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CMG-1 Evaluation

For purposes of this report I shall call the original model of the CMG-1 with the left or right hand feed feature the CMG-1. The second model with the larger bolt and left hand feed only I shall call the CMG-1A.

The H shaped feed lever of the CMG-1 and the accompanying mechanisms that allow a left or right hand feed is its best feature. However, it will feed dependably only from the left. When fed from the right, something in the feed system binds and will not allow the carrier to go into battery with enough velocity to (1), either strip the cartridge from the belt or (2), if it does strip, there is not enough remaining energy in the carrier group to fire the cartridge due to lack of energy transmitted through the firing pin.'

The AR-15 bolt and extractor used in the CMG-1 are not rugged enough for the job. Also, the bolt lug that strips the cartridge from the belt cannot, due to the small diameter of the bolt head, project far enough up into the feed tray to guarantee an adequate driving surface for stripping.

The AR-15 gas system considered for use in the CMG-1 does not lend itself to an interchangeable barrel system. A short stroke piston system was experimented with but the small diameter of the piston rod caused failures.

The problems mentioned above were the basic reasons for the changes in design that led to the CMG-1A. This model has a larger bolt head, a different type extractor, a short stroke piston of larger diameter, and feeds only from the left.

In examining the overall design concept of this model, and the design of the various components which comprise the total weapon, I have come to the following personal opinions.

1. The extractor design is inadequate for machine gun duty.

    1.1 It is not rugged enough. The cross sectional area of the extractor at the claw is inadequate. Very little attempt to avoid stress concentration has been made. The extractor can be pivoted completely out of the bolt, even though the extractor spring and plunger are in place. This is likely to happen often in service.

1.2 The extractor plunger is inadequate. Its length of service under firing conditions is most likely to be extremely limited. Basic design, which creates stress concentration, is at fault.

2. Bolt design:

2.1 The bolt design must be changed to accommodate an adequate extractor. Also, due to a necessary change in design of the cam track in the carrier, the cam pin hole in the bolt must be moved.

3. Carrier Design:

3.1 The cam track in the carrier is similar to the cam track used in the very early AR-10 weapons. This cam track had no dwell after its helical path and prior to picking up the bolt to begin its rearward movement. The combination of forces involved in both stopping the rotational movement of the bolt and at the same moment giving it a tremendous yank towards the rear of the weapon resulted in consistant bolt failure at the cam pin hole. Addition of a short dwell period at the forward end of the cam track solved this problem on the AR-10. As the sizes of the CMG-1A bolt and cam pin are very close to the AR-10 bolt and cam pin, I assume that the same situation would exist and that the same corrective action must be taken.

3.2 The depth of the carrier body necessitated by the gas system's position under the barrel makes necessary a distance from the bolt face to the ejection port in the bottom of the receiver which is excessive for dependable ejection, i.e., the cartridge case strikes the rear section of the ejection port at a point forward of the CG of the case. This is a very dangerous situation. Spin-backs are almost guaranteed.

Fastex films taken of the movements of the ejected case after firing demonstrated that the combination of the case striking the ejection port as it does, and then striking the traverse and elevation gear immediately to the rear and below the ejection port, would, at the cyclic rate of 250 rpm that the CMG-1A seems to be operating at present, result in two successive ejected cases trying to be in the same place for a duration of 1/16 second. Cyclic rate was calculated using the 4000 frames per second speed of the Fastex camera as a base. Exact cyclic rate must be arrived at by using a timing light in combination with the camera. A burst of X number of rounds cannot be timed at present to get cyclic rate because the feed system will not feed successive rounds.

If the CMG-1A were to be brought to a faster rate than the supposed 250 rpm, which should be done, then the problem is more serious. The ejected cases would probably bounce right back inside the receiver, causing jams.

4. Gas System:

4.1 The gas cylinder of the CMG-1A is, at present, welded to the receiver by two plug-welds. I do not believe this makes the assembly of these two components strong enough to withstand rough usage. Position of exhaust ports has not been established as yet. Also, the forward end of the cylinder is in line to line contact with the gas take-off boss. Due to thermal expansion and contraction of the barrel and receiver assembly, and tolerance accumulation, I am sure there would be many instances where the barrel could not be locked into the receiver because the barrel lock pin would not align with its hole in the barrel extension.

4.2 The short stroke piston rod assembly is made of three components, a piston head and an impingement rod press fit into either end of a tube with a wall thickness of .025 inches. The piston head and the impingement rod should be pinned or brazed to the tube. Also, it is probable that the wall thickness of this tube should be increased. In fact, if pins were used to secure the head and rod, this would be mandatory. The amount of flex in a driving rod sometimes exceeds expectations, and this would be the basic reason for the thicker wall.

5. Sight System:

5.1 Front sight design is adequate, although the components should be lighter in weight.

5.2 Rear sight design has not been initiated.

6. Feed System:

6.1 The CMG-1A feed system does not function at present. The feed pawls are attached to a plate which swings with the feed lever. This causes the feed pawls to contact the cartridge they are to pick up at markedly different times assuming the cartridge lies parallel to the bore of the gun. This gives me cause for immediate concern. I don't think it will work. The exact reason as to why the CMG-1A feed system doesn't function properly I can't determine at the present moment as I could not find enough in the way of Kinimatic studies of this feed system to make a judgement.

7. Barrel Locking:

7.1 The barrel lock lever is difficult to operate because you have to pull up on it. There is little room under it to insert your finger. It is so positioned that it is almost mandatory it be operated by the right hand. Either hand operation would be preferable. The amount of force delivered by the barrel lock spring to the barrel lock pin to keep it in its locked position is inadequate. A different spring that could deliver enough load would have such a high rate as to make operation of the barrel lock very difficult if the present barrel block design were used.

8. General configuration:

8.1 In my opinion the CMG-1A receiver is too wide. By the time a forestock is added, the width would be so great that it would be difficult to handle. The top of the receiver is open in front of the barrel block. In handling the weapon while the barrel was hot, it would be very easy to burn the hands.

9. Firing Pin:

9.1 Firing pin protrusion within acceptable limits using the present design of the components involved is, in my opinion, almost impossible. Also, the AR-15 firing pin tip was incorporated, and this is far from optimum.

In general, I found very little in the designs of both the CMG-1 and the CMG-1A, and in the supporting evidence available in the way of formal Kinimatic studies, tolerance accumulation studies, specific calculations recorded, etc., to give me confidence in any particular subassembly or the sum-total at present. A machine gun is not a collection of components, it is an extremely well integrated machine if it is a good weapon. Above all, if it is good, it is well engineered, with due and thoughtful consideration given to ruggedness, weight, feasibility and economy of manufacture, ease of handling, and dependability. The design is in detail in the fullest sense of the meaning of that phase from the earliest possible moment, and each detail is examined critically.

Conclusions:

Because of its commitment to delivery of thirty (30) CMG-1's to the Army in September, Colt's is in a very difficult position due to the almost complete redesign necessary.

In terms of time and how it is related to Colt's present position, I would like to tell you of a specific development effort in which I participated. Mr. E. M. Stoner and I started on the design of the S-62, the forerunner of the S-63 on January 2. Prior to that Stoner had completed rough design layouts of the system, in fact, he had been working on the design concept for at least a year prior to this time. We worked on the belt-fed machine gun version only, to prove the feasibility of the system. We both worked on the board, back to back, for 6-8-10 hours a day. At the end of the first two weeks we hired one model maker, and a week later another. We equipped our own separate model shop with the most modern of brand new machine tools and inspection equipment. We had no functions to perform other than to design and to supervise our model makers. At the end of March we had a machine gun, in the white, with no sights, and a rudimentary charging handle because, for our purpose of evaluating concept, design, and performance, the charging handle was of minor importance. In other words, we had the basic elements only. The only responsibility our model makers had had during this period was to us, so their time had been one hundred per cent (100%) on the project. It took us the entire month of April and 20,000 to 30,000 rounds fired to convince us we had removed the major bugs and that we had a dependable weapon. Both Stoner and I felt that we had accomplished a minor miracle.

My estimate of the amount of time it would take to clean this same weapon up for an Army test schedule, with the same quantities involved as in the Colt contract, would have to be, at the very minimum, another six months, and this would be accomplished only by adding considerably to the number of people involved.

Recommendations:

Because the job facing Colt's in delivering the required quantity of machine guns to the Army for test would ordinarily require a year's time or very close to it under the very best of conditions considering the present state of development of the CMG-1A, I would recommend that:

1. Colt's exact situation be explained to the Government and an extension on delivery be requested.
2. If this extension is not forthcoming, then Colt's should very seriously consider attempting to extricate themselves from their obligation to the Government.

I would like to say that I complete this report with a feeling of real regret as to its content.

Robert D. Fremont

RDF:s
cc: R. E. Roy