niles for finishing up the work on a Saturday morning when the proof house is normally closed, rather than to oblige us to come back from Boston after the holidays.

We also express our appreciation for the interest and attention to this test shown by the representative of the Chief of Infantry, Major Schlieker, and by the representatives of the Marine Corps, Major Edson, Major Strother, and Captain Van Orden.

Assuring you of our sincere desire to cooperate with you in every possible way and with very best wishes to you, the officers, civilians, and enlisted personnel of your command for a prosperous, happy New Year, we remain

Sincerely yours,

JOHNSON AUTOMATICS TRUST,
MELVIN M. JOHNSON, JR., *President.*

FEBRUARY 3, 1940.

Dear MR. JOHNSON: There is enclosed herewith for your information, copy of the report on the Johnson semiautomatic rifle, as conducted at the Aberdeen Proving Ground between the 19th and 30th of December. It is thought that you will find this report a matter of considerable interest and satisfaction to you.

When reports of this nature are furnished to corporations submitting material for tests, it is understood that such reports are to be given no publicity and are not to be used for advertising purposes. The department is very glad to furnish you with a copy of this report with this understanding.

For the Chief of Ordnance.

Yours very truly,

EARL MCFARLAND,
Brigadier General,
Assistant to the Chief of Ordnance.

FEBRUARY 7, 1940.

Reference No. 00 No. 474.2/2801.

DEAR GENERAL MCFARLAND: I gratefully acknowledge your very kind letter of February 3, 1940, together with the receipt of the very fair, thorough, and complete report of the test of the Johnson semiautomatic rifle, type R, at Aberdeen Proving Ground. We heartily agree with your comment that this report is a matter of considerable interest and satisfaction to us.

We wish to say that we especially appreciate the fact that this test and the very extensive report of it was made, completed, and reported on in so short a time, in view of the fact that we are well aware of the tremendous pressure under which the entire Ordnance Department has been and is now working, especially the staff at the proving ground.

With reference to the test report itself, we have prepared separately certain comments of a technical nature which occurred to us as a result of a thorough reading of the very excellent report.

There are, however, general points which we wish to take the liberty of bringing to your attention at this time, and which were brought up in our correspondence with your office prior to the beginning of the test.

First, we informed your office that we would try to have two types of bayonets available before the completion of the test, it being understood that the rifle primarily submitted was equipped with a dagger-type bayonet. We informed your office that with the dagger-type bayonet attached the rifle was designed to function with M1 ammunition; that without the dagger bayonet attached the rifle was designed to function with M1 and with M2 ammunition without adjustment. The ability of the rifle mechanism to perform in this manner was, we believe, brought out in a preliminary test of a much earlier model in August 1938 at the proving ground when 600 rounds of each type, M1 and M2, were fired consecutively.

The other type of bayonet which we described generally as the sword type, was, unfortunately, not completed in time to be shown at the proving ground. A full-sized blueprint was exhibited of this design, however. This bayonet was designed chiefly to offer a fixed bayonet which did not recoil with the barrel and which does not affect the barrel in any way, and which is better adapted for functioning with M2 ammunition, the bayonet being attached or detached as desired.

Our rifle No. R-13 which was used in one phase of the test has been since equipped with a fixed lug, and the barrel has been equipped with a guide lug for the assembly of a model of our sword-type bayonet, which weighs 0.9 pound and has a blade of optional length, 17 to 20 inches. We took the liberty of showing this rifle and bayonet to a member of your staff during January 1940, who very graciously suggested that possibly we might wish to submit this rifle with that bayonet for test.

Realizing as we do the terrific pressure of work upon Aberdeen Proving Ground, and already having been given priority during two whole weeks during December for a complete test of our rifle, we frankly hesitate to ask that this bayonet be tested at this time in view of our failure to make the bayonet available during the period of the test.

Secondly, with reference to the matter of functioning with M2 ammunition, it appears from the test reports that the ability of the rifle to function with this new standard type of ammunition has not been actually verified except by the firing of this ammunition from a machine rest.

The situation is, therefore, that the Ordnance Department has not actually tested this optional type of bayonet, and has not perhaps verified the ability of the rifle to function generally with M2 ammunition in its present form.

After some deliberation we feel that it would be an imposition on the Ordnance Department to ask that this bayonet be tested with the same identical model of the rotary feed type rifle merely for the purpose of showing that the rifle can fire with that bayonet, and incidentally, that the rifle can fire with or without that bayonet with M2 ammunition quite as satisfactorily as with M1. We have of course made our own complete tests, and we would learn nothing whatever from a test at the proving ground. We are already greatly indebted to the Ordnance Department for what we learned as a result of the extensive tests already completed.

If, however, there is any desire whatever on the part of you and your staff to make any sort of tests of these two features, please be assured that we will cooperate to the fullest possible extent and make the rifle and bayonet immediately available.

A picture of the rifle with this bayonet is being forwarded under separate cover.

Respectfully yours,

MELVIN M. JOHNSON, JR.,
President, Johnson Automatics Trust.

FEBRUARY 13, 1940.

DEAR SIR: Your letter of February 7, 1940, acknowledging receipt of the report of the test of the Johnson semiautomatic rifle, type R, has been received.

[Copy of enclosure accompanying Johnson Automatics Trust letter to General McFarland under date of February 7, 1940]

COMMENT OF JOHNSON AUTOMATICS TRUST ON REPORT OF TEST OF JOHNSON SEMIAUTOMATIC RIFLE, CALIBER .30, ROTARY MAGAZINE TYPE, BY ORDNANCE DEPARTMENT, UNITED STATES ARMY, ABERDEEN PROVING GROUND, ABERDEEN, MD. (ORDNANCE PROGRAM NO. 5082)

(1) Before making any comments we cannot refrain from stating that we are extremely pleased and entirely satisfied with this text by the Ordnance Department of the Johnson semiautomatic rifle; and we are extremely pleased and

satisfied with the report of this test, both as to its contents, presentation, and completeness.

(2) We wish to express our deep appreciation and gratitude for having been furnished with a copy of this report in complete form.

COMMENT ON SAFETY DEVICE

(3) Reference was made in the report to the safety device on the Johnson rifle, and it is stated that the safety may not be entirely foolproof as it is not possible to ascertain in the dark whether the safety is on or off without pulling the trigger. Attention is called to the fact that the safety lever rotates on its axis just in front of the trigger guard; that when the safety lever arm points to the right rear of the rifle the safety is on; that when the safety lever arm points to the left rear, being rotated approximately 30-40° to the left, the safety is off; that the operator can ascertain whether the safety is on or off by feeling with the forefinger or with the thumb and forefinger to ascertain whether the safety points to the right of the trigger guard or to the left of the trigger guard. The letters "S" and "F" can, of course, be stamped on the trigger guard to indicate the proper position for the safety. Attention is called to the fact that the Springfield safety lever sets the safety at "Safe" when the lever is to the right, and sets the safety for "Firing" when the lever is to the left. This can also be felt in the dark. We respectfully submit that no difficulty need be experienced in this connection after the operator has familiarized himself with the two positions of the safety lever, and that any operator should be able to detect without visual examination whether the safety lever is in the "Safe" or "Firing" position.

COMMENT ON SHOULDER RECOIL EXPERIENCED IN FIRING

We are interested in the comments made by Lt. H. L. Gau, Ordnance Reserve, relative to the recoil experienced by him in firing the Johnson rifle during portions of the test. We wish to state that we have the highest regard for Lieutenant Gau's opinion. Nevertheless, we feel justified in stating that of the several hundred or more persons who had fired Johnson rifles under all sorts of conditions, less than half a dozen have expressed to us the belief that the rifle kicks as much as the Springfield. A few persons have stated that they thought the rifle kicked almost as much as the Springfield. Lieutenant Gau is practically the first person we have encountered who thought that the Johnson rifle kicks more than the Springfield. A great preponderance of opinion has been expressed, at least to us, to the effect that the Johnson rifle does not kick nearly as much as the Springfield. Some authorities have stated that the rifle felt as though it kicked as much as 30 percent less than the Springfield.

We take the liberty of mentioning a few points in this connection.

(A) During the many occasions when we have conducted firing demonstrations, we have very often requested spectators to fire a Johnson rifle from the shoulder, first holding the rifle very tightly against the shoulder and then holding the rifle immediately thereafter loosely on the shoulder. The unanimous opinion expressed by spectators who have performed the firing above described has been that the rifle did not kick them appreciably when it was held gently on the shoulder, but that they did notice an increased kick by comparison when the rifle was held very tightly against the shoulder. This was usually followed where possible by asking the spectator to fire a standard bolt-action caliber .30 rifle with the same ammunition, the spectator invariably agreeing that the repeating rifle kicked them more than the Johnson rifle held in either of the two above positions.

The reason which we have ascribed for this difference in kick when the rifle is held tight or loose on the shoulder is that the recoil action of the Johnson rifle is such that the receiver and stock tend to absorb some of the jarring caused by the bolt and barrel in recoil. Where the rifle butt is held gently on the shoulder the stock and receiver tend to absorb some of the jarring of the action. However, when the butt is held very tightly against the shoulder, some of the jarring is naturally transmitted to the shooter's body. We do not contend that this difference is very marked, but it is sufficient to be noted. Now in this connection we observed that Lieutenant Gau, being an experienced Springfield rifleman, held the Johnson rifle very tightly against his shoulder in conjunction with the sling which he used. We were impressed by the fact that Lieutenant Gau made every possible effort to give his very best performance with the Johnson rifle both as to accuracy and rapidity of fire. Lieutenant Gau was particularly making his best effort to fire good groups on the target. Consequently, we believe that in holding

the rifle very tightly against the shoulder as is necessary with rifles of the Springfield type he may have experienced more kick than would have been the case had he held the rifle more gently against his body.

(B) During the endurance test firing it was our impression that a member of the proof house staff, Mr. Getsell, fired in the neighborhood of 500 or 600 rounds at 15 or more rounds per minute from the shoulder without pads, following this with approximately the same number of rounds fired from the hip, and repeating this on 2 consecutive days. We were particularly careful to question Mr. Getsell on the question of kick, and got the impression from him that he did not find the kick at all troublesome, to say the least.

(C) While we hesitate to bring up other experiences, there is on record an occasion when, before numerous competent witnesses, one individual without pads fired 800 rounds of M-1 ammunition at a very high rate of fire without any intermission and without any serious complaint relative to the kick of the rifle.

(D) The mechanical tests conducted indicate that the rifle kicked slightly less than the Springfield rifle. It did not occur to us until the test had been completed that it might have been interesting to have fired several shots in this test so that the bolt would reload after firing a shot. In the particular test the rifle was loaded with one round which was ejected, and the bolt remained open. Had the bolt gone forward under pressure of the mainspring, a weight of 1 pound of the bolt mechanism impelled by the mainspring would perhaps have slightly reduced the amount of energy which was computed. I fully agree, however, that the amount of foot-pounds measured does not necessarily indicate the effect of the rifle upon the shooter, one way or the other.

(E) With reference to the effect of the recoiling barrel upon the kick of the rifle, we take this opportunity to call attention to the fact that when the bolt and barrel of the Johnson rifle recoil for a short distance, the bolt begins to rotate on its cam. This rotation of the bolt has a very definite tendency to decrease the recoil force of the barrel, since this force is being utilized to do the work of unlocking the bolt, which at the time of unlocking is in such a condition as to create considerable resistance to this movement. This results in a marked decrease in the recoil force of the barrel by the time the bolt has been completely unlocked. This, in other words, serves as a decelerating means. This condition may be compared for contrast with the action of such rifles as the Remington or Browning Model 8 or Model 81 sporting autoloading rifle, in which weapon the barrel recoils about 4 inches instead of about seven-sixteenths of an inch as in the Johnson, the Remington barrel having no decelerating means other than a strong barrel spring and possibly friction bands such as are used in the corresponding mechanism adapted for shotgun shells.

DISCREPANCY IN WEIGHT FIGURES GIVEN FOR JOHNSON RIFLE BY JOHNSON AUTOMATICS TRUST AS COMPARED WITH ACTUAL FIGURES ESTABLISHED BY ABERDEEN PROVING GROUND

(5) In our advertising literature and catalogs, Johnson Automatics Trust generally states that the Johnson rotary type rifle weighs about 9.5 pounds. This weight was established by taking one of the first assemblies of this model with the first wooden stock made up, assembling the rifle and weighing it. That rifle weighed in the close vicinity of 9.5 pounds. As several more models had been assembled it was discovered that due to variations in the weight and density of the wood, and due to the effect of soaking the stock considerably in linseed oil, the weight of the assembled rifle varied from 9.5 up to 10 pounds. In other words, we discovered that the weight of our rifles could vary as much as half a pound.

We have looked into the practices of weighing various rifles. In general, we find that it is the practice to give the minimum weight for a rifle, with the understanding that this is the approximate weight and that the weight may vary in a great many instances as much as 4 to 8 ounces. For example, we note that in the recoil test at Aberdeen Proving Ground the Springfield M1903 rifle used weighed 9.125 pounds. This rifle is listed as weighing 8.69 pounds in the various manuals pertaining to that weapon. In other words, that rifle weighed 0.43 pound more than is stated in the manual. A member of our company recently purchased one M1917 rifle (new) and one national match type Springfield M1903 rifle. These rifles were weighed immediately after being received by their owner. The M1917 rifle, made by Remington Arms Co., weighed 10 pounds, 1 ounce. The M1903 national match rifle with type C stock without front sight cover weighed 9 pounds, 6 ounces. This model is generally supposed to weigh about 8 pounds, 14 ounces, so that its actual weight was exactly 8 ounces, or 0.50 pound more than its generally accepted weight. In comparison with these rifles, the Johnson

rifle No. R17, the rifle tested at Aberdeen Proving Ground, weighed on the scales used for the other rifles exactly 10 pounds, 1 ounce.

FUNCTIONING WITH M2 AMMUNITION

(6) We note in this report the statement that no definite information should be given as to the ability of the rifle to function with M2 ammunition, as this ammunition was used only when the rifle was fired in a machine rest. We respectfully invite attention to the fact that on the occasion of a test of an earlier model of the Johnson rifle having the vertical-type magazine at Aberdeen Proving Ground in August 1938, 600 rounds of M1 and 600 rounds also of M2 ammunition were fired in the same rifle consecutively, and we feel safe in stating that on the whole it was apparent that the Johnson mechanism is quite capable of functioning with M2 ammunition as well as with M1 ammunition without adjustment.

We also note, however, that 25 rounds of ammunition were fired having a charge of 75 percent of standard for M1. No malfunctions were noted with the 25 rounds so fired with the possible exception of a failure of the bolt catch to hold the bolt open in one instance, and it is believed that this was not due to the ammunition but to a defect in that bolt catch which was later replaced according to the report.

This company appreciated the opportunity offered by the Ordnance Department to select whether M1 or M2 ammunition should be fired during the bulk of this test. M1 ammunition was selected because of the fact that this ammunition has higher pressure and is generally more abusive in prolonged functioning to a semi-automatic rifle than M2. This company, however, has no preferences as between these two types of ammunition, and will always be ready at any time to furnish the same rifle or another rifle for whatever tests may be desired to prove conclusively that the same rifle will function as well or even better with M2 ammunition than with M1. It is hardly necessary to state that this company has fired many thousands of rounds of M2 ammunition or the equivalent in factory tests for functioning and accuracy.

The dagger-type bayonet which was furnished with the rifle tested at Aberdeen Proving Ground is not especially adapted for functioning with M2 ammunition. The rifle itself, however, is quite capable of doing so. A full-size blueprint was shown of a fixed-type bayonet which was not quite finished at the time of the test, and which is especially designed for functioning with M2 ammunition on the rifle. This bayonet assembly was installed on rifle No. R13, the rifle which was used in the recoil test at the proving ground, and this rifle with the bayonet was shown to the Chief of the Technical Staff, Small Arms Division, Ordnance Department, during January 1940. This model with the fixed-type bayonet is always available at any time for any functioning tests which might be desired, more especially in conjunction with M2 ammunition.

COMMENT ON BAYONET

(7) In the above paragraph mention was made of a fixed-type bayonet. Attention is called to the fact that this bayonet, full-size drawings of which were shown at the proving ground and a model of which is now available and which has been shown to a representative of the Ordnance Department, does not recoil during the thrust as it is fixed to the receiver of the rifle. This bayonet does not in any way interfere with the recoil of the barrel.

HANDGUARDS

(8) With reference to the very fair and fully justified criticism that after 90-100 rounds of rapid fire it was not possible to leave the hands for any length of time on the radiator sleeve over the barrel of the Johnson rifle, as well as the fact that it would be impracticable under almost any conditions to rely upon the bare barrel as a handle for bayonet fighting, we respectfully submit the following explanation of our reason for not providing handguards on our semiautomatic rifles.

First of all, by way of comparison, we have conducted or witnessed several tests or demonstrations wherein rifles, caliber .30, M1917 and M1903, having wooden handguards, have been fired at a rate of approximately 15 shots per minute up to 60-80 rounds under weather conditions which in most instances were very favorable to efficient cooling. One such demonstration was recently made at Camp Sims in the District of Columbia on an extremely cold day in January 1940. This was witnessed, incidentally, by several members of the Small Arms Division of the Ordnance Department. It was especially noted by the writer that with the standard bolt-action service rifle it was extremely impracticable to place the hands

around the handguard due to the overheating of the wood as well as to the heated oil which oozed around the wooden stock, not to mention the lower band, and the forward upper half of the exposed receiver. On the M1903 rifle the handguard clips burnt the hands even before the wood was sufficiently hot to make it impracticable to hold the rifle at that point.

We have therefore, as a result of these and other tests, been forced to the conclusion that while wooden guards might be serviceable in tropical countries to prevent the metal parts from becoming too hot to be handled because of the rays of the sun, nevertheless in a rifle of the semiautomatic type an attempt to cover the barrel with wooden guards merely serves to aggravate the conditions of overheating which are inevitable in a gun capable of being fired at rates of 15-40 shots per minute. It has been our conclusion that unless some new composition of asbestos can be made available, which material would in some respects otherwise be more satisfactory for the purpose than wood, it would not be practicable for us to present our rifle with any handguards.

We realize that this is very much a matter of opinion, and we are merely indicating the reasons which underlie our having adopted this position.

RATE OF FIRE

(9) We are quite in accord and deeply appreciate the comments made in this report relative to rate of fire. We deeply appreciate the confidence shown in us by the reporting officer in confirming without actual proof being required other than witness records our statement that our rifles have fired up to nearly 40 shots per minute, beginning with the magazine loaded, and firing at the equivalent of a D target at 200 yards or a reduced target at 100 yards. Following the conclusion of the test at the proving ground, we conducted a factory test in the presence of witnesses in which, beginning with Johnson rifle No. R15 empty, 66 rounds were loaded and fired in 1 minute, resulting in a group at 12 yards of 11 inches in diameter. The standard Army L target was used for this firing, and 25 out of 66 were in the bull's-eye. All shots were contained within the 8-ring.

We respectfully submit that one of the advantages of rifles of the semiautomatic type having magazine capacity of 10 cartridges plus 1 in the chamber, lies in the fact that in most cases the soldier may be carrying the rifle fully loaded, and may have an opportunity to fire only one magazine load. Under such circumstances, the soldier can certainly fire as fast as one aimed shot per second, depending upon the distance of the target, its size, and characteristics. As a typical instance we submit the case of a low-flying airplane which gives the soldier hardly time to fire 11 shots from a magazine which was loaded before the target appeared. In our test we have found it possible to fire 1 shot per second up to 10 shots at the D target at 200 yards or at the reduced D target at 100 yards, getting all shots into the bull's-eye.

MISCELLANEOUS

(10) A. We wish to comment on the fact that our rifle No. R13 was submitted for the recoil tests so as to expedite the test program, not because the R17 rifle was unfit to fire, as indicated in the report.

B. Mr. L. Whiting, our mechanic, assembled the new magazine body and new butt stock to the R17 rifle in about 11 minutes. However, that rifle was quite capable of firing as a five-shot auto-loader, as indicated in the report.

C. The R17 rifle was not cleaned between the first and second sand tests at Mr. Johnson's suggestion, chiefly to avoid delaying the program. Thus it was subjected to a double test.

D. With the permission of the test officer Mr. Johnson demonstrated rifle No. 13 as follows:

1. Removed the entire magazine assembly.
2. Loaded and fires six rounds using the rifle as a single-shot arm.
3. The rate of fire was about 3 to 5 seconds per shot, the rifle being fired generally at a mark from the shoulder. This was done to show that even though the magazine were damaged the rifle could still be fired very effectively.

CONCLUSION OF COMMENTS

(11) In conclusion we wish again to state that we are extremely grateful for and appreciative of the opportunity of having this test, of its fairness and thoroughness, and of the fairness and thoroughness of the report which has been furnished us and upon which these comments are based.

[From Time, May 6, 1940]

WANTED: A RIFLE

Without infantry, armies cannot win wars; without rifles, infantry cannot fight. The United States Army therefore thought hard and long before deciding in 1936 to junk its rugged, battle-tried Springfield rifle and adopt a new, rapid-fire, semiautomatic called the Garand (for inventor John C. Garand, a civilian who works for the War Department). After nearly 5 years, the Army last week was still using mostly Springfield rifles, and thinking about Garands. Official excuse for this situation: That the Garand has not yet been supplied to the Army because it is still going through a normal process of trial, error, correction. Some critics think there is another reason: Misjudgment, followed by scandalous reluctance to admit and repair a mistake. This week a serious charge against the Garand is being made public.

Last March a House subcommittee thrashed out the Garand argument with the Army's Chief of Ordnance Charles M. Wesson. Cagney, capable Major General Wesson stood up for the Garand ("the best semiautomatic rifle every considered by the Army"). When Congressmen wanted to know who originally sponsored the Garand, General Wesson passed the buck to the Infantry. He also confirmed a rumor which reflects more gravely on Army bureaucrats than on their new rifle. In the fourth year (1939) of Garand tests, the Army discovered a defect so serious that a new barrel had to be designed. As of last February 16, the Army had on hand 28,088 Garands with the faulty barrel. It is still getting them (200 a day from its own Springfield Arsenal), will have 35,000 to 40,000 defective Garands in service before tools are installed to make the corrected barrel.

The Army has spent some \$15,000,000 on Garands, needs at least \$6,500,000 more to reach its goal of 240,559 new rifles by June 1942. After hearing General Wesson, the House committeemen approved a \$2,000,000 appropriation for fiscal 1941 with this significant reservation: "The committee is unwilling to take the responsibility of not doing so, even though it later may be found that we have gone ahead too rapidly." Said Committeeman D. Lane Powers (New Jersey): "We do not want to appropriate for * * * additional rifles if what we hear and what we read and what we are told by some well-informed people is true."

One of Congressman Powers' informants was Maj. Gen. Milton A. Reckord, who is head of the Maryland National Guard and executive vice president of the authoritative (though civilian) National Rifle Association. "My opinion," testified General Reckord, "is that the War Department has made a very grave mistake. * * *" Just how grave the mistake may have been, General Reckord's National Rifle Association disclosed in the May issue of its *American Rifleman*.

A Rifleman expert (F. C. Ness) somehow got one of the jealously guarded Garands, tested it by firing a moderate 692 rounds in 3 days. Mr. Ness's verdict: "A fine combat weapon, with certain shortcomings." He emphasized the shortcomings:

Garands are supposed to be rapid-fire guns, banging out (from clips of 8 cartridges) 26 aimed shots a minute, many more shots if unaimed. Mr. Ness wrote: "When we fired (the Garand) very slowly, loading each cartridge into the chamber by hand, the oil started to bubble out * * * in tiny specks after 40 shots to 60 shots fired in 25 to 35 minutes." In brief: Fired at speed, the Garand would get so hot no soldier could hold it.

By Army account, the Garand is accurate at ranges up to 600 yards (far enough for ordinary combat). National Rifle Association's Garand was disgracefully inaccurate at 600 yards and less. On a 600-yard target, with the gun locked in a bench vise, its shots at the end of 60 rounds were hitting 6 feet below the mark. Reason: "* * * The barrel * * * warped or buckled as it heated from our slow-fired shooting (only 130 shots in 3 hours)."

At the three-hundred and ninety-fifth shot, the National Rifle Association Garand began to falter. During the final rounds it broke down, so hopelessly fouled by carbon that it could not be used until it was dismantled, cleaned, lubricated, reassembled—a complicated job for a soldier under fire.

One man who rubbed his hands over this report was a tall young Bostonian named Melvin Maynard Johnson, Jr., captain (Marine Corps Reserve). Johnson wants the Army to buy a semiautomatic rifle which he has designed. The Army has tested the Johnson rifle, says the Garand is better, has not published enough comparative data to prove or disprove its statement. "Ideal for combat and for battlefield firing," Maj. Gen. Walter C. Short called the Garand

last week, reporting its performance in Army maneuvers. Expert Ness rates the Johnson far above the Garand.

Whoever is right, Melvin Johnson makes sense when he says: 'The point is not whose rifle, or whose face, or what procedure. * * * The real problem is to get a suitable, manufacturable, reliable, rugged rifle, and plenty of them.'

[From the American Rifleman, June 1940]

SEMIAUTOMATIC DEMONSTRATION

Under the auspices of the War Department, a group of interested observers gathered on May 9, at Fort Belvoir, Va., to witness some limited firing with three makes of semiautomatic weapons. These were the gas-operated M1 (Garand), the short-recoil Johnson and the blow-back Thompson submachine gun. The latter used the .45 pistol cartridge so that the focal point of interest was upon the other two arms which were fired with both M1 and M2 .30 caliber ball ammunition. The demonstration was conducted under the direction of Capt. Rothwell Brown, who is one of the Army's experts on the Garand and will be remembered by those who were present at Camp Perry last year as the Garand rifle instructor in the Small Arms Firing School.

The presence of Senators, Congressmen, and high Army officials as well as newsmen lent importance to the shooting. The demonstration, however, proved absolutely nothing. As planned and conducted it was not a test, but merely a noncompetitive firing demonstration. The D target (26 inches), and the B target with its 20-inch bull, were used and hits were scored as they landed on these big targets without reference to relative accuracy and without measurement to ascertain relative group sizes. As a matter of fact, the writer noted that the smallest groups observed through his spotting scope made poorer scores than more-scattered but better-centered strings.

Each rifle was sighted in before each separate demonstration, which arrangement made it impossible to determine whether any rifle or barrel tended to "walk" or change its zero. However, we did note, in some unscheduled firing of 160 rounds with the Garand at 600 yards, that the impact moved lower and lower until shots registered on the ground in front of the target. The marksman admitted holding higher on the target to compensate for this low-shooting tendency, which fact supported our recent criticism of the Garand rifle with reference to the buckling of its barrel, as published in the American Rifleman last month, and since supported by other tests.

JOHNSON SEMIAUTOMATIC RIFLE FIRING-TEST REPORT, MONTAUK POINT, N. Y., FEBRUARY 9-10, 1940

[NOTE.—This is merely an illustrative report. It does not purport to represent the very best performance. The results are only average. Particular attention is invited to the severity of the sand tests, as well as to the adverse weather conditions of February 10. This report has been abstracted to include only essentials for record.]

REPORT—DEMONSTRATION AND TEST OF JOHNSON SEMIAUTOMATIC RIFLE, CALIBER .30, 1906 (M1, M2), TYPE R AND TYPE V; THE JOHNSON LIGHT MACHINE GUN, CALIBER .30, 1906 (M1, M2), FOR THE REPRESENTATIVES OF THE FRENCH AND BELGIAN GOVERNMENTS, ALSO ATTENDED BY THE BRITISH PURCHASING COMMISSION, DATE: FEBRUARY 9-10, 1940

Place: Montauk Point, Long Island, N. Y.

Test conducted by Johnson Automatics Trust.

Total number of rounds fired.—1,200, approximately.

Rifles used.—Johnson semiautomatic rifles Nos. R13, R15, R17¹, V5, and model No. 1, Johnson light machine gun. (One new Springfield, model 1903, caliber .30, national match type rifle and one new Enfield, model 1917, caliber .30, rifle were used for comparative purposes.)

Barrels used.—Two 24-inch Winchester barrels, two 22-inch Winchester barrels, one 20-inch Winchester barrel, all in .30 caliber; also one Winchester 24-inch, caliber .270 barrel.

¹ Johnson rifle No. R-17 with barrel No. W-17 was the rifle used in the endurance test made by the Ordnance Department, U. S. Army, at Aberdeen Proving Ground, Md., during the period Dec. 19-30, 1939.

Bayonets used.—One Johnson dagger-type bayonet with 8-inch blade, and one Johnson sword-type bayonet with 20-inch blade. (The dagger bayonet weighs one-half pound, the sword bayonet 1 pound, approximately.)

Range used for record target firing.—500 yards.

Targets used for record firing.—United States Army "D" silhouette targets.

Size of bullseye.—Bullseye represents head and shoulders of man in the prone position; extreme width, 26 inches; extreme height, 19 inches.

Note.—The United States Army "D" target is used in marksmanship qualification firing with the M1903 Springfield rifle at 200, 300, and 500 yards. The same target is used by the United States Marine Corps for qualification firing. At 500 yards, commencing with the magazine loaded and one round in the chamber, 10 shots are fired in 1 minute and 20 seconds at the "D" target for qualification.

Rifles fired by.—M. M. Johnson, Jr. (Captain, U. S. Marine Corps Reserve).

Weather conditions.—On February 9 conditions were excellent until about 2 p. m. when the sky became very overcast and hazy. There was very little wind. On February 10 all firing, including target firing, was conducted in a driving rain with wind. The target firing was conducted in the morning. By 2 p. m. it was impossible to distinguish the target frame at 500 yards and target firing was given up of necessity. This, in particular, prevented target firing at 1,000 yards.

MORNING OF FEBRUARY 9

1. General functioning with a Johnson semiautomatic rifle, type R (rotary-feed, clip-loaded). This rifle was loaded with and without clips, and was reloaded when wholly and partially empty by means of clips and single rounds. The rifle was fired as a single loader, loading through the magazine, and loading through the ejection port.

2. Immediately following the above, the operator gave general firing demonstrations of fire at long ranges onto water and on areas of the beach where the strike of bullets could be observed. Bursts were fired rapidly from the rifle with the maximum elevation consistent with observation of the bursts, which in this case, due to the conditions of the water equalled approximately 1,200 to 1,500 yards.

3. Commencing with the magazine loaded and one round in the chamber, the operator fired 46 aimed shots in 1 minute at a range of approximately 350 yards. This firing, in addition to the above was all done without any intervening delay, and resulted in heating the barrel so that it could not be touched, but did not prevent the observers from placing their hands over the radiating portion of the handguard without any discomfort whatsoever. Only the very foremost part of the receiver just above the forward barrel bushing was sufficiently hot to prevent the hands from being placed on that part.

4. A brief demonstration was given of the fire power coupled with mobility of a Johnson semiautomatic rifle. The operator advanced from the firing position used in the above demonstration at a run, loading the magazine while running. The operator then took a kneeling position and fired a 10-shot burst at a given area where the strike of the bullets could easily be observed in the sand. The operator then rose and ran forward approximately 50 or 60 yards, meanwhile reloading the magazine with 10 shots. The operator then again took the kneeling position and fired 10 shots at the area. This was repeated several times until approximately 30 shots had been fired.

5. A Johnson rifle was demonstrated with the dagger-type bayonet, and 5 rounds were fired with this bayonet attached. Another Johnson rifle was demonstrated with the sword-type bayonet, and 5 rounds were fired with this bayonet attached. Both bayonets were thrust into a board to illustrate the penetrating characteristics, especially those of the dagger-type bayonet which recoils slightly and was therefore hammered home more deeply in the board due to the thrust obtained from the short recoil.

6. Using the same rifle employed in the above demonstrations, each of the official observers and other witnesses were given an opportunity to fire the rifle. Among those who fired the rifle personally was the representative of the War Department of the United States, Colonel Clement, of the New York Ordnance District.

7. Approximately five 10-shot rapid-fire bursts were delivered with a view to illustrating the high rate of fire which can be delivered from a Johnson semiautomatic rifle.

(a) Ten shots were fired in 1.2 seconds.

(b) Ten shots were fired in 1.4 seconds.

8. To illustrate the shifting of fire, the operator fired 4 shots into the water, and then suddenly swung his body approximately 90 degrees and delivered a 6-shot

burst at an imaginary target approximately 25 yards distant. This was to illustrate the flexibility of fire from a rifle of this type.

9. Throughout the demonstration a considerable amount of firing was done at aerial targets for the purpose of illustrating the ability of the rifle to fire against low-firing airplanes, etc.

10. Aiming at a small bush some 400 yards from the firing point, the operator fired a rapid 10-shot burst of aimed fire to illustrate the accuracy and speed of fire of the Johnson rifle. Observers noticed that the strike of the bullet was contained within a small area on the sand hill at which the fire was directed. Ten shots were fired in approximately nine-tenth seconds.

11. Approximately two bursts of 5 shots were fired from the Johnson rifle, held in one hand with the arm extended, or by the normal method used for firing a pistol. This was done to illustrate the absence of recoil and jump of the weapon when held in a virtually unsupported position.

AFTERNOON OF FEBRUARY 9

12. At this time the operator, using standard 100-yard small-bore targets at a range of 100 yards, sighted in two Johnson semiautomatic rifles, type R. (R17¹ with barrel W12, and R13 with barrel W15. Both of these rifles have the new Johnson micrometer sight.) (NOTE.—Only 3 shots were fired with R17W12 rifle, as the range had to be closed at that time.)

13. Two operators (Johnson and G. G. Whitney, Jr., of Johnson Automatics Trust), each using a Johnson type R rifle, adjusted fire on an ice cake floating approximately 400 yards from shore. Sights were adjusted as a result of observing the strike of the bullets in the water.

14. Using Johnson rifle No. R15 with barrel No. R13, the operator (Johnson) gave an exhibition of aerial shooting. This was done for the purpose of illustrating the handling qualities of the Johnson rifle, and to illustrate the speed with which this rifle can be aimed and fired at moving targets.

(a) Holding the rifle in the left hand, with the hand around the forestock, the operator threw small rocks and stones into the air with the right hand, placed the rifle on the shoulder, aimed the rifle at the target, and fired before the target had dropped appreciably from its maximum height of flight. Approximately 10 consecutive hits were made in this fashion. The operator then used smaller targets and had approximately 50 to 70 percent hits.

The operator then used a .30 caliber empty shell as a target. The first shell thrown into the air was hit in the center. This shell was turned over to one of the observers by request.

15. In conjunction with the above aerial shooting, the operator placed a small can in the water near the edge of the beach, fired one shot under the can so as to cause the can to be bounced into the air, and then hit the can in the air. Due to the lack of sufficient cans, the operator was forced to use small pieces of wood to illustrate this type of firing.

16. The rifle was then again fired in one hand in the fashion of a pistol, and was also fired with the weapon being held upside down, supported only by the hands.

FIRST DAY'S RECORD TARGET FIRING

Range.—500 yards.

Target.—Plain beaverboard with 16-inch round bull's-eye painted on board. (This was the type of target used for firing with a 37 mm. antitank gun.)

Position.—Prone with forearm rest, without use of sling strap.

Ammunition.—Remington caliber .30 M1 (boattail, 172-grain bullet, Kleen-bore primer).

Rifle used.—Johnson No. R17¹ with barrel W12.

(a) This rifle having been sighted in at 100 yards, the operator placed the sight on the 500-yard elevation. No other correction was made. Five shots were then fired single loading. These shots grouped just to the right of the bull's-eye at 3 o'clock. In order to get a 10-shot group without regard to hitting the aiming point, the operator then loaded 5 rounds, and fired 5 shots at the rate of approximately 2-3 seconds per shot.

¹ This rifle was subjected to a 5,000-round endurance test conducted by the U. S. Ordnance Department at Aberdeen Proving Ground.

² Johnson rifle No. R17 with barrel No. W17 was the rifle used in the endurance test made by the Ordnance Department, U. S. Army, at Aberdeen Proving Ground, Md., during the period December 19-30. This rifle was also subjected to all of the abuse tests included in that program, in addition to the endurance test. Abuse tests included throwing the rifle on a concrete floor, jumping on the unsupported rifle to try to bend the receiver, breaking the stock, subjecting the rifle to sufficient abuse to bend the barrel although the receiver could not be bent, and firing excessive loads plus a 5,150-round endurance test. Barrel W12 had fired about 1,500 rounds previously.

(b) The following data was obtained from this target:

Total number of shots: 10.
 Extreme spread of the group: 19.187 inches.
 Diameter of group of 8 shots out of 10 (80 percent spread or "normal" spread): 13.5 inches.
 Extreme vertical deviation: 18.125 inches.
 Extreme horizontal deviation: 12.562 inches.
 Mean vertical deviation: 7.03 inches.
 Mean horizontal deviation: 9.16 inches.
 Mean radius: 6.87 inches.

By comparison the following data is quoted from the official accuracy chart prepared by the Ordnance Department, United States Army, for caliber .30 M1 ammunition fired from machine rest: 500 yards:

Extreme vertical: 56 inches.
 Extreme horizontal: 25 inches.
 Mean vertical: 8.3 inches.
 Mean horizontal: 3.6 inches.

The mean radius is given as 6.5 inches.
 This concluded the first day's firing.

MORNING OF FEBRUARY 10

17. The official representatives were given a complete description and explanation of the mechanism of the Johnson rifle and Johnson light machine gun. All of these weapons were completely disassembled and assembled. A detailed explanation of the operation of the weapon was given. This part of the demonstration followed part I of the program exactly.

18. Following the above program, Mr. Horace St. Amant of the Taft-Peirce Manufacturing Co. gave a complete explanation of and answered all questions concerning all manufacturing aspects of the Johnson rifle and machine gun. Mr. St. Amant exhibited all of the manufacturing drawings, together with parts list, and including a complete engineering study of the manufacturing methods and processes required for the production of Johnson rifles. This part of the demonstration was the equivalent of part IV of the original program.

19. Returning to the firing range, the firing program continued in a driving rain storm with strong wind. A general functioning demonstration was given with Johnson semiautomatic rifle No. R17. Several shots were fired with caliber .30 ammunition in a caliber .30 barrel. The barrel was then exchanged for a .270-caliber Winchester barrel, and the same rifle was then fired with ammunition of that caliber. Sample empty cartridge cases were given to the official representatives.

20. Using the above rifle with a .30-caliber barrel, several shots were fired with standard caliber .30 Remington ammunition. Bullets were then pulled from two cartridge cases. The official representatives were then requested to remove what they considered a fair amount of powder from the standard powder charges. This was done, the bullets were replaced, and both rounds were fired and the cases ejected successfully.

21. Rifle No. R17² was fired with cal. .30 ammunition in a 20-inch carbine barrel. This barrel was then exchanged for a 22-inch barrel, and the rifle functioned with this barrel. In turn, a 24-inch barrel was substituted, and the rifle functioned with this barrel successfully. This test was conducted to show the flexibility of the Johnson mechanism in that it is not only capable of firing with variations in the powder charges, but is also capable of firing with variations in the length of the barrel, as well as with ammunition of different calibers.

Demonstration of Johnson light machine gun

Cal. .30-'06 (M1, M2)

22. The operator fired two 10-shot bursts from the shoulder without supports, using the Johnson light machine gun, which weighs approximately 12 pounds, and fires full automatically. This mechanism is the same as the Johnson rifle. This was done to show that the machine gun can be fired in bursts without artificial supports, and that the bursts can be delivered with reasonable accuracy.

² Johnson rifle No. R17 with barrel No. W17 was the rifle used in the endurance test made by the Ordnance Department, U. S. Army, at Aberdeen Proving Ground, Md., during the period December 19-30, 1939.

This also demonstrated that the gun does not climb. The operator then fired the machine gun in single and double shots by manipulating the trigger rapidly. This gun was also fired vertically into the air to illustrate its application on aerial targets. One burst was fired from the kneeling position.

23. The official witnesses then fired bursts of 3, 5, and 7 shots from the Johnson light machine gun. It was noted that the official representatives found no difficulty in controlling the bursts fired from this gun, notwithstanding the fact that this was their first experience with that weapon.

Brief demonstration of rifle functioning with M1 and M2 ammunition

24. Rifle No. R17³ fired 5 rounds with M1 ammunition, and then 10 rounds of M2 ammunition were fired in the same rifle. The functioning was identical.

Target firing for record

Range.—Five hundred yards (500 yards).

Position.—Prone, with forearm rest, without using sling.

Rifle used.—Johnson Rotary Feed No. R17³ with Winchester W12 cal. .30 barrel.

Ammunition.—Remington cal. .30 M1¹ (boattail 172-grain bullet, Kleenbore primer).

Target.—United States Army standard "D" silhouette target.

NOTE.—This target is used in United States Army and United States Marine Corps qualification firing at 200, 300, and 500 yards. At 500 yards in the standard Springfield M1903 cal. .30 rifle qualification course the operator is required to fire 10 shots in 1 minute 20 seconds, commencing with the weapon loaded. This is an average rate of fire of 8 seconds per shot. Excluding the time required to load the second 5-shot clip during this course, the actual rate of fire of the rifle is approximately 7 seconds per shot, allowing 10 seconds for the loading of one clip which is more than the usual time required for that operation. The possible score at this range is 50, since the target has a value of 5 for a hit in the bull's-eye, and has in addition 4, 3, and 2 rings. A score of 45 out of 50 is within the general average for expert with the Springfield rifle. It must be noted that the qualification course prescribed for the United States Garand (M1 model) semiautomatic rifle, cal. .30 M2, does not include any rapid fire beyond 300 yards, and requires only 4 shots slow fire at 500 yards. The "D" target bull's-eye is 19 inches high by 26 inches wide at the extreme measurements, and represents the head and shoulders of a man in the prone position. The 4-ring which surrounds the bull's-eye offers its greatest scoring area below the bull's-eye, for the reason that in actual combat a shot striking short of the target would normally ricochet, causing a casualty. The bulk of the 4-ring, therefore, represents the ricochet area or the body area of a man in the kneeling position, not including the legs or lowest portion of the torso.

25. (a) Five shots were fired using the same sight setting of the day before so as to establish the uniformity of the weapon and its barrel mounting. This group of five shots struck at 3 o'clock just to the right of the bull's-eye, as on the day before.

(b) The operator then moved the receiver sight 4 clicks to the left, or the equivalent of 12 inches, each click being approximately .6 minutes. The next 5-shot group resulted in 4 bull's-eyes and 1 just out. This completed the sighting in of the rifle.

Accuracy in rapid fire

26. (a) This test consisted of firing two consecutive strings of 10 shots each at a rate slightly above 1.4 seconds per shot in the first string, and slightly below 1.4 seconds per shot in the second string (14.5 seconds for 10 shots in the first string, and 13.5 seconds for 10 shots in the second string), or an average of 1.4 seconds per shot for two strings. This firing was done, commencing with the rifle fully loaded.

Range: 500 yards.

Number of shots in first group: 10.

Diameter of first group, extreme spread: 28 inches.

Number of shots in second group: 10.

Diameter of second group, extreme spread: 26 inches.

Rate of fire: 1 shot per 1.4 seconds, or 43 shots per minute, cyclic rate.

³ Johnson rifle No. R17 with barrel No. W17 was the rifle used in the endurance test made by the Ordnance Department, U. S. Army, at Aberdeen Proving Ground, Md., during the period December 19-30, 1939.

[NOTE.—The following tabulation is made taking the entire 20 shots together as one group. It should be noted that it is the normal practice to take the average of separate groups of 10 shots each, rather than to combine groups, and take the figures for the entire combined groups. However, a 20-shot group is extremely indicative of the uniformity of the rifle and ammunition.]

Total number of shots in group: 20.

Extreme spread, 20 shots: 32.25 inches.

Scoring value: 12 bull's-eyes, 8 in the 4-ring or 92 out of 100 (this would be an average of 46 out of 50 for 10 shots).

Normal spread or diameter of group containing 85 percent of 20 shots: 23.5 inches.

Extreme vertical deviation, 20 shots: 25.5 inches.

Extreme horizontal deviation, 20 shots: 29.5 inches.

Mean vertical deviation: 12.43 inches.

Mean horizontal deviation: 11.24 inches.

Mean radius: 9.23 inches.

[NOTE.—The above score is above the expert requirement of approximately 90 percent. In comparison with a standard 5-shot magazine repeating rifle, such as the Springfield M1903, the rate of fire of the Johnson rifle with a 10-shot magazine on the basis of 10 shots from each rifle, is slightly over 5 times as great for at least the equivalent of accuracy. (The rate was slightly better than 1.5 seconds per shot with the Johnson, as compared with 8 seconds per shot for the Springfield. On the basis of merely firing 5 shots from each rifle, the fire superiority is about 4 times as great in the Johnson.)]

Accurate deliverable fire per minute at 500 yards

27. Commencing with the magazine and chamber empty, 23 shots were loaded and fired within 1 minute.

[NOTE.—Considerable difficulty was experienced due to the weather conditions. The operator was troubled by water, which splashed in the eyes, and the visibility was very poor.]

First 1-minute rapid-fire target

Number of shots: 23.

Extreme spread, 23 shots: 32 inches.

Extreme vertical deviation, 23 shots: 30.5 inches.

Extreme horizontal deviation: 25.125 inches.

Normal spread (82 percent of the shots): 21.625 inches.

Scoring value: 13 bull's-eyes, 8 in the 4-ring (all of these were casualty hits), 2 in the 3-ring.

Total possible score: 115.

Actual score: 103-115.

Scoring percentage: 89.5 percent.

Due to the increasingly bad-weather conditions, which soon resulted in entirely obscuring both the 500-yard and 1,000-yard target frames, further target firing was discontinued.

AFTERNOON OF FEBRUARY 10

28. The official representatives again fired the light machine gun for several bursts, and also fired one of the Johnson rifles from the shoulder to compare the recoil with the Enfield and Springfield rifles.

29. The operator then gave a demonstration to compare the fire power of the Johnson rifle with that of the Enfield and Springfield rifles, using the test data of the previous day as well as that of the morning of February 10 for comparisons, as follows:

(a) Maximum potential rate of fire of Enfield or Springfield rifle

The operator fired 5 shots from the hip with these bolt-action repeating rifles in approximately 3 to 5 seconds per 5 shots. One string of 5 shots was timed in 3 seconds. It was commented that this was the absolute maximum possible speed that could be obtained by almost any operator with this type of weapon. In comparison it was noted that the maximum speed of the Johnson rifle for 10 shots was 1.2 seconds and 1.3 seconds. For 5 shots the Johnson averaged approximately .6 to .7 second, or on this basis the Johnson went slightly over 5 times as fast potentially as the bolt-action repeating rifle. The repeating rifles were chiefly fired from the hip without aim.

(b) The operator fired both the Springfield and Enfield rifles from the shoulder, very hastily aimed, at the rate of about 5 shots per 7-8 seconds.

(c) The operator fired an Enfield rifle for 1 minute from the shoulder, at a rate of about one shot per 2 seconds. Unfortunately, there was a serious magazine malfunction in the Enfield rifle which necessitated removing the magazine group, and prying out the jammed cartridges. This slowed down the actual fire delivered in 1 minute.

(d) The official representatives were asked to examine the handguards of the Springfield and Enfield rifles after several minutes of rapid fire, and it was noted that it was impossible to hold the hands on certain parts of the wooden handguards. Moreover, the oil from the stocks was sizzling. However, due to the cold and wet condition, these weapons did not become as hot as would have otherwise been the case, but it was noted by comparison that the Johnson radiator was practically cold despite all of the rapid fire conducted with this weapon. The operator was extremely fatigued as a result of rapid fire conducted with the repeating rifles, and this was noted by the official representatives.

Sand test

30. Before describing this portion of the test, it must be distinctly understood that the entire demonstration had been conducted on a sandy beach, and that throughout the entire day of February 10 it had been raining quite heavily. As a result all of the sand on the beach was wet, and therefore very sticky, and quite unlike the type of sand normally used in so-called official sand tests, especially in that the grains of sand were larger than those of the fine powder sand normally used. This test was conducted as follows:

(a) Johnson rotary-feed type rifle No. R15 with W13 barrel fired 10 rounds for general functioning. The operator then laid the rifle on its left side with the ejection port up on the beach, the muzzle of the rifle being elevated just sufficiently to prevent sand from getting into the muzzle. The magazine was loaded and a round was in the chamber. The safety was on. No part of the gun was plugged with any artificial material. Handfuls of sand were then thrown over the entire rifle. This included throwing sand into all apertures which were exposed. Attention was called to the fact that there were no apertures on the left side of the gun, and therefore it was placed in its worst position, being exposed on the right-hand side. Sand was particularly thrown also into the radiator. The official representatives having indicated that they were more than satisfied with the severity of this test, and it being commented that this was quite unfair to the weapon, the operator then picked up the rifle, shook it a half dozen times, and blew some of the sand out of the radiator and around the bolt. The operator then removed the safety, and fired the rifle. The rifle functioned satisfactorily, without any stoppages or malfunctions. The operator then reloaded the rifle, and fired it again, without any malfunctions or stoppages. After firing approximately 4 or 5 clips it appeared that the rifle was functioning in a perfectly normal manner and was not in the least injured or damaged by this test. The rifle was not cleaned or oiled thereafter.

(b) The operator then dug a trench in the sand, and laid the rifle on it, with the muzzle raised sufficiently to prevent sand from getting in at that point. The muzzle was not plugged, however, as is customary in sand tests. The rifle was loaded with a cartridge in the chamber and the safety on. The operator and an assistant then proceeded to bury the entire rifle in sand until no part of it could be seen other than the point of the muzzle. The rifle was photographed in this position. It was commented that this was grossly unfair to the rifle to subject it to this type of test, especially in wet sand. The official representatives having indicated that they were more than satisfied with the severity of this test, the operator removed the rifle, shook it three times, but did not blow any sand from the mechanism. The rifle functioned for approximately 8 rounds as a hand-operated weapon. On approximately the 9th and 10th rounds the empty cases were ejected. The rifle was then reloaded and in the next 5 rounds it began to eject normally. By the time several more clips had been fired, the rifle was functioning more or less normally, without any stoppages. The operator continued to fire the rifle until it appeared very obvious that the rifle was now functioning in a normal manner. About 30 rounds were thus fired.

(c) The rifle not having been cleaned at any time since the beginning of this sand test, the operator then threw a standard 5-shot clip into the wet sand. The operator picked up this clip, shook it a few times, wiped the sides of it on his trousers, loaded this clip into the magazine, demonstrated that the rifle would still function as a repeating arm with sand-covered ammunition. A second clip

was inserted and in operating the weapon by hand, the operator pushed the bolt forward so fast to load a round by hand that the link connecting to the mainspring jumped out of its socket in the mainspring follower. This caused the bolt to stick in the half-open position after that round was fired. The operator removed the back plate or bolt stop plate, reconnected the link, and continued to fire the rifle. After approximately 5 or 10 more rounds the rifle commenced functioning in a normal manner. Approximately 50 or 60 rounds were thereafter fired with this rifle and it was noted that the functioning became almost normal, except for the fact that there was an occasional failure to feed due to the failure of the bolt to eject the empty shell with sufficient power. It was observed that the more the rifle was fired the better its functioning became, and at the very end of the afternoon's demonstration it was noted that the rifle was functioning almost normally. About 150 rounds were fired with this rifle thereafter, all without any cleaning or oiling.

CONCLUSION OF FIRING DEMONSTRATION

31. Using the rifle No. R15 which had been subjected to the above sand test, the operator gave a final demonstration of aerial shooting to the official representatives, which consisted of throwing a bottle in the air, of throwing an empty shell in the air and hitting that in the center, of causing several blocks of wood to be bounced out of the water with one shot and hit in the air with another, and of hitting several small stones thrown in the air, the last stone hit being approximately one-half inch in diameter.

NOTE.—The fog had become so thick by 3:30 p. m. that it was impossible to do any more shooting, and the official representatives were then asked if there was any further firing which they required in order to satisfy themselves as to the performance of the Johnson semiautomatic rifle or machine gun. It being indicated that nothing further could be required and that everything possible had been done, the representatives were then taken indoors where the Johnson rifle No. R15 with barrel W13 was disassembled for their inspection, in order to give them an opportunity to examine this mechanism which had been subjected to the rather severe sand tests above described. The representatives were shown the ease with which the mechanism could be readily cleaned after field stripping, and it was noted that there was comparatively little sand in the vulnerable parts of the mechanism. It was noted that the design of the magazine is such that even a substantial amount of sand inside of it would not actually cause any material interference with the passage of cartridges, due to the ribs which are stamped into the body of the magazine itself. These ribs prevent the cartridges from rubbing against the walls of the magazine except at two points.

This concluded the official demonstration and test.

[NOTE.—On February 11, rifle No. R15 fired approximately 200 rounds in the presence of witnesses after having been given a simple field cleaning. This rifle functioned normally throughout this firing.]

OBSERVATIONS

While the test program originally specified firing at 100 or 200 yards for record targets, the official representatives agreed with the operator that it was much more conclusive to conduct the target firing at a range of 500 yards. The representatives were informed that in rapid fire it would naturally be much more impressive for the operator to shoot at the standard "D" target at 200 yards where its comparatively larger dimensions would make it much more simple to obtain a high score. The attention of the representatives was called to the fact that in a recent issue of a nationally distributed picture magazine, a "D" target fired on by the Garand semiautomatic rifle was shown, but it was pointed out that this target was fired upon at a range of only 200 yards, instead of at 500 yards.

MILITARY HANDBOOK OF THE JOHNSON SEMIAUTOMATIC RIFLE

FOREWORD

No army in the world is actually equipped with semiautomatic rifles. Yet there can hardly be a general staff which is not acutely aware that the advent of the semiautomatic rifle is inevitable in the development of firearms. The single-shot breech loader rendered the muzzle-loader immediately obsolete. The magazine rifle displaced the single-shot breech loader. The self-loading semiautomatic is now about to dislodge the magazine rifle, which, as a bolt-action type, has been the standard military arm for 50 years.

The armies of the world have not accepted these developments from choice but from necessity. Technical and tactical superiority go hand in hand. The issue of modernity is too important to be disregarded.

No technical development, however, has displaced the infantryman and his rifle as the basis of all battle action. Their success depends on mobility and fire power. The former has been aided by mechanization. The latter is precisely where it was in 1914.

Presumably it can be accepted that until some radical substitute for the conventional rifle cartridge is evolved, the semiautomatic rifle is the most deadly, most efficient, and most mobile single weapon capable of being carried and operated by the individual soldier. Firing between thirty and forty aimed shots a minute, its effective rate of fire is from two to three times that of the magazine rifle.

Little imagination is required to visualize the opportunities offered by such an increase in potential fire power. The small, compact corporal's command assumes the present importance of the platoon. The low-flying airplane, the tank, the armoured car, become menaced by infantry, who virtually helpless today, tomorrow may be capable of delivering bursts of ultra high-velocity armour-piercing ammunition at the rate of a round a second per rifle.

With no necessity for bolt manipulation, the plane can be led as one would a flying bird with a shotgun. So intense a concentration by a number of rifles would render the tracks of vehicles and all but the heavier types of armour vulnerable.

For short bursts, the semiautomatic rifle will accomplish some of the missions of the light machine gun, with economy in life and energy, while still retaining its main characteristic as the mobile individual weapon for assault or defense.

The military semiautomatic requires little more for its development than an action capable of economical and rapid manufacture which will function reliably in spite of the maltreatment and harsh conditions inevitable in active service. Needless to say, it must be light enough to fulfill its function as the individual soldier's weapon.

Both energy and ingenuity have been bestowed on this problem which at first sight might appear simple enough. Many solutions have been offered. A fraction of them, like the gas-operated Mondragon which was given a trial by the German Army in 1914, have been carried beyond the tool room to the field-test stage, only to be discarded in the end as impracticable. Today another gas-operated weapon is probably the only military semiautomatic which has achieved the stage of actual manufacture in quantity.

There are two expedients, generally speaking, by which a rifle may be made self-loading—by harnessing the energy of recoil, or by utilizing the gases generated in the explosion of the cartridge. The necessity for highly critical tolerances combined with essential lightness in weight have served to defeat the latter. For the moment, at least, gas-operated rifles, constitutionally delicate and intricate to manufacture, may be regarded as interesting experiments but impracticable for military use.

Recoil is the simplest and most fundamental force available in a rifle for performance of the cyclic functions of ejecting the fired round, recocking, and reloading. It has been used in the past in belt-fed machine guns and in automatic pistols. The former are necessarily intricate mechanisms, heavy and cumbersome. The latter are suited only to ammunition developing low pressures.

Military requirements and the modern high-powered cartridge, developing pressures from fifteen to forty tons per square inch present peculiar problems. The Johnson Semi-Automatic Rifle, a newcomer in the field, has solved these problems.

The Johnson Semi-Automatic Rifle is a recoil-operated weapon. Weighing approximately nine and a half pounds, it is within the weight limit for a military weapon. It is sufficiently simple that there is no part of it which could not—indeed which has not—been manufactured in a normally equipped machine shop. In functioning it is at least as reliable as the modern manually operated bolt-action rifle.

No special lubrication is required. It is accurate. It may be stripped to the last part in a matter of seconds. It may be stripped, moreover, by unskilled hands.

The Johnson Semi-Automatic Rifle fulfills military requirements. It is the individual soldier's weapon, the military semiautomatic par excellence.

SECTION I. OBJECTIVES AND POLICIES

The Johnson Automatics, Inc. takes pleasure in announcing the Johnson Semi-Automatic Military Rifle, cal. .30 M1 and other military calibers. The Johnson Semiautomatic Rifle (as well as the Johnson Light Machine Gun, described separately) was invented by Captain Melvin Maynard Johnson, Jr., U. S. Marine Corps Reserve, of Boston, Mass., in 1936. The inventor is the president of Johnson Automatics Trust.

A semi-finished pilot model of the rifle was completed in 1936, and the manufacture of several test models was begun. During 1938 four additional models of the rifle were completed and given unusually severe firing tests.

In the same year complete production drawings were prepared. Proof models made from these drawings were built for the purpose of establishing the reliability of the measurements on the drawings.

The Johnson Automatics, Inc. is now prepared to furnish these rifles upon order in any desired quantities. Qualified manufacturing organizations indicate that delivery of initial lots can be made within 8 to 10 months of receipt of orders, subject to the quantity required.

The Johnson Automatics, Inc. is organized for the purpose of procuring the manufacture of Johnson rifles. Thus, it is possible for the Trust to contract with one or more manufacturing organizations for the filling of orders. The Trust is, therefore, in a position to fill orders promptly and efficiently.

The Johnson Automatics, Inc. lays primary emphasis upon manufacturability, and, more especially, upon interchangeability of component parts. Johnson rifles are made from thoroughly proven production drawings. The tolerances established on these drawings have been proved in by the construction of firing models made to the maximum, minimum, and median limits established on the drawings. There are no hand fitting operations (gunsmithing) required or allowed in the making of Johnson semiautomatic rifles. All parts are expected to fit as they come from the machines. The accomplishment of this objective is believed to be unique in the field of military firearms.

In the event a buyer of military rifles prefers to arrange for the manufacture of the rifles in the buyer's own factories or arsenals, the Johnson Automatics Trust has prepared complete manufacturing data. It is in a position to furnish all the necessary specifications of production equipment, together with the necessary production equipment if it is desired that the Trust shall furnish this.

Attention is called to the fact, however, that the Johnson Automatics, Inc. can give more rapid deliveries of completed rifles when orders for the manufacture of rifles are placed with the corporation. Inasmuch as the Johnson Automatics, Inc. is also engaged in the manufacture of semi-automatic sporting rifles, it will be possible for the Corporation to give extremely rapid delivery where the buyer's specifications do not deviate materially from the specifications of the standard Johnson semi-automatic sporting rifle.

The Johnson Automatics, Inc. is, of course, fully protected by domestic and foreign patents. In order to avoid misunderstanding, attention is drawn to the fact that the Johnson Semi-Automatic Rifle is a very recent development. It has never been rejected by any government or other buyer.

SECTION II. GENERAL DESCRIPTION

a. The Johnson Semi-Automatic Military Rifle is a self-loading shoulder weapon of the short recoil type adaptable to any high-powered cartridge. It is equipped with a rotary feed magazine with a capacity of ten rounds loaded from any standard clip, or with a vertical feed box magazine of optional capacity.

The rifle fires semi-automatically only, as slowly or as fast as may be required, by a separate pressure of the trigger for each shot. The rifle will only fire if the breech is closed and locked. The force of recoil is utilized to operate the mechanism of the rifle.

Upon the cartridge being fired, the barrel recoils approximately $\frac{3}{8}$ ths of an inch. During the rearward passage of the barrel the rotary bolt is turned through 20° by the action of the camming arm on the bolt against the camming face in the receiver. The bolt does not begin to unlock until the bullet is approximately two feet from the muzzle. The bullet is between four and five feet from the muzzle when the bolt is fully unlocked. The unlocking of the bolt lugs precedes primary extraction. When the bolt is fully unlocked the barrel is arrested in its movement.

The bolt, impelled by its momentum and by residual pressure, then travels to the rear, extracting and ejecting the empty case.

This movement compresses the recoil spring in the butt stock and cocks the hammer.

The force of the main spring returns the bolt. In its forward movement, the bolt picks up the top cartridge from the magazine and chambers it. In loading, the cartridge is not required to enter the chamber from the side or at an abrupt angle, so that the bolt has full control of the head of the cartridge at all times, and the possibility of jams is eliminated.

The locking cam rotates the bolt to the locked position, engaging the locking lugs with the locking abutments.

The rifle is then ready to fire. When the last round has been fired the bolt remains open on rotary magazine models.

b. The theoretical cyclic rate of fire of the Johnson Semi-Automatic Rifle is 600 rounds per minute. The deliverable rate of fire is limited only by the dexterity of the operator. Starting with a fully loaded magazine, ten aimed rounds can be fired in ten seconds. The approximate maximum rate of aimed fire is forty rounds a minute.

The barrel is exposed to the air for its entire length, allowing the most efficient air cooling by the natural radiation of barrel heat. In practice it is impossible to overheat the barrel.

c. The accuracy of aim is not impaired by the automatic action. Under conditions of deliberate fire it is fully as accurate as any standard bolt action military rifle.

Under conditions of sustained rapid fire it is far more accurate by comparison. Sights can be held on the target and the recoil on the shooter's shoulder is rendered negligible, as recoil is partially absorbed in actuating the mechanism.

d. There being no critical tolerances, the parts of any Johnson Semi-Automatic Rifle are interchangeable with the parts of any other of the same caliber. It is possible, moreover, to change to a barrel of different caliber in a matter of seconds, provided certain essential dimensions of the cartridge remain the same.

e. Specifications—Standard Johnson Semi-Automatic Military Rifle, caliber .30 M1:

Barrel length: 22 inches (20 or 24 inches at buyers option).

Length overall: 45½ inches.

Weight: Rotary 9½ lbs. Vertical 8¾ lbs.

Action: Short recoil with 8-lug rotary bolt.

Feed: Built-in rotary feed magazine chargeable from clips or with single cartridges—ten-round capacity, or vertical feed box magazine of optional capacity.

Sights: One piece square post protected military front sight.

Receiver peep rear sight with elevation to 1000 yards and windage and elevation adjustment in minutes of angle with clicks.

Stock: Two-piece wood or plastic, military semi-pistol grip type.

Finish: Standard black.

Bayonet lug: To fit any standard bayonet or Johnson bayonet.

Optional Equipment: Barrel handguards (Johnson bayonet handle serves the same purpose).

Sling: Standard military sling.

SECTION IV—OPERATION

6. To load and fire the rotary magazine rifle

(a) The operation of charging the ten-round capacity rotary magazine may be carried out with the bolt open or closed, or with cartridges already in the magazine. The magazine is charged from standard clips (chargers) or it can be charged by inserting individual rounds one at a time.

(b) The hinged magazine cover is situated on the right side of the receiver just below, and parallel to, the ejection port. The charging port is equipped with clip seats (charger guides) into which the clip is inserted horizontally.

The cartridges are stripped from the clip and pressed into the magazine in the usual manner by the even pressure of the thumb of the right hand. The cartridges load counter clockwise and feed clockwise. (Figs. 1 and 2.)

(c) When the last round has been stripped from the clip, or as each individual round is inserted in single cartridge loading, or when the clip is removed, irrespective of the number of rounds remaining in it, the magazine cover spring returns the magazine cover to the closed position.

The top cartridge is held in position in the feed lips by the guide ramp which is part of the inside face of the magazine cover, and by the pressure of the tension spring-actuated follower on the cartridges below.

(d) If the rifle has been firing, the bolt will have been held open by the bolt catch, actuated by a cam on the rear end of the magazine follower shaft. To load the first round from the magazine into the chamber, pull the operating handle 1/16th of an inch rearward and release it, allowing the bolt to move forward into the locked position, carrying the top round from the magazine into the chamber.

(e) If the rifle has not been firing, the bolt will be closed and the hammer uncocked. Raise the operating handle 20°, pull it back to its fullest extent and release it. The bolt will move forward into the locked position carrying the top round from the magazine into the chamber.

(f) The rifle is now loaded, cocked, and ready to fire. The rifle fires at each pressure of the trigger. It may be fired as fast or as slowly as required.

[NOTE i.—If after loading the magazine with the bolt open, it is required that the bolt be closed with the chamber empty, depress the magazine cover with the third finger to prevent the top cartridge from entering the feed lips, and release the operating handle. The bolt will move forward into the locked position on an empty chamber.]

[NOTE ii.—The magazine can be so designed that the bolt will be released automatically when the magazine is loaded. It is, however, believed to be undesirable to design a magazine which will permit the automatic chambering of a round. The loss of time in pulling back the operating handle 1/16th of an inch is insignificant.]

7. To load and fire the vertical magazine rifle

(a) The magazine must first be removed from the rifle. Press forward the magazine catch with the thumb of the right hand, releasing the magazine and allowing it to slip into the palm of the hand.

(b) The magazine is charged by depressing the magazine follower with the base of a round and sliding the cartridges individually under the incurving shoulders (feed lips) of the magazine, where they are held in place by the upward pressure of the magazine spring under the follower.

(c) Insert the loaded magazine in the magazine guides and press it smartly upward into the rifle until it is engaged by the magazine catch. The magazine is inserted with the bolt closed, as the bolt does not remain open after the last shot is fired.

(d) To cock the rifle and chamber a round, proceed as in 6 (e) above.

8. To operate the rifle as a single loader

(a) Raise and pull back the operating handle to its fullest extent, so that the bolt will engage and be held open by the bolt catch. Insert a round through the ejection port. Depress the magazine cover and pull back the operating handle 1/16th of an inch and release. The bolt will move forward chambering the round. On vertical magazine rifles, the bolt must be held back manually while the round is introduced through the ejection port. The rifle is now loaded, cocked, and ready to fire. When the rotary magazine rifle is fired, the bolt will be held open by the bolt catch, allowing another single round to be inserted.

9. To unload the rotary magazine rifle

(a) To empty the magazine, depress the magazine cover to its full extent with the thumb of the right hand. The cartridges are forced by the follower into the palm of the hand.

(b) Clear the gun by pulling back the operating handle to its fullest extent, extracting the unfired round from the chamber and ejecting it through the ejection port.

(c) To close the bolt when the rifle is empty, depress the magazine cover, pull back the operating handle and release it as described in 6 (d) above.

10. To unload the vertical magazine rifle

(a) Remove the magazine as in paragraph 7 (a).

(b) Clear the rifle as in paragraph 9 (b).

11. To adjust the rear sight

(a) To elevate the rear sight, slide the rear sight elevator rearward with the thumb and forefinger. To facilitate movement, raise the end of the rear sight leaf with the third finger of the right hand while sliding the rear sight elevator rearwards. (Fig. 3.) Each notch on the rear sight elevator represents two minutes of angle.

(b) To adjust for windage, turn the windage knob at the right of the rear sight. Each full rotation of the windage knob gives two clicks. Each click represents two minutes of angle.

[NOTE.—When using U. S. caliber .30 M1 ammunition, each minute of angle change in elevation or windage changes the center of impact one inch for each 100 yards of range. Suitable allowance must be made for ammunition of other velocities and trajectories.]

12. Safety precautions

(a) While any cartridges remain in the magazine after a round has been fired, the rifle is ready to fire. There is, moreover, no visible indication whether the rifle is cocked or uncocked.

The operator must be impressed with the fact that a rifle with the bolt closed is not known to be safe until the bolt is opened, or when it is positively known to have been cleared. **IT SHOULD BE STANDARD PROCEDURE TO CLEAR THE RIFLE IMMEDIATELY BEFORE HANDLING ANY WEAPON.**

(b) The safety lock lever is located immediately in front of the trigger guard. When the free end of the lever lies at an angle to the right of the barrel axis, the sear is positively locked and the rifle is at "safe" and cannot be fired. When the lever lies at an angle to the left of the barrel axis, the safety is "off," and the rifle ready to fire.

SECTION V. FUNCTIONING

13. Action during recoil

(a) When the rifle is loaded as described in Par. 6 and 7, the hammer spring has been compressed and the sear is engaged in the lip of the hammer, holding it in the cocked position.

(b) *Ignition.*—When the trigger is pressed, the sear disengages from the lip of the hammer. The hammer spring drives the hammer against the firing pin which is protruding slightly from the rear of the locking cam and explodes the primer of the cartridge.

[NOTE.—Because the firing pin cam is opposed by the firing pin cam face within the bolt, it is impossible for the firing pin to move forward to come in contact with the primer of the cartridge until the bolt has rotated to the fully locked position. The rifle cannot be discharged until the bolt is fully locked.]

(c) *Recoil and unlocking.*—As the bullet travels through the bore, the barrel, which has been held in the forward position by the tension of the barrel recoil spring and of the main spring (transmitted through the bolt) begins to recoil against the tension of the springs. This recoil does not become apparent until the bullet has left the muzzle. The muzzle blast is the primary operating force of the action.

When the bullet is at the muzzle, the barrel has moved rearward about $\frac{1}{44}$ of an inch. When the bullet is about 2 feet from the muzzle, the barrel has recoiled about $\frac{1}{2}$ of an inch. At this point the camming arm on the bolt engages the camming face in the receiver, and unlocking begins. When the bullet is about 5 feet from the muzzle, the barrel has recoiled its full $\frac{1}{2}$ of an inch and the bolt has been rotated through 20° to the unlocked position by the action of the camming arm against the camming face. The rearward motion of the barrel is arrested by a shoulder in the receiver.

(d) *Extracting.*—The bolt, being unlocked from the barrel, jumps away from the chamber actuated by momentum and the residual pressure in the chamber. The extractor claw engaged in the cannellure of the cartridge case gives the empty case a sharp pull, effectively loosening it in the chamber. At the same moment the bolt receives a sharp blow from the locking cam, which due to the impetus received during the rotation of the bolt taps the bolt rearward.

[NOTE.—There is enough residual pressure in the chamber to give appreciable assistance to extraction by blowing the loosened case from the chamber.]

(e) *Retracing.*—The initial impetus given to the bolt by the barrel recoil and the force of residual pressure causes the bolt to be forced back in its channel in the receiver, cocking the hammer and compressing the main spring.

(f) *Ejecting*.—Further movement of the bolt traveling to the rear in the receiver brings the base of the empty case in contact with the ejector, which throws the case clear of the receiver through the ejection port at an angle of 45°. The bolt is finally halted in its rearward travel by the forward end of the link bringing up against the bolt stop, when the head of the bolt has passed behind the base of the top cartridge in the magazine.

[NOTE.—Except that the ejector key is heavier and stronger, ejection is similar to that in the U. S. Rifle Model '03, the British SMLE, and the Mauser.]

14. Action during counter recoil

(a) As the bolt moves forward, actuated by the compressed main spring, the lower part of the face of the bolt comes in contact with the base of the top cartridge in the magazine and carries it into the chamber. The locking lugs enter the barrel locking bushing and the locking cam causes the bolt to rotate through 20° to the locked position.

(b) The trigger must be released after each round is fired to allow the rear sear lip to engage the rear hammer lip.

(c) The rifle is ready to be fired again and the cycle described above is repeated each time the trigger is pressed except when the magazine has been emptied.

On rotary magazine rifles, when the magazine is empty and the last round has been fired, the cam on the rear end of the follower shaft raises the bolt catch which holds the bolt open against the pressure of the main spring.

SECTION VI. DISASSEMBLING AND ASSEMBLING

15. General information

The Johnson Semi-Automatic Rifle can be stripped to its main component parts with no tools other than the point of a bullet round, the screwdriver blade which is part of the operating handle, and the point of the firing pin. A screwdriver and any pointed instrument such as a punch, marlinspike, or even a common nail are equally effective. These simple and available tools are sufficient for all the disassembling which could possibly be necessary for the operator to perform in the field or in barracks, either for cleaning, for remedying stoppages, or for replacing worn or broken parts.

The only disassembling normally required by the operator consists of removing the barrel for cleaning after firing, and occasionally removing the bolt group for cleaning prior to inspections, etc.

Such an operation as the removal of the barrel locking bushing from the barrel requires the use of a vise and wrench. To remove the barrel guide collar a drift and a copper or wooden mallet must be available. Such extensive stripping, however, should not, in any rifle, be permitted in unskilled hands. This section contains complete instructions for the guidance and information of ordnance specialists and technical authorities.

BEFORE BEGINNING TO DISASSEMBLE THE RIFLE EMPTY THE MAGAZINE AND MAKE SURE THAT THE CHAMBER IS EMPTY.

16. Dismounting the Barrel Group

(a) Grasp the rifle in the left hand at the point of balance.

(b) With the point of a bullet round compress the latch plunger of the hinged barrel latch by inserting the point of the bullet into the hole provided in the right side of the forward end of the forestock, and push the barrel rearward. The barrel latch will fall downward on its hinge. (Fig. 4.)

(c) Raise the operating handle with the thumb of the left hand to the unlocked position and withdraw the barrel from the receiver. (Fig. 5.)

[NOTE I.—As the bolt is normally locked to the barrel, the latter cannot be withdrawn without unlocking the bolt.]

[NOTE II.—Time for dismounting barrel, four seconds.]

(d) Further stripping of the barrel is normally unnecessary and cannot be carried out without more elaborate equipment. The sequence however is continued as follows:

i. To remove the barrel locking bushing, place the barrel in a vise and unscrew with a wrench.

ii. To remove the front sight, drive out the two front sight pins and drive off the sight.

iii. To remove the barrel guide collar, drive out the barrel collar pin and drive off the collar with a wooden mallet or brass block.

17. Removing and disassembling the bolt group

(a) Disengage the bolt stop plate plunger with the point of a bulletted round and lift out the bolt stop plate. (Fig. 6.)

(b) Remove the bolt stop. (Fig. 7.)

(c) Disengage the link from the main spring plunger. (Fig. 8.)

(d) Raise the operating handle and retract the bolt about two inches. With the thumb and forefinger of the right hand, grasp the knob of the operating handle spindle and pull it outward to its fullest extent. Slide the operating handle forward until it is clear of the shoulders in the extractor recess and remove it. Lift out the extractor.

[NOTE.—The operating handle should be regarded as a single part, but should it be necessary to disassemble it, merely unscrew the operating handle nut and allow the plunger and plunger spring to fall into the hand.]

(e) Grasp the projecting end of the link and pull it to the rear, withdrawing the bolt through the rear end of the receiver. (Fig. 9.)

(f) Rotate the locking cam counterclockwise and withdraw it from the bolt.

(g) Withdraw the firing pin.

(h) Push out the link pin and remove the link.

[NOTE i.—Any operator should be able to remove and disassemble the bolt group. Time—ten to fifteen seconds.]

[NOTE ii.—It is possible, with the barrel dismantled, to remove the bolt through the forward end of the receiver. This is not desirable, as replacing the bolt in the receiver from the front is difficult.] The operation is carried out as follows:

(a) Raise the operating handle and retract the bolt about two inches, holding it back against the tension of the main spring with the forefinger of the left hand on the bolt face.

(b) Remove the operating handle and extractor as in 17 (d) above.

(c) Depress the forward end of the rifle and clear the bolt gradually, allowing the bolt to slide through the receiver into the palm of the right hand.

(d) Disassemble the bolt as described in 17 (f), (g), (h) above.

18. Removing and disassembling the stock group

I. Rotary Magazine Type.—(a) Disengage the bolt stop plate plunger with the point of a bulletted round, and lift out the bolt stop plate. (In order not to lose the bolt stop, it is advisable to remove it at this point.) (Figs. 6 and 7.)

(b) With the point of a bulletted round disengage the hammer block pin, and push it out with the point of the cartridge. (Fig. 10.)

(c) Grasp the rifle with the left hand at the point of balance, turn the weapon on its side and pull off the butt stock group. (Fig. 11.)

(d) Remove the ejector pin and ejector.

[NOTE i.—The above operation can be accomplished with the rifle in a completely assembled condition.]

[NOTE ii.—The removal of the hammer block pin effects the disengagement of the bolt catch. When the butt stock group has been withdrawn from the receiver, the bolt catch should be lifted from the hammer block.]

[NOTE iii.—The hammer should be cocked before removing the butt stock group.]

[NOTE iv.—Care must be taken to avoid losing the ejector and pin in removing the stock.]

(e) Unscrew the front trigger guard screw and the hammer block screw and lift out the hammer group from the stock. Unscrew the rear trigger guard (wood) screw and remove the trigger guard and safety assembly.

(Disassembling of the hammer group is set forth in Par. 19.)

(f) Remove the forestock screws and detach the forestock.

(g) Unscrew the butt plate screws, and remove the butt plate.

(h) Unscrew the mainspring tube screw and remove the buffer assembly, mainspring follower, and mainspring.

[NOTE i.—The buffer assembly should not be removed by the operator. It is not in any way essential to the functioning of the rifle and it is almost impossible for this assembly to get out of order. Disassembling of this unit can be done in the armory if absolutely necessary.]

(i) Unscrew the two screws which retain the mainspring tube positioner, and withdraw the mainspring tube.

[NOTE i.—The mainspring tube should be removed only under the most unusual conditions. It should really be regarded as an integral part of the stock, and for purposes of cleaning, it can be treated in exactly the same fashion as the bore of the rifle barrel.]

II. Vertical Magazine Type.—(a) Remove the bolt stop plate and bolt stop as described in 18 I (a).

(b) Unscrew the two forward stock screws and the front trigger guard screw with the blade of the operating handle or screwdriver.

(c) Separate the stock from the receiver.

(d) Unscrew the rear trigger guard (wood) screw and remove the safety lock and trigger assembly. (This is part of the hammer group.)

(e) Complete the disassembling of the stock as described in 18 I (g) (h) (i).

19. Removing and disassembling the hammer group

I. Rotary Magazine Type.—(a) The hammer group being removed from the butt stock as described in 18 I (e) above, press the trigger and release the hammer slowly against the thumb.

(b) Push out the hammer pin and lift out the hammer. The hammer strut and hammer spring will come out with the hammer.

(c) Push out the hammer strut pin, and remove the hammer strut from the hammer. The hammer spring is pulled off from the tail of the hammer strut.

(d) Push out the trigger pin and the sear stop pin, slide the sear forward and lift it up from the hammer block.

(e) Push out the trigger sear pin, and remove the trigger from the sear.

(f) Remove the sear spring from its recess in the rear end of the sear.

(g) To disassemble the safety lock and trigger guard assembly, drive out the safety lock lever pin, drive off the safety lock lever, and remove the spindle, being careful not to lose the safety lock plunger and spring, which will fall out of their recess in the safety lock lever when the latter is removed. Remove the safety lock bushing from its recess in the floor of the hammer block.

[NOTE i.—The safety lock assembly should not be removed from the trigger guard by the operator except under very unusual circumstances.]

II. Vertical Magazine Type (stock removed).—(a) Push out the hammer block retaining pin and slide the hammer block to the rear out of its channels in the receiver.

[NOTE i.—The hammer must be cocked before removing the hammer block.]

(b) Push out the magazine catch pin and remove the magazine catch and magazine catch spring.

(c) Pull the trigger and release the hammer.

(d) Disassemble the remaining parts as described in 19 I (b) (c) (d) (e) (f) (g).

20. Disassembling the receiver group (stock removed)

(a) With the point of a cartridge disengage the bolt stop plate plunger, lift up and remove the bolt stop plate. (Fig. 6.)

(b) Remove the bolt stop. (Fig. 7.)

(c) Push out the ejector pin and lift out the ejector.

(d) Remove the barrel recoil spring and latch assembly. Drive out the barrel latch pin, drive out the latch plunger pin and remove the latch plunger and latch plunger spring. Drive out the recoil guide pin and remove the recoil spring plunger and barrel recoil spring.

[NOTE.—Disassembling of the barrel recoil spring and latch assembly should not be done in the field. This operation should be confined to the armory. It is highly improbable that this assembly will require any special attention on the part of the operator. Moreover, the weapon will function under normal conditions without the aid of the recoil spring. If for any reason the latch plunger should fail to hold the assembly in its normal position, any temporary expedient such as a piece of wire, a wooden match, a nail, or other similar device can be restored to in an emergency.]

(e) To remove the rear sight elevator, lift up the rear sight leaf and remove the elevator from its track on the top of the receiver.

(f) To remove the rear sight leaf, with a wooden block or a soft brass rod, drive the base out of its dovetailed slot in the receiver.

(g) Remove the windage screw and aperture assembly. Drive out the windage knob pin and pull off the windage knob. The windage knob plunger and windage knob spring will fall out of their recess in the windage knob when this

is removed. Remove the windage screw, at the same time disengaging the rear sight peep or aperture.

[NOTE.—Disassembling of the windage screw and aperture assembly should not be done by the operator. The sight leaf should be removed only at the armory.]

(h) On rotary magazine models, the forestock being removed, drive out the transverse forward magazine retaining pin, and drive out the longitudinal retaining pin on the left side of the receiver, using the point of a cartridge or the point of the firing pin, and remove the rotary magazine assembly from the receiver.

(i) Drive out the magazine cover pin, and remove the rotary magazine cover and magazine cover spring.

(j) Disengage the rotary magazine follower shaft and remove the follower shaft, follower, and follower spring.

21. Assembling the receiver group

Follow directions in Paragraph 20 in reverse order.

22. Assembling the hammer group

Follow directions in Paragraph 19 in reverse order.

[NOTE.—The hammer must be cocked before returning the hammer group to the receiver.]

23. Assembling the stock group

Follow directions in Paragraph 18 in reverse order.

[NOTE.—On rotary magazine models, the hammer block pin hole and bolt catch pin hole must be accurately lined up before attempting to drive in the hammer block retaining pin.]

24. Assembling the bolt group

Follow directions in Paragraph 17 in reverse order.

25. Assembling the barrel group

Follow directions in Paragraph 16 in reverse order.

[NOTE.—In returning the barrel, it is advisable to raise the operating handle to the unlocked position.]

SECTION VII. CARE AND CLEANING OF THE JOHNSON SEMI-AUTOMATIC RIFLE

26. General

The Johnson Semi-Automatic Rifle is a weapon of precision. The same care should be accorded to it that is advisable for any military rifle of the manually operated type. Its demands, however, are no greater. It will function without oil, and with dirt, sand, and mud in the mechanism, but normal lubrication with any good rifle oil and a clean mechanism will permit it to function more smoothly. In general, the care and cleaning of the Johnson Semi-Automatic Rifle differs only in detail from that of any standard military rifle.

[NOTE.—Perhaps it is unnecessary to remark that the ammunition needs no lubrication or special treatment of any kind.]

27. Care and cleaning of the barrel

The barrel does not necessarily have to be removed from the receiver to clean the bore. With the bolt open, a cord pull-through can be passed from breech to muzzle. To reach the abutments of the barrel locking bushing, however, the barrel should be removed. (See Par. 16.)

28. Care and cleaning of the bolt, receiver, and hammer groups

A few drops of oil applied to the bolt through the ejection port will improve the smoothness of functioning. To clean the bolt group, disassemble from the receiver. (See Par. 17.)

When the bolt group has been removed for cleaning, clean the inside of the receiver, paying attention to the camming face and cam channel.

The hammer group needs little care. It should be examined occasionally and the parts oiled for smooth operation and as a protection against rust.

SECTION VIII. SPARE PARTS AND ACCESSORIES

29. General note

The parts of any rifle will, in time, become unserviceable through breakage or wear resulting from continuous usage. Based upon firing over 75,000 rounds from Johnson Semi-Automatic test rifles, one of which alone fired approximately 25,000 rounds, it appears unnecessary, therefore, to burden the operator with spare parts.

30. Accessories

A bulleted round is the only tool not a part of the rifle which is required to take the rifle down for clearing.

SECTION IX. IMMEDIATE ACTION AND STOPPAGES

31. General Note

To those familiar with the use of firearms, the close relation of immediate action and stoppages is well understood. The former is the unhesitating application of a probable remedy for a stoppage. The latter, infrequent though they are in the Johnson Semi-Automatic, can be almost eliminated by an intimate knowledge of the rifle and a clear understanding of their causes.

32. Table of stoppages and immediate action

A table of stoppages and the remedial actions is appended:

Table of stoppages and remedial actions

Stoppage	Position of bolt handle	Probable cause	Immediate action
1. Failure to fire.....	Closed, down.....	a. Defective primer..... b. Defective firing pin..... c. Defective hammer spring.	a. Reload by pulling handle. b. Examine firing pin. c. Examine hammer spring.
2. Failure to extract (if rim of cartridge breaks, remove barrel to facilitate removal of case by hand).	Closed, handle up.	a. Defective cartridge..... b. Defective extractor..... c. Barrel recoil prevented by foreign matter in barrel sleeve.	a. Reload by pulling handle. b. Change extractor. c. Remove barrel, clear obstruction, and reassemble.
3. Failure to eject.....	Open, handle up, part-way back.	a. Defective cartridge..... b. Obstruction in bolt path. c. Rifle full of sand or dirt... d. Defective extractor..... e. Defective ejector.....	a. Pull handle for reloading. b. Remove bolt, clear, replace. c. Remove bolt, clean, replace. d. Change extractor. e. Change or correct ejection.
4. Failure to reload.....	Open, handle up, part-way closed.	a. Defective magazine spring (temporary). b. Same (permanent)..... c. Rifle full of dirt..... d. Deformed cartridge.....	a. Pull handle for reloading. b. Repair spring. c. Clean dirt. d. Pull handle for reloading.

NOTE.—Both the barrel recoil spring and the mainspring are manufactured with closed ends. In the event of breakage of either spring, the springs can be removed and the ends turned inward butting against each other, thus effecting an efficient temporary repair and keeping the rifle in action.

APPENDIX I. COMPARISON OF THE JOHNSON SEMI-AUTOMATIC RIFLE WITH "MILITARY CHARACTERISTICS FOR SEMI-AUTOMATIC RIFLES"

[NOTE.—Under date of September 21, 1938, the U. S. War Department, Office of the Chief of Ordnance, at Washington, D. C., submitted to the Johnson Automatics Trust a two-page mimeographed list (bearing an identification number 6160) entitled "Military Characteristics for Semi-Automatic Rifles". All of the characteristics are contained in the quotations in the following comparison.]

"(a) The rifle must be simple, strong, and compact, and adapted to function with the standard caliber .30 ammunition. Weights should be well balanced and so placed that the essential strength is given to components requiring it. Ease of manufacture should be a guiding factor in preparing a design".

Johnson: Functions with M1 (48,000 lbs. per sq. in.), M1906, and M2, (38,000 lbs. per sq. in. plus) ammunition. Functions without adjustment with pressures from 38,000 lbs. per sq. in. to 68,000 lbs. per sq. in. Has no critical tolerances. Ease of manufacture is the paramount factor of its design. Aside from its slidable barrel, operating parts are all contained in the breech. The mainspring is protected by the buttstock.

“(b) The mechanism must be well protected from the entrance of sand, rain, or dirt; and should not be liable to derangements due to accidents, long wear and tear, exposure to dampness, sand, etc.”

Johnson: Mechanism is protected. Dirt makes little difference due to design. Has successfully withstood severe sand tests.

“(c) Components of the mechanism should be the fewest possible, consistent with ease of manufacture and proper functioning of the weapon. Parts requiring constant cleaning or which may require replacement should be designed with a view to ease of dismounting by the use of not more than one small tool, preferably the service cartridge.”

Johnson: Has no parts of a type or class not essential to a repeating arm except mainspring, barrel recoil spring, two cams, semiautomatic sear. If desired, stock screws can be replaced by latches. Barrel easily removed for cleaning.

“(d) The rifle must be so designed that the magazine may be fed from clips or chargers. The capacity of the magazine should not be less than five rounds, preferably ten, but not to exceed ten rounds.”

Johnson: Equipped with a rotary-feed, ten-shot magazine, chargeable from standard clips or with single cartridges, or with a vertical feed detachable box magazine of optional capacity.

“(e) The breech mechanism must be so designed as to preclude the possibility of injury to the firer due to premature unlocking. The firing mechanism should be so designed that the firing pin is controlled by the trigger and sear direct; that is, the bolt mechanism should move forward to the locking or firing position with the firing pin under the control of the trigger and sear mechanism, so that the cartridge is not ignited until the trigger is pulled to release the firing pin. The bolt, or block should remain open when the last cartridge in the magazine has been fired. In case a detachable magazine is used, it should be possible to insert a new magazine with the bolt in either open or closed position.”

Johnson: Has a strong breech-end cover or lock plate (bolt stop plate) positively preventing injury. (Premature unlocking is impossible.) The receiver is closed entirely on top and in the rear.

Weapons using hammer mechanism cannot provide a sear-controlled firing pin.

Johnson cannot be fired unless and until the bolt is safely locked. The rifle cannot fire unless the trigger is pulled, releasing the hammer.

Bolt remains open when last shot is fired on rotary magazine rifles. Magazine may be charged at any time with the bolt open or closed. Detachable box magazine may be inserted in the vertical feed rifle at any time.

“(f) The trigger pull, measured at the middle point of the bow of the trigger, should be not less than 3 or more than 5 pounds. The trigger action should be similar to that of the present service rifles, i. e.; it should have a light first pull, after which there should be no appreciable backward motion until the sear is released.”

Johnson: Can be furnished with 2 to 5 pound pull. Present Johnson pull is designed to overcome anticipation of ignition, or flinching.

“(g) An efficient safety or locking device must be provided, permitting the rifle to be carried cocked and with cartridge in chamber without danger. The rifle should remain cocked and ready for firing when the safety device is unlocked.”

Johnson: So equipped.

“(h) The weight of the rifle, with magazine empty and without bayonet or sling, should be a minimum consistent with proper functioning and in no case should exceed 9.5 pounds.”

Johnson: Weight about 9.5 lbs. (Established with a standard M1903 24-inch barrel.) With lighter barrel weight is reduced by 0.2 lb. Vertical magazine rifle weighs 8.75 pounds.

“(i) The rifle must be so designed as to give good balance and be adapted to shoulder firing.”

Johnson: Conforms.

“(j) The rifle is to be strictly semiautomatic, that is: a self-loading type, and is not to function as an automatic rifle. The trigger mechanism should be so designed that it will be impossible to fire more than one shot with each pull of the trigger; the trigger must be released and pulled again for each successive shot.”

Johnson: Conforms.

"(k) The accuracy of the rifle should be comparable with that of the present service shoulder rifle."

Johnson: Conforms. The Johnson semiautomatic rifle is fully as accurate as the M1903 Springfield.

"(l) The stock should be so designed, if practicable, as to allow ventilation of the gun without charring or overheating the wood."

Johnson: Barrel so well ventilated that 2400 successive rounds fired in less than 1½ hours did not put barrel out of action, nor gun out of action, nor was the wood at all charred.

"(m) The rifle should be capable of being used as a hand functioning arm in case the self-loading feature is disabled. The bayonet should be so attached as not to interfere with the proper operation of the piece under any conditions that may normally be expected."

Johnson: Excellently adapted for hand operation. If the barrel is prevented from recoiling, the arm works like a Springfield M1903. This has been proved by burying this arm in sand, and then removing and firing it. Barrel can be blocked and V-B. rifle grenade fired, as in the M1903 rifle. Two types of bayonets are available.

"(n) The use of special high-grade material, highly specialized heat treatment, or special grade machine work or finish in general should not be required."

Johnson: Any chromium-nickel steel such as S. A. E. 3140 or 4650, ordinary spring wire. No special steels. Conventional heat treatment. Conforms.

"(o) The use of special oil or grease or any other material not readily obtainable in the field should not be necessary to the proper functioning of the piece."

Johnson: Not only requires no special oil or grease, but can function and has functioned for appreciable intervals without any oil or lubricant of any kind whatever. (2900 continuous rounds without cleaning or oiling mechanism.)

"(p) The use of special tools for adjustment, dismounting, or assembling should be reduced to the minimum."

Johnson: No special tools required, except the point of a cartridge and the screw-driver blade on the end of the operating handle. Or "Boy Scout" knife blades may be used if available. Use the firing pin to push out pins.

"(q) Sights should be over the center of the bore and so firmly fixed as to avoid any possibility of variation in position due to constant firing or rough handling."

Johnson: Conforms. Sights extremely rugged and well protected.

"(r) The rear sight should be not less than 2½ inches and not more than 6 inches from the eye when using the weapon in the prone position. It should be graduated up to 1000 yards and have a windage adjustment, equivalent to that on the sight of the U. S. rifle caliber .30 M1903. In case a sight embodying the above points is not devised by the designer, the rifle should be constructed as to permit the installation of such a sight."

Johnson: Any sight desired. Johnson sights conform to this requirement.

The following additional requirements for a military semiautomatic arm are submitted by the Johnson Automatics Trust as being worthy of consideration, especially in a comparison between two or more types of semiautomatic rifles. These requirements were set up by the inventor in his development of the Johnson Semi-Automatic Rifle.

I. If possible, the barrel should be easily removable by a soldier in the field for cleaning, inspection, or in the event of over-heating, or in the event that it becomes necessary to exchange a worn barrel for a new one.

II. The chamber of the barrel should be readily accessible from the breech end, so that it may be cleaned by any ordinary means. The barrel should be capable of being cleaned from the breech end, instead of only from the muzzle.

III. The breech locking mechanism should be sufficiently strong to withstand the maximum pressures developed in the caliber .30 M1 ammunition, and preferably should be sufficiently strong not only to stand these pressures, but also to withstand pressures which may develop in the near future in service ammunition, or pressures up to 65,000-70,000 lbs. per sq. in. (In view of the possibility that at a later date higher velocity, flatter trajectory, higher pressured ammunition may be developed, it is believed to be desirable that the mechanism should be built with the future adoption of such ammunition in mind.)

The Johnson Semi-Automatic Rifle conforms to these three self-imposed requirements.

APPENDIX II. TEST PERFORMANCES OF THE JOHNSON SEMI-AUTOMATIC RIFLE

1. *Endurance tests.*—Various tests, some harsh in the extreme, have been carried out to discover, if possible, at what point the Johnson Semi-Automatic Rifle

actually breaks down. The Johnson Automatics Trust, however, cannot say what is the ultimate limit to the functioning capabilities of the Johnson Semi-Automatic Rifle.

[NOTE.—All performances quoted took place before witnesses. As a matter of policy, the names of officials and official places must be omitted. All tests were carried out with caliber .30 service ammunition.]

(a) Approximately 75,000 rounds have been fired in tests since the rifle was invented in 1936. One rifle, MN1, cal. .30, fired approximately 25,000 rounds between January and December 1938. It is still functioning.

(b) Endurance firing: Johnson rifle, MN3, fired 500 rounds, at 30 rounds per minute, without cleaning or oiling. The rifle barrel was then arbitrarily cooled. The chamber and bore were cleaned but the mechanism was not lubricated. This rifle then fired 2,400 rounds at the rate of 25 to 80 rounds per minute.

The total of 2,900 rounds was fired in two hours. The last 2,400 rounds were fired in less than ninety minutes. Several hours later, without cleaning or oiling, the rifle was still firing successfully.

(c) Firing without lubrication: Johnson MN1, cal. .30, beginning in a cleaned but unoled condition, fired over 500 rounds without any lubrication.

(d) Firing with sand in chamber: Johnson MN1 on a number of occasions has been fired with sand in the chamber. This rifle has functioned automatically for six consecutive shots with sand on each shell. Twenty-four successive sand-covered rounds were fired and extracted but not ejected. Functioning was obtained by working the operating handle manually.

(e) Firing with sand in action: Johnson MN1 was buried in sand, removed, and the barrel cleaned to avoid bursting it. The rifle functioned easily by hand operation. Placed in a sand box equipped with a blower for three minutes and then removed, it functioned automatically. Rifle MN1 fired 250 consecutive rounds in an artificial sand storm.

(f) Firing with mud and sand in action: Johnson MN1 was placed in a mud bath for five minutes, after which it functioned normally. Without being cleaned or dried it was at once put in a sand box. This rifle continued to function notwithstanding this unusual treatment.

(g) Firing with variations in pressure: The normal pressure of caliber .30 M1 ammunition is 48,000 lbs. per square inch. Rifle MN1 fired 600 continuous rounds with standard pressure. Then, without adjustment, 600 continuous rounds were fired with loads giving 37,000 lbs. per sq. in. The barrel in this rifle had already fired 10,000 rounds when the above test was conducted.

On a previous occasion, rifle MN1 fired every available commercial .30-'06 load. A proof load of 68,000 lbs. per sq. inch was then fired. It functioned with all loads.

Johnson MN4 has functioned with pressures as low as 35,000 lbs. per sq. inch.

Rifle MN1 has on many occasions been fired with heated cartridges developing excessive pressures.

(h) Firing with rifle elevated and depressed: Johnson rifles function at angles to 90° elevation and depression.

(i) Firing to establish point of overheating: Johnson rifle MN3 was not overheated to the point of breaking down after firing 2,400 rounds in less than ninety minutes. The rate of fire averaged 25–30 shots per minute for 1,600 rounds, and was increased to 80 shots per minute for the last 400 rounds.

The M1903 Springfield barrel was, of course, badly worn from this firing.

(j) Firing to determine pre-ignition: A round left in the chamber, after 2,400 rounds had been fired in less than ninety minutes, exploded and was extracted by pre-ignition. Rounds left in the chamber after firing 150 rounds in three minutes did not pre-ignite. Moreover, they were ejected when fired after being cooked in the chamber for four minutes.

2. *Incidence of stoppages.*—Previous attempts to produce a satisfactory semi-automatic rifle have brought to light various serious faults in functioning which have appeared to be inescapable. They seem to have been successfully eradicated in the Johnson.

(a) Rifle MN1 fired 300 consecutive rounds of 1918 (wartime) U. S. C. Co. .30-'06 ammunition without stoppage of any kind.

(b) Rifle MN3 (having just fired 757 rounds without cleaning or oiling) fired 627 consecutive rounds at a rate of about 30 rounds per minute without any stoppage of any kind. This rifle at this same time fired 895 consecutive rounds with one failure to feed, the rifle having just fired 500 rounds without cleaning or oiling. In a total of 895 consecutive rounds of continuous fire there was but one feed failure.

be found in the article "What Price Automatic", by Melvin M. Johnson, Jr.: "Army Ordnance" September-October 1936 (Part I) November-December 1936 (Part II). The rationale set forth there was followed prior to its composition in developing this rifle.]

The Johnson rifle permits instant removal of the barrel and stripping of its parts for care and replacement. It also offers an extremely simple mechanism which can be mastered by the least intelligent, and one which can be manufactured easily in quantity. There are relatively few parts, many of them intentionally conventional to avoid confusion in instruction.

The mechanism for locking and unlocking, for extracting and ejecting, for cocking and reloading is the heart of any self-loading mechanism. The Johnson mechanism is positive, depending on the most fundamental force, that of recoil, for its motive power. The tendency of the Johnson mechanism to provide positive unlocking is obvious. Nothing is more certain than that the barrel will recoil when fired if free to do so. The bolt must, of course, go with it. The automatic unlocking is therefore absolutely reliable. This is an inherently simple means of producing unlocking without complications.

If the Johnson rifle depended upon the exact distance of barrel recoil to insure proper timing as to the exact amount of residual pressure, the retraction of the bolt would be uncertain and unreliable. This mechanism, however, regulates its unlocking time directly in proportion to the resistance of the bolt to unlocking under pressure. The movement of the barrel is incidental.

This phenomenon can be explained more technically, but it is that the desired result has been achieved rather than an ex post facto mathematical calculation which is important.

In a word, the bolt regulates its own unlocking time with each round (in turn relatively regulated by the amount of its rotation) by the variable pressures which it experiences, and by the angle of the crumpling surfaces against which, during recoil, it rotates.

In proof, the barrel movement can be increased 1/32 of an inch, or weights added to the barrel to increase its inertia, and ejection is obtained, notwithstanding. Such variations, of course, cannot be made to an unlimited extent without encountering a noticeable alteration in the action. There are, however, wide margins within which reliable actuation is obtainable.

If the pressures were too great, the retracting power could be reduced by:

- (1) increasing the amount of locking.
- (2) increasing the angle of the camming surfaces.
- (3) using a stronger barrel recoil spring.
- (4) putting a friction band on the barrel locking bushing or barrel guide collar.
- (5) using a heavier barrel.
- (6) a combination of any of the above changes.

Retracting power could be increased by:

- (1) decreasing locking.
- (2) decreasing angle of cams, etc.

In view of the above, it is not necessary to manufacture the actuating parts with extreme nicety. No dimension of any part need be closer than several thousandths of an inch. In consequence, the parts can also be subjected to excessive wear without rendering the weapon unserviceable or unsafe.

The Johnson mechanism employs a modified rotary bolt, a locking system which is simple, time-tried, and completely reliable. The Johnson bolt, however, will withstand pressures far in excess of those normally used in modern military weapons. It will be especially adaptable to any ultra-high-speed armor-piercing rifle ammunition of the near future. The actuation is basically dependent upon the bolt, which, due entirely to the design of the lugs, can be unlocked quickly from a fully locked position.

Due to the construction of the firing pin, the rifle can never be discharged unless the bolt is locked. The position of the operating handle indicates whether or not the bolt is locked.

If the eight locking lugs should give way, the bolt stop and bolt stop plate effectively protect the operator from a blow back. The operating handle would serve as a safety lug in the event of the bolt blowing back and breaking the bolt stop.

The rifle can be fired by manual operation is desired. To do this, insert a 3/8ths inch thick washer or "block" behind the barrel to hold it in its forward position. Unless the barrel can recoil, the bolt cannot unlock automatically.

A number of parts can be removed without rendering the rifle incapable of firing and ejecting the cartridges.

It is believed that the Johnson mechanism is unique, in that it is the first high-powered rifle to utilize any residual pressure for extraction WITHOUT NECESSITATING LUBRICATED CARTRIDGE CASES. To stress the fewness of parts in any mech-

anism is misleading. It is the simplicity of parts, rather than a reduction in their number, which has been accomplished in this weapon. Yet the Johnson Semi-Automatic Rifle has no more parts than a corresponding military repeating, bolt-action rifle.

APPENDIX IV. GENERAL SIMILARITY TO U. S. RIFLE, CAL. .30, M1903

Inasmuch as the M1903 Springfield served, in part, as an inspiration for the Johnson Semi-Automatic Rifle, certain comparisons can be made.

1. Barrel and front sight; same on both rifles; Johnson barrel slidable $\frac{3}{4}$ ths of an inch to permit automatic unlocking.
2. Locking system: Johnson rifle modified by using eight lugs in order to achieve a rotary bolt capable of unlocking more rapidly, yet having even greater locking strength than the M1903 Springfield.
3. Extractor: generally similar, but Johnson claw shorter so as to avoid strain; no rotating collar; easier to dismount.
4. Ejector: same type; Johnson larger, stronger; dismountable from outside.
5. Camming arm: Johnson camming arm similar in location to M1903 rifle; on Johnson rifle it causes automatic unlocking.
6. Receiver "bridge": general contour same on Johnson; camming arm guided through extended channel.
7. Cocking cam: note that the same general type of cam used to cock the M1903 on the opening stroke is followed in the locking cam of the Johnson.
8. Stock: the Johnson has followed generally the conventional types of stocks.
9. Trigger and trigger guard are similar to the 1903 Springfield.
10. Trigger pull: although using a "semi-automatic" sear, the Johnson is smoother and lighter than the Springfield.
11. Other parts, such as the firing pin, the hammer mechanism, and the closed receiver are different for obvious reasons. The receiver permits the proper attachment of a telescope, top or side mounting, as desired.
12. Assuming the Springfield contains only "conventional" parts, that is, parts which must be found on any hand-operated rifle, it will be noted that the only "extra" parts found on the Johnson are the mainspring, the link and the cams. All automatics must have a mainspring and a link or "strut." All of the other parts are essentially "conventional."
13. Accuracy: The automatic action of the Johnson rifle in no way affects its accuracy. The accuracy of the Johnson Semi-Automatic Rifle, as in any other, depends upon the quality of the barrel with which it is equipped. Using a Springfield, Enfield, or Mauser barrel, it is fully as accurate as the condition of the barrel permits, and, due to the reduced kick, far less fatiguing to shoot.

JOHNSON LIGHT MACHINE GUN

(See also Catalog of Johnson Light Machine Gun)

Brief description.—The Johnson Light Machine Gun is operated on exactly the same principle and has the same basic action as the Johnson Semi-Automatic Rifle. The only essential differences are that the machine gun is cocked with the bolt open, the hammer being automatically released when the bolt has locked; so that it fires automatically, and semiautomatically with the bolt closed.

Caliber: .30 M1, and other military calibers.

Weight without mounts: 12 pounds.

Barrel: any standard rifle barrel or in certain types, M-G. barrel. Lengths 20 to 26 inches. (Barrel may be removed and replaced in six seconds.)

Cooling: air.

Feed: three types: box magazine; charger-loaded 20-, 30-, or 40-round rotary feed magazine; belt feed of any belt capacity specified.

Sights: mounted on side.

Cyclic rate of fire: 300–1,000 rounds per minute.

Mounts: bipod or tripod.

Time required for full field stripping: 12 seconds.

Overall length: 42 inches with butt stock and 24-inch barrel. With carbine 20-inch barrel, 38 inches.

Comment.—The Johnson Light Machine Gun can be, and usually has been, fired full-automatically from the offhand position, without any supports, without climbing or undue dispersion.

Parts interchangeable with Johnson semiautomatic rifles.—Barrel assemblies, extractors, ejectors, operating handles, barrel recoil spring and latch assemblies, hammer struts, hammer pins, hammer springs, and a number of miscellaneous pins in the various parts groups.

Individuals familiar with the Johnson Semi-Automatic Rifle require practically no instruction on the Johnson Light Machine Gun. This greatly simplifies the training program. It is believed that no such combination of infantry weapons has ever before been made available. (See catalog of the Johnson Light Machine Gun.)

REPORT OF JOHNSON AUTOMATICS, INC., ON DEMONSTRATION AT FORT BENNING OF JOHNSON SEMIAUTOMATIC RIFLE

(Submitted by John Babcock Howard, Johnson Automatics, Inc., in view of some misunderstanding which may have existed concerning this firing)

A recorded total of 3,936 rounds were fired by the Johnson rifle at Fort Benning; in fact over 4,000 were actually fired. However, there were not 86 malfunctions of the Johnson. There were 86 stoppages. According to established military definitions, a stoppage is an accidental cessation of fire due to the gun or ammunition or any cause. A malfunction of the gun is also a stoppage, but a stoppage due, for example, to defective ammunition is not a malfunction of the gun. A functional failure is a failure of the automatic mechanism to operate. A failure due, for example, to a defective magazine is not a functional failure, according to competent authorities. The magazine is not a part of the operating mechanism. It is a separate unit, operated by a spring.

Attention is called to the actual report by Capt. R. H. Brown, Infantry, of the Johnson firing at Fort Benning, June 29-July 6, 1938, a photostatic copy of which is included herewith:

FIRST DAY: 544 ROUNDS, 14 MALFUNCTIONS

(See p. 1 of photostatic copy of actual record.)

Nine feed stoppages were due to lightweight magazine spring. One stoppage was due to the experimental empty cartridge case deflector. One hundred and nineteenth failed to extract due to the defective brass cartridge case (lot 1889, Frankford Arsenal ammunition, was used to determine whether the Johnson rifle could function with soft brass cartridge cases, which are not standard). One hundred and ninetieth, one hundred and ninety first, one hundred and ninety seventh, two hundredth were stoppages resulting from a seriously defective cartridge case which burst in the gun. But the rifle kept on firing afterward. No one was hurt.

Summary of first day's firing

Magazine stoppages.....	9
Functional failures attributable to Johnson firing mechanism.....	0
Total rounds.....	544
Total rounds defective cases (soft brass).....	144
Stoppages due to ammunition.....	5

SECOND DAY: 500 ROUNDS, 24 MALFUNCTIONS

(See p. 2 of actual record.)

Five hundred rounds of soft brass cased ammunition, lot 1889, which is not standard, were fired at a rate of about 30 per minute by the Infantry officials to determine the ability of the Johnson to function under adversity. The two hundred and forty-eighth failed to extract. The rifle therefore fired 247 continuous rounds of defective soft brass cased ammunition without a single stoppage. There were then 24 stoppages in the last 253 rounds. The Johnson rifle did not malfunction. It was represented to the committee that out of these 500 rounds the Johnson rifle malfunctioned 24 times, due to the fault of the rifle.

Total stoppages.....	24
Magazine stoppages.....	0
Functional failures attributable to Johnson firing mechanism.....	0
Total rounds.....	500
Total rounds defective cases (soft brass).....	500

SECOND DAY: 2,400 ROUNDS, 30 MALFUNCTIONS

Then, the same rifle was allowed to cool, the barrel was cleaned, no other part was cleaned or lubricated. This rifle then fired continuously at a rate of from 25 to 80 or more shots per minute for about 90 minutes.

Out of the first 895 continuous rounds, this Johnson rifle failed to feed once; it failed to feed 3 times in 1,000 continuous rounds. Some soft brass cased

ammunition was occasionally loaded into the rifle. Therefore, it failed to extract or eject on the 1147th, 1302nd, 1320th, probably the 1386th, 1430th 1622nd, 1847th, 1856th. It was found that some of this defective ammunition was mixed with the ammunition supposed to be used.

First 2,000 continuous rounds

Total stoppages	14
Magazine stoppages	5
Functional failures attributable to Johnson firing mechanism	0
Total rounds	2,000
Total rounds defective cases (soft brass)	8
(Misfire, due to primer)	1

Percentage of malfunctions due to Johnson magazines furnished, one-quarter of 1 percent (0.25 percent).

The last 400 continuous rounds were fired chiefly in the air, and due to a defectively designed short coil spring, not properly heat-treated, the barrel was not put into battery so readily in aerial firing. This condition, afterward corrected, accounted for about 10 stoppages, all cleared by pulling the operating handle. There were also 2 magazine feed failures, and at least 3 soft cases, noted in the record.

Stoppages	15
Magazine stoppages	2
Total rounds	400
Total rounds, defective cases (soft brass)	3

NOTE.—The actual record shows that the Johnson mechanism still functioned successfully.

Summary of second day's firing

Total stoppages	30 (29)
Magazine stoppages	7
Functional failures	0
Total rounds	2,400
Total rounds, defective cases (soft brass)	11
(Worn "bolt stop"—had no functional affect whatever. This was tang cover)	(1)

THIRD DAY: 324 ROUNDS, 18 MALFUNCTIONS

The following is an exact account of this firing on this occasion:

First, the rifle was fired with sand poured into the magazines. This is noted in the record put into the hearings. However, it was not noted that 324 rounds were fired after that, that the same magazines were used, and that they were not cleaned. This would tend to cause remaining sand particles to continue to work through the mechanism and into the firing chamber. This, of course, does no rifle any good.

The firing record of the Garand rifle which competed with the Johnson on this occasion was not included. The Garand rifle used numbered below No. 90 and later models have no doubt been improved, as have the Johnsons.

Actually, both the Garand and Johnson fired 100 rounds of soft-brass-cased ammunition and then the Garand fired 197 rounds of good ammunition, while the Johnson fired 224. The Johnson magazines still had some sand left in them from a sand test.

The Garand rifle failed to extract frequently in the first hundred rounds, often breaking the cartridge rims, occasionally failed to feed, to eject the clip, and to eject the shells. After 160 shots in the second series the Garand wood handguards and stock were smoking badly. On the 198th, 199th, 200th rounds it failed to extract the standard brass-cased ammunition, breaking the rims, and requiring a rod to clear the action. The officials then ordered the Johnson to stop because the Garand was out of action. The Johnson operator ceased firing over the inventor's protest. The Johnson had then fired 324 rounds, and, as would appear from the previous firing of 2,400 continuous rounds, could have gone right on. On each failure to extract in the Garand, a rod was needed to clear the chamber.

Summary of third day's firing

Total stoppages	18
Magazine stoppages	8
Functional failures	0
Total rounds	324
Total rounds, defective cases (soft brass)	100

It appeared rather obvious at the time that weak magazine springs were causing the feed failures noted above. Stiffer springs were used.

FOURTH DAY: 168 ROUNDS, NO MALFUNCTIONS

(This included; firing at 80° elevation and depression.)

On the fourth day enough rounds were fired to establish that it has been weakness or lack of tension on the springs in some of the magazines used on the previous day that had been causing trouble.

Summary of grand total, Fort Benning

Total stoppages.....	86
Magazine stoppages.....	24
Functional failures.....	0
Total rounds.....	3, 936
Total rounds defective cases including 4 split-case stoppages.....	760
Stoppages caused by known defective ammunition, not including misfires due to primers.....	49
Stoppages due to defective coil spring, under severe adversities.....	10
Misfires due to primers.....	2
Deflected shell.....	1

Percentage of stoppages, grand total, 2.18 percent malfunctions.

Percentage of stoppages, excluding 49 out of 86 which were due to known defective ammunition having soft brass cases, nine-tenths of 1 percent (0.009).

Percentages of stoppages attributable to Johnson magazines furnished, 24 out of 3,936, two-thirds of 1 percent (0.006).

Percentage of functional failures due to any reasonable breakdown of the Johnson mechanism..... 0 percent.

The committee was informed that out of about 4,000 rounds the Johnson rifle malfunctioned 86 times, but in fact 49, or more than half, of the so-called malfunctions were due to defective soft brass cased ammunition.

DEMONSTRATION TO INFANTRY BOARD FOR THE CHIEF OF INFANTRY, UNITED STATES ARMY, FORT BENNING, GA., JUNE 29 TO JULY 6, 1938. TEST OFFICER: CAPT. R. H. BROWN, INFANTRY, JOHNSON SEMIAUTOMATIC RIFLES MODEL NOS. 1 AND 3

Record of firing of Johnson semiautomatic rifles

NOTE: No. 1 Gun is the gun fired during March, 1938. No. 3 Gun is a new gun incorporating a few changes

FIRST DAY'S FIRING

Gun	Rounds fired	Malfunctions
No. 1.....	200 F. A. 1386.....	7th and 194th rounds failed to feed due to light weight magazine springs.
No. 1.....	120 F. A. 1889 ¹	97th round was flipped back into chamber by deflector.
	Both firings above were continuous aimed shots.	6th round failed to feed as above.
	Totals 320.....	119th round failed to extract.
No. 3.....	200 F. A. 1386.....	3 magazine failures.
		1 deflector failure.
		1 failure to extract.
No. 3.....	200 F. A. 1386.....	46th, 143d, 180th rounds failed to feed due to magazine springs.
		190th round had a very bad split case.
		191st round failed to extract. It was found that the gas escaping through the split case had bent the extractor shank. New extractor placed in gun in 45 seconds.
No. 3.....	24 F. A. 1889.....	197th, 200th rounds misfires. Fouling from split case had jammed firing pin.
		Gun was disassembled after firing above. Bent extractor was bent into shape and replaced in the gun.
	Totals 224.....	3 failures to feed due to magazines.
		6 failures to feed due to magazines.
		1 failure to extract. Due to split case Rn3.
		2 misfires, all due to the split case.

¹ F. A. 1935, Lot No. 1889 has very soft brass cases.

CAPITULATION—SECOND DAY'S FIRING

0th to 1,000th round, 3 failures to feed due to magazine.

1,000th to 1,500th round:

- 3 failures to extract.¹
- 1 failure to eject.
- 1 failure to feed.
- 1 misfire.

1,500th to 2,000th round:

- 1 failure to extract.
- 2 failures to eject.
- 1 failure to feed.

2,000th to 2,350th round:

- 3 failures to extract.¹
- 2 failures to feed.

2,350th to 2,400 round, 10 failures to extract.

THIRD DAY'S FIRING

Gun No. 1. Three magazines were loaded and then filled with sand. They were then placed in the gun. No rounds were ejected by the operation of the gun but all rounds fired and were extracted and ejected by pulling the bolt handle to the rear.

Gun No. 1 fired 100 rounds of lot 1889 at 30 r. p. m.:

- 5 failures to extract.²
- 4 failures to feed.
- 5 failures to eject.

Gun No. 1 fired 224 rounds of lot 1324 at 30 r. p. m.: 4 failures to feed.

FOURTH DAY'S FIRING

Gun No. 1. New magazine springs in magazines. New and heavier main spring.

Lot No. 1324 was used, 144 rounds being fired with no malfunctions. Eight rounds were fired at 87 degrees elevation with no malfunctions. Sixteen rounds were fired at 87 degrees depression with no malfunctions.

R. H. BROWN.
Capt., Inf.

STATEMENT BY M. J. B. HOWARD

AMMUNITION FOR JOHNSON RIFLE

Mr. HOWARD. In view of statements made concerning the adaptability of the Johnson rifle to ammunition caliber .30 M1, and especially in view of the fact that Johnson Automatics, Inc., has advertised the Johnson rifle as a long-ranged, powerful weapon, we beg leave, in conjunction with submitting a summary of the ordnance tests of our rifles which were fired with M1 ammunition for endurance, to indicate wherein we feel that the Johnson rifle, designed for the caliber .30 M1 ammunition, is an unusually powerful, formidable weapon, and, in so doing, to compare this rifle's effectiveness with other caliber .30 ammunition, including .30 M2, etc.

COMPARISON OF AMMUNITION—CALIBER .30 M1, M2, M1906, 150-GRAIN—
HI-SPEED, 180-GRAIN, 170-GRAIN

Prepared by Johnson Automatics, Inc.

ADVANTAGES OF .30 M2

- (1) Twenty percent less chamber pressure than .30 M-1.
- (2) Bullet 22 grains less in weight.
- (3) Flat base bullet slightly easier to manufacture.
- (4) Less wear on barrel.
- (5) Same muzzle velocity as .30 M1 and M1906.

¹ All soft cases.

² Extracted by manual operation of bolt.

- (6) Save 2,200 grains or 0.31 lb. per 100 rounds, or about 0.62 lb. per 200 rounds, or for 100 rounds the equivalent of about five or six cartridges. (Note: M1905 bayonet weighs 1 pound or the weight of 16 rounds.)
- (7) Slightly less kick than .30 M1.
- (8) Accuracy good up to 300 yards.
- (9) In absence of wind good accuracy up to 600 yards.
- (10) Suitable for barrage fires up to 1,500-1,600 yards.
- (11) Higher trajectory for overhead fire. At 600 yards M2 requires about 5 minutes of angle more elevation (strikes about 30 inches lower than M1). Maximum range: 3,000 yards.
- (12) Safer to fire on target ranges because it neither travels nor ricochets so far as M1. Not as dangerous.
- (13) Will probably reduce maintenance costs on some rifles.
- (14) Not so likely to cause failures to extract when left in hot chamber.

ADVANTAGES OF .30 M1

- (1) Least affected by wind from 200-300 yards up than any other including M2.
- (2) Highest maintained terminal velocities at ranges above 300-600 yards than any other including M2.
- (3) Most accurate at long range, 600-1,000 yards up to maximum ranges.
- (4) Longest-ranged of any rifle ammunition in the world, 5,500 yards.
- (5) Longest ranged for effective machine gun barrages, 3,000-4,500 yards. At 3,000 yards the beaten zone for machine guns is 50 yards long by 9 feet (3 yards) wide. At 2,000-2,500 yards the beaten zone is but 6 feet wide.
- (6) Permits most effective and efficient fire by indirect as well as by direct laying.
- (7) For barrage fires against personnel it is practically as effective as the .50 cal. types.
- (8) Makes machine gun fires almost as effective as shrapnel from 75 mm. guns up to 2,000-3,000 yards, yet is more easily delivered.
- (9) Most accurate military rifle ammunition in the world, as well as the most accurate at 1,000 yards.
- (10) Has greater penetration and energy at long range.
- (11) Due to its flat trajectory it gives greater danger space.

DIFFERENCE BETWEEN AMMUNITION CAL. .30 M1906 AND AMMUNITION CAL. .30 M2

- (1) Ammunition cal. .30 M1906 uses the same 150-grain flat base bullet as the M2. However, due to the nature of the powder which was available prior to and during the World War when the M1906 ammunition was extensively used, it was necessary to develop a chamber pressure of approximately 50,000-51,000 lbs. per square inch in order to drive the 150-grain bullet 2,700 feet per second at the muzzle.
- (2) Due to the great advances which have been made in the development of rifle powder since the World War, it is not possible to drive the same 150-grain bullet at a muzzle velocity of 2,700 feet per second with a chamber pressure of less than 40,000 lbs. per square inch.
- (3) The external ballistics of ammunition cal. .30 M1906 and ammunition cal. .30 M2 are approximately the same. Based upon some firing, it appears, however, that the ammunition cal. .30 M2 has a slightly higher trajectory, or in other words requires more elevation to reach the same point than ammunition cal. .30 M1906. The extreme range of both types of ammunition is approximately 3,000-3,300 yards with an elevation of 30 degrees which gives the maximum possible range. The 150-grain bullet is materially affected by the wind, and it is stated by authorities including J. R. Mattern, author of "Handloading Ammunition", that the flat-base bullet is affected by the wind three times as much as the streamlined boat-tail bullet used in the M1 ammunition.
- (4) The material reduction in chamber pressure is extremely beneficial to weapons such as the Garand semi-automatic rifle which encountered difficulty in functioning with high-pressured loads. For this reason in particular the M2 ammunition constitutes a distinct advance over the M1906 ammunition.

COMPARISON OF .30 M2 WITH 150-GRAIN HI-SPEED LOAD

- (1) Such companies as the Remington Arms Co. have for some years manufactured a cartridge described as the 150-grain hi-speed which gives approximately the maximum muzzle velocity obtainable with modern powders using

the 150-grain bullet. This load is the equivalent of a maximum powder and pressure load developed in the so-called M2 ammunition. To illustrate the effect of putting a normal maximum powder charge giving normal maximum pressures behind the 150-grain or M2 bullet, it is sufficient to say that in actual firing at 600 yards it was found that the M2 bullet required 20 percent more elevation than the hi-speed, or actually at 600 yards the Remington hi-speed load struck the target approximately 58 inches higher than the M2 load.

(2) In terms of practical combat fire by riflemen, this means that the danger space on level ground created by the 150-grain hi-speed load is materially greater than the danger space created by the present M2 load. From the combat rifleman's point of view, less sight adjustment is necessary with the hi-speed load at ranges from point blank up to 500 or 600 yards. Inasmuch as in combat it is often difficult to set sights accurately in a hurry, the advantage of a flat trajectory ammunition is very obvious. It would therefore seem that if it were desired to use the 150-grain bullet, more practicable results from a combat point of view would be obtained by increasing the effective danger space through the use of the maximum average chamber pressure.

COMPARISON BETWEEN CALIBER .30 M2 AMMUNITION AND COMMERCIAL 180-GRAIN
FLAT BASE AMMUNITION

(1) It is a well-known fact that heavier bullets maintain themselves over ranges with greater accuracy and with less deviation and less effect from the wind than lighter bullets. Probably the most accurate flat based bullet ever developed was the 180-grain Palma match bullet which was propelled by a full charge of modern rifle powder giving a normal maximum chamber pressure of approximately 50,000 pounds per square inch. The performances of this ammunition are described by Capt. E. C. Crossman in his book entitled "The Book of the Springfield." Up to 600-1,000 yards this 180-grain bullet will perform almost as well as the 172-grain boat-tail bullet. If it is desired to adopt a flat base bullet in order to avoid alleged manufacturing difficulties, it is submitted that the 180-grain bullet is far more desirable for all around purposes. In particular, it is much less affected by the wind than the 150-grain M2 bullet. The same would also be true of a 170-grain flat-base bullet. (In connection with bullet companies, commercial manufacturers of ammunition state that the difference in cost between the M1 (boattail) and M2 (flat-base) bullet is inconsequential.)

QUOTATION FROM J. R. MATTERN'S "HANDLOADING AMMUNITION" ON COMPARISON
BETWEEN BOATTAIL AND FLAT-BASE BULLETS, PAGES 235 AND 236

"A .30-caliber bullet of 175 grains weight, fired at 2,500 foot seconds velocity encounters 28 percent less air resistance if it has a boattail base than with a flat base. This lessening of resistance is actually greater than the difference in this respect between round-nose bullets and pointed or spitzer bullets.

"As a result of this decreased resistance and increased ranging capacity, the trajectory at 1,000 yards of the .30-caliber boattail bullet, fired at 2,500 f. s. velocity, is only about 14 feet as compared with about 19 feet for similar flat-base bullets."

(Note: At 1,000 yards, trajectory of the 150-grain bullet is between 25-28 feet.)

"At 500 yards range there is a difference of perhaps 20 percent in trajectory in favor of boattail base; at 2,000 yards almost 40 percent.

"The striking energy at any range is correspondingly affected. At 500 yards, for instance, with flat base remaining velocity about 1,500 f. s., the energy remaining is 870 ft. lbs.; with boattail base the remaining velocity is 1,684 f. s., and the energy 1,100 ft. lbs. At 1,000 yards the remaining velocity of flat-base bullets is about 1,000 f. s. and remaining energy about 380 ft. lbs.; but with boattail base bullets remaining velocity is about 1,125 f. s. and energy about 490 ft. lbs. Velocity and energy retained by the boattail bullets fired at 2,500 f. s. muzzle velocity thus are 25 to 75 percent greater than velocity and energy retained by flat-base bullets, at ranges from 400 yards onward to 2,000 yards.

"As for wind deflection, when the two types of bullets are fired as above, flat-base bullets require one-third more wind allowance or windage sight correction."

NOTES AND CITATIONS OF ARTICLES IN ARMY ORDNANCE MAGAZINE RELATIVE TO SMALL ARMS AMMUNITION AND SEMI-AUTOMATIC RIFLES FROM THE PERIOD 1919-1930.

Citations—Army Ordnance Magazine, November-December 1921, page 135 et seq.

According to the authoritative article on ammunition herein contained, it appears that just after the World War based upon experience gained in that war the Infantry Board of the United States Army requested the development of rifle ammunition having increased accuracy, a flatter trajectory at least up to 1,000 yards, and having a reduced wind deflection. It was expressly desired that the effect of the wind upon the projectile be reduced to the absolute minimum.

Attention is especially called to the requirements that the trajectory be made flatter at least up to 1,000 yards for rifle fire.

The requirements of the Infantry Board for machine guns based upon World War experience were stated specifically to require increased effective range, a flatter trajectory, and less wind effect. It was noted that the extreme range of the Model 1906 ammunition was only 3,300 yards, and that its effective range was considerably less than this.

Citation—Army Ordnance Magazine, March-April 1922, page 299

This citation includes one of a series of articles by Col. Glen P. Wilhelm, Ordnance Department, United States Army, entitled "Long Range Small Arms Firing."

In the article cited at page 299 the author, who conducted extensive tests with small arms ammunition shortly after the war, points out at the beginning of the article that ever since early history in warfare there has been a need for increased range on the part of missiles, especially a need for greater range than that possessed by the enemy. The author points out that the M1906 ammunition with the 150-grain flat base bullet was not at all effective beyond 2,000-2,200 yards. He points out that this bullet was difficult to control at these ranges. He points out that the boattail bullet later known as the .30 M1 could be controlled at practically twice the range of the 150-grain flat base bullet. He mentions the fact that the Germans used boattail bullets throughout most of the World War, and that the Swiss and French originally developed the boattail bullet, and that the Swiss, French, and Swedish, used the boattail bullet. A history of the boattail bullet, giving credit to the French for having first originated this design is given by the author.

The author points out the increased efficiency in trajectory, terminal velocity, terminal energy, and greater effective range of the boattail bullet. Exhaustive tests were conducted with boattail bullets especially those of the M1 type, weighing approximately 172-175 grains having a tapered heel or tail of six-nine degrees.

The author points out that there is practically nothing more that can be done in the way of developing the flat-base bullet. He points out that as compared with the round-nose bullet, the pointed nose or spitzer pointed bullet gives much better efficiency with high velocities especially with the velocities which are obtained at or near the muzzle. He points out that during the first part of the bullet's flight so much disturbance is created around the nose of the bullet, even around the nose of a pointed bullet, that the effect of the boattail streamlined stern of the bullet is not noticeable. However, it is pointed out that as the bullet begins to slow down, the efficient action of the streamlined tail becomes increasingly noticeable. Thus, beyond 600-1,000 yards the efficiency of the boattail bullet over a corresponding flat-base bullet is such that nearly twice the extreme range can be obtained with that form of projectile. The author also points out that this type of projectile is more accurate at long range, and he points out especially that it is much less affected by the wind.

The author then points out the advantages of such a projectile for machine gun as well as rifle fire, especially for long-range machine gun fire.

The author points out that less sight adjustment is required with the improved type of bullet (M1). He points out that this type of bullet due to the fact that it requires less elevation at a given range can be fired with greater effect by machine guns, as a greater error can be made by the crew in estimating the range without throwing the burst entirely off the target due to the increased danger space which is obtainable with this improved type of bullet.

The author points out that there is no future in the development of the flat-base bullet, whereas the boat-tail bullet offers unlimited possibilities:

The author points out the fact that the boattail bullet, since it hits the ground with greater force at longer ranges, tends to ricochet greater distances, and is therefore more effective especially for machine-gun barrage fires.

Citation—Army ordnance magazine, March-April 1921, pages 270-272

In an article herein contained by the well-known ordnance engineer of the Ordnance Department, United States Army, Mr. J. C. Gray, it is pointed out by Mr. Gray that the Army required a long-range machine gun .30-caliber bullet. Mr. Gray points out the advantages to be obtained in a machine gun by virtue of the improved boattail type ammunition and states that it is difficult to adapt the highpower .30-caliber cartridge to semiautomatic rifles.

Mr. Gray goes on to point out the reasons why it is difficult to reduce the weight of automatic mechanisms down to the limits prescribed for the individual soldier's rifle and states that the use of high-powered ammunition in the semiautomatic rifle creates great difficulty, to the extent that after 20 years of experimentation and research it has not been possible to develop a mechanism capable of handling the standard caliber .30 ammunition successfully. Mr. Gray then indicates that it is possible that a special cartridge may be developed for the rifleman only.

It is noted that in the requirements given on page 272 of this magazine for semiautomatic rifles, it is stated in paragraph 8 that the rifle should not weigh over 10 pounds.

Attention is called to the fact that in the Army Ordnance magazine for July-August 1928, on page 17 in an article on semiautomatic rifles, it is stated at page 20 that considerable trouble has been encountered with .30-caliber ammunition in semiautomatic rifle mechanisms. Considerable mention is made during this period in various articles in Army Ordnance magazine of the caliber .276 ammunition which was especially designed because of its reduced pressure and simplification of the problem of adapting a semiautomatic rifle mechanism suitable for infantry use.

Attention is called to the fact, without further citation on the point, that the Pederson and Garand rifles as well as a model of the White rifle and several others were submitted for test in 1929 and most of these rifles were in caliber .276. Shortly after 1930, however, the Chief of Staff, General Douglas MacArthur, decided that it was not practicable to have two types of small-arms ammunition, and decided that henceforth all rifles and machine guns should use the same caliber .30 full-powered ammunition. He therefore instructed the Ordnance Department to proceed in further development of semiautomatic rifles in the standard caliber .30 M1. It should be noted that in that period, 1921-30, the ammunition caliber .30 M1 was developed and adopted as the standard of the United States Army for rifles and machine guns.

With reference to the caliber .276 ammunition, the following citations are given from Army Ordnance magazine:

Nov.-Dec. 1928, page 166.

May-June 1929, page 411 (chiefly on semiautomatic rifles) on page 412 illustrations are shown of the .276 ammunition, and it is noted that the bullet for the .276 cartridge had a boat tail.

Citation—Technical Regulations No. 1350-A, War Department, May 18, 1934 "Infantry and Aircraft Ammunition" (ammunition for small arms and automatic guns) (Prepared under the direction of the Chief of Ordnance)

At page 30 section 8 will be found a general description of cartridge, ball, caliber .30 M1. It is stated in paragraph 21: "The cartridge, ball, caliber .30, M1, was adopted in the early part of 1926, after a series of experiments with various types of bullets. The development work was undertaken primarily to gain increased range and superior accuracy over the war-time M1906 cartridge. The caliber .30 M1 cartridge is the standard service ball ammunition and will supersede the M1906 when the supply of the latter is exhausted. It is used in the United States rifles, caliber .30, M1903 and M1917, as well as in all caliber .30 automatic rifles, machine rifles, and machine guns."

At page 35 of the same regulations the maximum range of this ammunition is given at 5,500 yards, the muzzle energy 2,675 foot pounds, the average maximum chamber pressure 48,000 pounds per square inch, and the muzzle velocity approximately 2,647 feet per second.

Citation—Army Ordnance magazine Jan.—Feb. 1922, page 240

This citation refers to an article by Colonel Wilhelm on anti-aircraft bullet flight. This article indicates the relative efficiency of the boat-tail ammunition over the standard war-time M1906 ammunition when fired vertically into the air.

It is particularly noted in this article that the boat-tail M1 bullet gives much greater range fired vertically. For example, in one test, different types of ammunition were fired vertically, the time was taken from the moment when the projectile was fired until the projectile returned to the ground. It is noted in the figures given by the author that the .06 bullet returned to the ground in approximately 50–60 seconds, whereas the M1 bullet did not return to the ground for 1 minute 50 seconds. It was noted that boat-tail bullets of the Swiss, French, and others did not return for at least 1¼ minutes. This test indicated that the boat-tail bullet was much more efficient in this respect than the flat-base type.

Citation—Army Ordnance magazine Jan.—Feb. 1926, page 246

An article by Colonel Julian Hatcher relative to the excellent ammunition made by Frankford Arsenal cites that Frankford Arsenal M1 ammunition made in 1925, when fired at 1,000 yards, gave a mean radius of 4.48 inches, as against a mean radius with the Frankford Arsenal M1 ammunition made in 1924 of 5.499 inches. This in general indicates an extreme spread at 1,000 yards well within the V ring of 20 inches in diameter used on the standard 1,000-yard "C" target.

Citation—Army Ordnance magazine Nov.—Dec. 1921, pages 148–149

On page 149 is given a list of requirements for semiautomatic rifles. It is pointed out herein that it is desired by the infantry to have a semiautomatic rifle, and the advantages of such a weapon are enumerated. It is pointed out that some tests were conducted with the sporting type Remington auto-loading rifle, but that this rifle with its ammunition was not powerful nor accurate enough for military use. The limited range, of this weapon was also commented upon. It should be noted, however, that the ammunition which was fired in this Remington auto-loading rifle is sufficiently accurate to hit a man target at least up to 500 yards.

Citation—Army Ordnance magazine Jan.—Feb. 1924

This copy of Army Ordnance contains an article on "New Designs" by Colonel Julian Hatcher. In this article it is stated that the War Department through the Ordnance Department seeks improvements in weapons and ammunition at all times. In particular it is pointed out that the Ordnance Department constantly seeks the cooperation of engineers and inventors in their attempts to develop the best of equipment.

Citation—Speech of the Chief of Ordnance at the Annual Meeting of the National Rifle Association, February 2, 1940. (See also March issue 1940, American Rifleman magazine)

With reference to the above-cited requirements set down for shoulder rifles and ammunition directly following the experiences of the World War, attention is called to the statements of the Chief of Ordnance at the N. R. A. meeting to the effect that the combat rifleman did not need accuracy beyond 600 yards, and that the flat-base M1906 bullet incorporated in the so-called M2 ammunition constituted a distinct step forward in the development of small arms ammunition; that this M2 ammunition had been adopted as standard for all shoulder rifles and all machine guns, to replace the caliber .30 M1 ammunition. Attention is called to the fact that in his speech the Chief of Ordnance stated that the Ordnance Department was serving the demands of the using arms, and that the Infantry Board had set up the requirements which resulted in the adoption of the M2 ammunition. It was pointed out that this ammunition gave a higher trajectory and could therefore be used to fire over the heads of supported troops.

This may be compared with a statement in Army Ordnance magazine for November–December 1921 at page 135 relative to the requirements of the Infantry Board for rifles and machine guns. Attention is also called to Army Ordnance magazine for March–April 1922, page 299, relative to the requirements then set up for ammunition, and attention is called to the statement by the author that high-angle fire weapons such as mortars and the like were used for

firing chiefly at high angles as distinguished from the type of fire required in flat trajectory weapons such as the rifle and machine gun. Attention is also called to the fact that several foreign governments are still using boat-tail ammunition which has considerably more range than the M2 ammunition.

With reference to the adoption of M2 ammunition originally for use in the standard semiautomatic rifle (Garand), particular attention should be called to the articles in Army Ordnance magazine above cited which indicated the difficulty which had been encountered in the adaptation of the standard caliber .30 ammunition to semiautomatic rifle mechanisms. It should be noted that the caliber .276 ammunition was first used in the Garand gas-operated rifle, and that this rifle was tested in this caliber in 1929 when it was determined to proceed further with its development.

M1 AMMUNITION IS SUPERIOR TO 1906 OR M2 AMMUNITION

I quote the following information directly from the June 1935 issue of United States "Infantry Journal" magazine. This statement in praise of M1 ammunition was made 7 months before the Garand rifle was adopted in January 1936 as the standard rifle of the U. S. Army.

[From *Infantry Journal*, June 1935--*Infantry Digest*]

"M1 ammunition at 4,200 yards.

"To determine the effectiveness of the new caliber .30 ammunition (M1), machine gun firing was conducted at a range of 4,200 yards. Officers stationed in a dugout close to the beaten zone observed the following:

"The cone was compact; no strays or tumbler.

"The bullets made a soft 'swishing' sound in the air.

"The bullets penetrated soil to a depth of eight inches.

"One bullet struck a piece of hard pine $1\frac{1}{4}$ inches thick. It passed through, making a clean hole, and then penetrated five inches into the ground.

"In this connection it is interesting to note that the '06 bullet often fails to penetrate a cardboard target at 2,000 yards."

I submit at this time for inclusion in the record the following pertinent material:

[Army Ordnance, Washington, D. C., November-December 1921]

IMPROVED SMALL ARMS AMMUNITION

By Townsend Whelen, Member A. O. A.

[Prior to the World War, Colonel Whelen was serving as captain, Twenty-ninth Infantry. On the outbreak of the war he was assigned as major and ordnance officer, Seventy-ninth Division, and assisted in equipping and training that division. It is interesting to note that this was the first division to be completely equipped with Browning machine guns. Two days before the Seventy-ninth Division sailed for France, Major Whelen was detailed as a member of the General Staff Corps, and ordered to Washington for duty in the War Plans Division, where he remained during the war in charge of Infantry Training in the United States, particularly training in marksmanship and musketry, of which he had made a specialty. He was promoted to the grade of lieutenant colonel in June 1918. His work on the General Staff brought him into very close touch with the Ordnance Department, and it was natural that he should have transferred to that corps after the war. He is at present in command of Frankford Arsenal.—Ed.]

The United States has always been to the fore in the character and development of its small-arms ammunition. We have many incentives to encourage such work. Not only do we strive to keep abreast of other nations, but we are driven and encouraged by a very critical and demanding class of small-arms users, both military and civilian. The rifleman of America differs greatly from his brothers of other countries. He is not willing to take what is given him, but demands the very best, and he knows what is the best because he is a very close student of small-arms ballistics and mechanics. For example, we find even civilian riflemen in this country loading their own ammunition and developing their own charges, and there is a host of amateur experimenters. The largest users of small arms are of course the Infantry of the Regular Army and National Guard, and they too are very critical and demand the best, for they say that without the best am-

munition they cannot develop that nail-driving marksmanship which should be a characteristic of the United States Infantry.

The Ordnance Department has endeavored and has succeeded in keeping in the closest touch with all the using services and classes, and it is a matter of pride with us that we have not only kept abreast of their demands, but have actually given them better ammunition than they asked for or believed possible. The improvements and developments in the various types of ammunition will be discussed seriatim.

BALL AMMUNITION, CALIBER .30

The service type of a year ago contained a 150-grain pointed cupro-nickel jacketed bullet and sufficient of Pyro D. G. (nitrocellulose, regular burning) powder to give a muzzle velocity of 2,700 feet per second. The mean radius at 600 yards was about 5 inches. Practically its group of shots could be contained in about a 22-inch circle at that range. This ammunition, while superior in most characteristics to that of any other nation, was not quite what was desired in several respects. The best criticism of it comes from the using services, particularly from the Infantry Board. It asks for a service ammunition which shall have better accuracy, which shall give no metallic fouling, which shall have the flattest possible trajectory up to 1,000 yards, and which shall be least deflected by wind. These are requirements for ammunition for riflemen only; machine gun service ammunition will be dealt with later.

MACHINE-GUN AMMUNITION

At present the service machine-gun ammunition is the regular 150-grain service ball cartridge having a muzzle velocity of 2,700 feet per second. But this is far from satisfactory to the machine gunner. Its extreme range is only 3,300 yards, and it lacks destructive power at long range. The trajectory is too high, and the effect of lateral winds is too great. The Infantry Board have indicated that they desire the longest range and flattest trajectory possible. It had already been determined by Major Wilhelm at the Small Arms Ballistic Stations at Miami and Daytona, Florida, that these desired characteristics could only be obtained by using a heavy boat-tail bullet. Difficulty has been encountered in obtaining such a bullet that will be both reliable and accurate, but experimental work has now progressed to such an extent that it is possible to predict success in the very near future, and to indicate the nature of such a bullet. An enormous amount of experimental firing has been done. As to weight and form of bullet, the best results have been obtained from bullets weighing 175 grains. Such a bullet must be full groove and must be as hard and stiff as possible to resist deformation.

[Army Ordnance, Washington, D. C., March-April 1922]

LONG RANGE SMALL ARMS FIRING

PART VII. BOAT-TAIL BULLETS

By Glenn P. Wilhelm, Member A. O. A.

From time immemorial it has been considered sound tactics to obtain the longest possible range with all missile weapons of war, as it is sound tactically to have a weapon which will outrange the corresponding enemy weapon. For ages the attempt has always been made to have the projectile travel as nearly as possible in a straight line. This, of course, would only be obtained with an infinite velocity so that the higher the muzzle velocity the more nearly has a right line been approximated for short ranges. If it were possible to shoot in a straight line all range finding, sight setting, fire control tables, etc., would be eliminated and the danger space as ordinarily defined would be continuous.

Of course special weapons have been designed to use curbed fire over obstacles, such weapons being mortars, howitzers, grenades, etc. No one, however, has ever expected the same weapons to serve both purposes, as they are obviously different in principle.

The range of weapons has been increased, from time to time, by increasing the weight, the muzzle velocity and by new and improved methods of projection such as the use of rifling and by improvements made in the shape of the projectile. Up until recently the greatest advance in progress has been made by improving the shape of the point or forward portion of the projectile. It has been shown that the most promising method of increasing the range of the present infantry weapons, particularly the machine gun, is along the lines of changing the shape of the base of the bullet so as to decrease the resistance of the air.

The present series of articles has already indicated the great flatness of trajectory of boat-tail bullets (bullets having a tapered, streamline rear portion) beyond a range of about 1,000 yards. Elevation curves have been shown for ranges as great as 3,000 yards with photographs of the impact of the boat-tail bullet in sand at ranges as great as 5,000 yards and with comparative photographs of impact of the service bullet in sand at 2,500 yards. There has also been shown photographs of the splashes of the impact of the boat-tail bullet in water at about 2,200 yards compared to the service bullet at the same range.

The service bullet is probably effective insofar as causing a casualty (if it struck a vital spot) at ranges as great as 2,500 yards. In fact, during the course of the experimental firing, a sergeant observer, who, overconfident of the ability of the range crew to control the location of the burst from a Browning machine gun, had remained outside the bombproof during the firing of a ranging burst, was struck in the fleshy part of the ankle by a direct hit at a range of 2,200 yards. The bullet passed entirely through the ankle and bulged the skin on the opposite side, from which it was later easily removed, leaving a very superficial wound. However, at ranges greater than about 2,000 yards it is exceedingly difficult to hit even the largest and most vulnerable of machine-gun targets, due to lack of control over the bullets. At ranges greater than 2,500 yards the bullet will not bury itself in the hard sand. On the other hand, the boat-tail bullet is well under control at nearly twice the ranges for service ammunition and such a bullet on hard sand will continue to ricochet up to ranges nearly as great as 5,000 yards.

HISTORY OF THE BOAT-TAIL BULLET IN OTHER COUNTRIES

Omitting from consideration the attempts of early investigators of the flight of projectiles previous to the invention of the modern cartridge case, the history of the boat-tail bullet originates with the experimental work carried out by a French Commission during the years 1894 to 1897. This work was the basis upon which they made the change from their old blunt-nose cylindrical body, square-heeled, Model 1886, bullet to their present bi-ogival, Model 1898, Balle-D.

In general, the Commission's method of investigation consisted of making up brass bullets (turned on a lathe) having variously proportioned head and tail ogives, and different points and bases. These they fired in rifles having different barrel characteristics and then studied the resulting velocity, trajectory, and accuracy, giving a proper consideration to the powder charge and the atmospheric conditions. The trajectories were usually compared by measuring the height of their ordinates at 50 meters on a paper screen when firing at 1,600 meters range.

These experiments were probably the most complete of those of any nation up until the World War and the efficiency of the work can be seen from the fact that this bullet was used by the French and, to a great extent, by the United States for machine guns during the war. It was probably the most effective machine-gun bullet used by either side with the possible exception of the development by the Germans of a somewhat similar long-range machine-gun bullet in the latter stages of the conflict.

Our objections to the French Hotchkiss machine gun 8 mm. bullet are that this type of bullet has too great a weight, will not give the maximum effective range possible with the flatness of trajectory desirable at short range, nor is its accuracy up to American marksmanship ideals. Moreover, it is not considered suitable for manufacture in large quantities in time of war as compared to a jacketed type of bullet.

The adoption by the French of a boat-tailed bullet so far back as 1898, undoubtedly stimulated the interest of other nations in the possibilities of this type of bullet, but judging from the lack of results it is probable that the majority of them considered the manufacturing difficulties insurmountable in view of the inaccuracy of such type of bullets with no appreciable advantage except that of long range. Particularly the merits of the boat-tail bullet were overlooked, due to the fact that the ranges at which it showed superiority over flat-base bullets were greater than those ordinarily considered to be of use in battle.

It will be noted that the French in their tests used a range nearly as great as 1,800 yards. Now most investigators of the characteristics of the boat-tail bullet contented themselves with firing at ranges not to exceed 1,000 yards. As a result of such experiments, it was predicted that the boat-tail bullet was little if any superior to flat-base bullets. Other investigators presented long-winded mathematical, theoretical deductions to show that the boat-tail bullet would never be of use except in weapons having the very highest velocity, as the vacuum at the base of the bullet was only formed at high velocities and that, therefore, this type of bullet would only be efficient at correspondingly high velocities.

Several other nations, particularly Switzerland and Sweden, have adopted boat-tail bullets, while during the war the majority of German small-arms bullets were boat-tailed. The Swiss rifle team in 1913 used a boat-tail bullet with which they were able to defeat the American team at a range of 300 meters. Probably the most efficient and highest developed form of boat-tail bullet in use by any nation at the present time is that of the Swiss.

STATEMENT BY JOHN BABCOCK HOWARD, GENERAL MANAGER AND TREASURER
OF JOHNSON AUTOMATICS, INC.

Mr. HOWARD. In the memorandum just submitted for me by Capt. Melvin M. Johnson, Jr., to your committee, our company made certain general comments, statements of facts, and opinions concerning why the "Johnson rifle is superior to the Garand rifle." The testimony taken from others during the latter part of the day prompts me to add the following statements and observations as well as to raise certain questions for consideration by your committee.

The unfavorable comment contained in the "conclusions" of the Aberdeen Proving Ground report referred to by Major Schleiker is fully answered in the last section, entitled "Further Comment," of the memorandum of Johnson Automatics, Inc., referred to above. Also, the testimony of Captain Johnson in today's hearings further covers this criticism in detail.

It is clear from every statement of criticism made during today's hearing that the Johnson rifle is fundamentally sound in design, satisfactory in performance as a semiautomatic rifle even under adverse conditions, and finely accurate, even though certain preferences have been indicated for minor corrections in specifications. To meet these criticisms, we summarize the following points:

1. Reduce the weight to that of the average Garand rifle by reducing the weight of the barrel to that of the Garand.
2. Mark the two safety-switch positions to read "safe" and "off."
3. The Johnson dagger or sword bayonet may be modified slightly in design.
4. The magazine body shall be reinforced to withstand even more severe blows from service abuse.
5. The buttstock shall be reinforced to improve its longitudinal strength.
6. The trigger pull shall have minor modification to incorporate the desired "double pull" or "slack and take-up" movement.

RIFLE REQUIREMENT FOR ARMY

Mr. JOHNSON. With reference to Colonel Drewry's statement that 240,000 rifles are sufficient for 1,000,000 men or 960,000 for 4,000,000 men, I respectfully submit that these figures surely are not intended to include the full rifle equipment for the United States Army of such a size except as to the infantry and cavalry branches only. For example, in the German Army all enlisted personnel carry a rifle, including engineer, artillery, service, and special troops. Moreover, I understand the peace-time replacement allowance for rifles is usually 25 percent, approximately, of the basic number. I seriously doubt that our emergency requirements are likely to be less, and they may be more, than in the last war, when we needed over 4,000,000 rifles.

FUTURE AND OTHER JOHNSON DEVELOPMENTS

Mr. JOHNSON. Gen. R. C. Moore, of the General Staff, made some very interesting comments about an experimental gas-operated rifle which he has recently seen. Major Schlieker also mentioned this experimental weapon. It was intimated that there are new developments coming along all the time. It was pointed out that the Johnson recoil-operated rifle and the Garand gas-operated rifle are not the only semiautomatic weapons in existence.

I can hardly concur with that position, particularly in view of the fact that we have already conducted experiments with a very novel gas-operated mechanism which has the particularly unique feature of being gas operated and yet not having any gas port in the barrel or at the muzzle of the barrel. In fact, there are no gas ports on the barrel at all, the entire actuating mechanism being contained within the small space in the breech. This experimental mechanism has an advantage over the experimental Winchester mechanism mentioned by General Moore, in that it uses the time-tried Mauser-type rotary bolt, which the Winchester mechanism does not.

We have already shown the committee a model of the latest Johnson light machine gun, and in due course at some appropriate future date we may very likely be in a position to disclose later models of the Johnson recoil mechanism. There is nothing strange about this, as developments occur, for example, in the automobile and airplane industries all the time. It need not be assumed, so far as the Johnson organization is concerned, that having developed what we have shown the committee within the past 4 years, we are necessarily going to become barren of developments during the next several years. But we beg leave to point out that what may be done in the future is of no concern of the American people in view of the urgency of equipping our manpower with reliable weapons now, and not years from now.

SUMMARY OF TESTIMONY

Mr. JOHNSON. If it please the chairman, I beg leave to summarize what we have shown today.

(1) The Johnson semiautomatic short-recoil operated rifle is favorably regarded mechanically by competent authorities, including representatives of the Marine Corps, National Guard, National Rifle Association.

(2) The Johnson rifle has no major defects. In response to Senator Chandler's direct question the Infantry representative admitted that his meticulously detailed criticisms were not major, and were mostly remediable. I have, I believe, given authoritative responses to most of those criticisms.

(3) Most important of all, we have shown by the authoritative testimony of several very large manufacturing organizations that the Johnson rifle can be made in large production in a very short time and without difficulty. We have shown that the Johnson rifle is well engineered for production, and that competent, nationally prominent American manufacturing organizations are ready, willing, and able to produce the Johnson rifle at once.

(4) The testimony proves that the Marine Corps and National Rifle Association, as well as certain others, are not satisfied with the present standard (Garand) M-1 rifle for various reasons.

(5) The War Department and Marine Corps representatives stated that the Johnson rifle has yet to be tried out in combat tests.

(6) The president of the National Guard Association of the United States urged favorable consideration of the bill to adopt the Johnson rifle. He also urged the procurement of Johnson rifles without delay.

(7) The Marine Corps indicated their policy of testing only adopted arms.

(8) The Navy Department indicated their policy of buying only adopted arms.

(9) The War Department stated that in order to test properly any weapon for its combat effectiveness, it would be necessary to take a substantial quantity of such weapons directly from the factory production lines and to place them in the hands of the various using services.

(10) Johnson Automatics, Inc., exhibited a new ultra lightweight caliber .30 high-powered machine gun substantially similar in its major parts to the Johnson rifle. This weapon weighed little more than a rifle.

(11) We respectfully represent that if the critics of the present standard rifle prove to have been incorrect, as perhaps they may, a second string to the nation's bow will nevertheless benefit the national defense. On the other hand, if they should prove correct in their criticisms of this rifle, and the opportunity of having the Johnson rifle as a second weapon is rejected, then unquestionably it will be the people of the United States who will suffer irreparably.

(12) In the interest of adequate national defense I, therefore, urge favorable action on this bill, S. 3983, a bill to provide for the adoption of the Johnson semiautomatic rifle as a standard arm of the military and naval forces and its procurement for the using services, and such other action as the committee may deem appropriate.

EXTRACT FROM ARTICLE BY MAJ. J. S. HATCHER (ORDNANCE DEPARTMENT UNITED STATES ARMY), "THE MILITARY SEMIAUTOMATIC RIFLE"—MARCH, 1932 AMERICAN RIFLEMAN

A great many years ago the Army recognized the desirability of the semiautomatic rifle, but for many years little success attended the efforts to design such a weapon. Numerous gas-operated guns were tried. These had the disadvantage of having the piston and gas cylinder under the barrel or at the side of it, which added weight and bulk. Then another trouble with these guns was that gas was tapped off the barrel at such tremendous pressure that it was hard to handle

it without introducing severe strains on the gun. When the bullet passes the gas port in the barrel, the pressure at that point will be anywhere from 40,000 to 10,000 or 12,000 pounds per square inch, depending upon where the port is located. The closer to the breech it is, naturally, the higher will be the pressure. Assuming that the port is at the point where the pressure is 25,000 pounds to the square inch, a sudden application of this enormous pressure on the head of the piston slams the breechlock open with extreme violence, and the result is not only undesirably quick opening, tearing the heads off the empty cartridge cases, and such troubles as these, but also excessive breakages of parts.

The logical thing to do was to move the gas port as far forward as possible, where the pressure would not be so great, and reduce the area of the port so that the gas was throttled down to a lower pressure before striking the piston. By doing these things a number of very successful gas-operated guns have been made; but there is another disadvantage to the gas-operated system, and that is the hole bored in the barrel to form the gas port. It is difficult to clean this hole, so that it is always a point where rust and corrosion are likely to start.

Gas operation has been more successfully applied to machine guns than to shoulder rifles. In machine guns the moving part can be made heavy enough so that the very sudden blow of the gas is partly absorbed by the inertia of the piston. Moreover, the pressure of the gas on the piston endures only about one one-thousandth of a second, and if these parts are made heavy they will absorb sufficient energy from this blow to continue their rearward motion against the action of the return spring and complete the opening action even after the gas pressure is gone.

With the shoulder rifle, conditions are very much more difficult. The piston and other moving parts cannot be made heavy or the gun will weigh too much; and light parts do not have enough inertia to carry through the rearward motion after the gas pressure is gone unless the impact of the gas is made extremely violent. The result has been that in most gas-operated shoulder rifles the light piston gets up energy enough to open the breech against the spring action by being slammed to the rear with very high speed, and this violent action is conducive to very high breakages.

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