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CONCEPTS OF SINGLE SHOT GRENADE LAUNCHERS ATTACHED TO AN INFANTRY RIFLE

TECHNICAL REPORT

BY
ROBERT E. DUNCAN

APPROVED BY
CHARLES J. RHOADES

JUNE 1971

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13. ABSTRACT

This report discusses the initial phase of an in-house design activity for the development of a 30mm grenade launcher. The launcher work is one aspect of the total Future Rifle System Program. As such, the concepting efforts were molded around many of the requirements of that program so as to produce a composite weapon system consisting of both area and point fire components. In a span of ten weeks, a team of five people produced 14 deserving concepts from more than 23 basic approaches. Out of these 14, two concepts were selected for further development and inclusion in the overall Future Rifle System Program. Detailed design activity is currently underway to reduce these two concepts to firing hardware by Fall, 1971. This will provide feasibility hardware under the exploratory development area while further system refinements and sophistication will follow in the Advanced Development Phase.

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TABLE OF CONTENTS PAGE

ABSTRACT

This report discusses the initial phase of an in-house design activity for the development of a 30mm grenade launcher. The launcher work is one aspect of the total Future Rifle Program. As such, the concepting efforts were molded around many of the requirements of that program so as to produce a composite weapon system consisting of both area and point fire components. In a span of ten weeks, a team of five people produced 14 deserving concepts from more than 23 basic approaches. Out of these 14, two concepts were selected for further development and inclusion in the overall Future Rifle System Program. Detailed design activity is currently underway to reduce these two concepts to firing hardware by Fall, 1971. This will provide feasibility hardware under the exploratory development area while further system refinements and sophistication will follow in the Advanced Development phase.

FOREWORD

It is recognized that this effort could not have been completed in the depth and short time frame without the hard work, imagination, and creative talents of Messrs. Robert R. Blankert, George E. Cooksey, and George L. Reynolds, SWERR-S and Mr. Charles E. Lanizzani, AMSWE-RDF.

INTRODUCTION

The Future Rifle Program is based on the rationale that the individual soldier will be provided with a weapon system which will demonstrate increased combat effectiveness over and above that of our present M16A1 Rifle and M203 Grenade Launcher. As such, the Future Rifle will consist of an integrated point and area fire weapon system. This report describes the results of an in-house concepting activity associated with the area fire aspects of that program. Previous grenade launcher development efforts for the Future Rifle Program (SPIW) resulted in a determination that 3 shot, 40mm, semi-automatic launchers were not desirable. Consequently, the concepting effort described in this report concerned itself primarily with single shot, 30mm, grenade launcher mechanisms. This effort was performed in conjunction with and in support of a 30mm grenade development being performed concurrently by Picatinny Arsenal.

RESULTS

On 24 Nov 1970 the concepting activities were initiated with the formulation of the general guidelines and tasking of the design team. From this team, more than 23 different approaches were conceived. From these ideas, 14 concepts were finalized and will be discussed in the following pages. The various launcher concepts fell into the general classification of either single shot pumps, pivots, drop barrels, or revolvers with variations of both manual and impulse locking systems. During the week of 8-12 Feb 1971, the 14 concepts were discussed in detail and evaluated against a list of 26 different points by a team of 4 people. A condensed listing of the evaluation criteria can be noted in Appendix A. From this evaluation, two concepts (figures 2 & 12) surfaced which merited being pursued in detail. Preliminary design efforts on the two selected concepts were undertaken on 16 February 1971. It is anticipated that these two concepts will be committed to hardware and tested by Fall of 1971.

DISCUSSION & PROCEDURE

The design team, the composition of which is shown in Appendix B, approached the concepting effort under the general guidelines noted below:

minimum number of parts

minimum manual motions

simplicity of operation

ease of maintenance

integrated point/area fire trigger mechanism

integrally mounted on the XM19 rifle

weight not to exceed 3 pounds

30mm; 3 lb-sec impulse

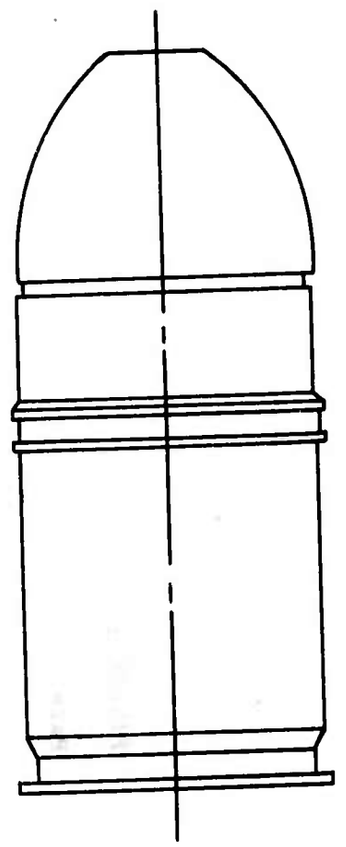
One of these parameters stated that the grenade launcher should be a single shot launcher, integrally mounted on the XM19 Rifle. The XM19 Rifle is more commonly known as the AAI SPIW and it is one candidate of the Future Rifle System Program. The XM19 was used as a design vehicle because of its relatively firm configuration plus the availability of shooting hardware. Additionally, it would allow for testing the launcher as mounted on the rifle thus approach the problem from a weapon system standpoint. It would help identify possible interface problems induced by one component on the other early in the development program. It is this rifle configuration which is shown in each of the described concepts.

Another feature which was common to all of the concepts was the mode of actuating the launcher firing mechanism. A slide bar, contained within the rifle stock, engaged both the rifle trigger group and the launcher searing mechanism. Therefore, one trigger would be provided to fire either the point or area launcher. Selectivity was built into the rifle trigger group and controlled through a selector mounted on the side of the rifle stock.

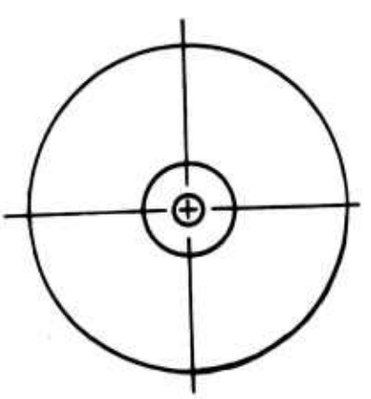
Generally speaking, those were the only restrictions pertaining to the mode of operation. However, other desirable design characteristics were incorporated to the maximum extent possible. Drawing from prior experience, it was felt best to include as many of these features now in an initial prototype rather than waiting and having to do it at a later date. For an example, some of these features were such things as: primary and secondary searing, round retention, barrel hold-open, and speed of operation. During the evaluation period, the entire list of 26 points noted in Appendix A, were individually addressed by each evaluator for each and every concept.

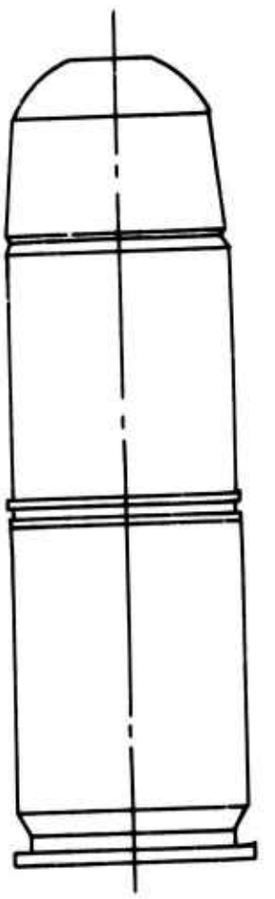
In conjunction with the launcher work, an associated development program was being pursued by the Munitions Command on a 30mm grenade. Picatinny Arsenal awarded a contract to Honeywell, Incorporated for its development. A qualitative comparison between the 40 and 30mm grenades can be noted in figure 1. This 30mm configuration was used as an initial design feature in the concepting effort.

Finally, the level of detail shown in each of the following concepts makes their description lengthy and involved. Therefore, they will be described in only sufficient detail in order to give general understanding of their operation. Additionally, it should be noted that each concept is depicted in two positions; the opened and the closed. The unloaded, open position will be the lower, right view.



M406, 40 MM GRENADE





PROPOSED, 30 MM GRENADE

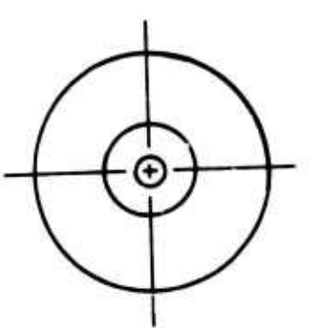


FIGURE 1.

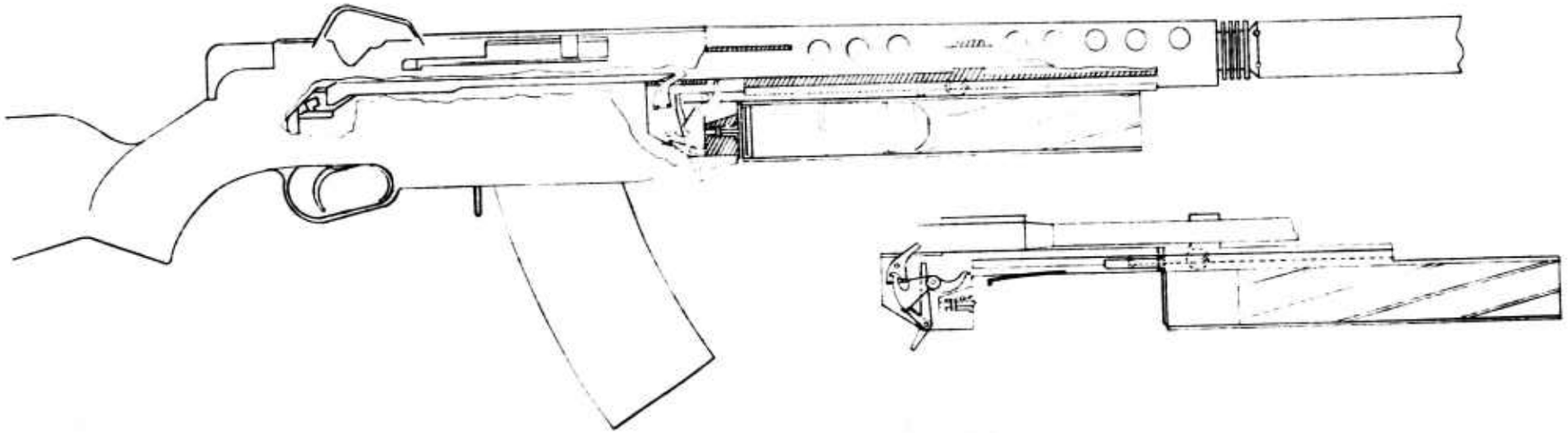


FIGURE 2

In figure 2, a concept is shown which is a single shot, pump forward mechanism. As the mechanical lock is depressed, depicted by a dotted circle just forward of the projectile, the barrel can be pumped forward. During the forward movement of the barrel, several operations are performed simultaneously; the cartridge case is extracted and ejected and the hammer is rotated up to its searing position. The searing notches can be seen on the hook of the hammer. This concept incorporates the use of a "Browning" type sear which is a well proven method of providing a simple primary/secondary searing device. This will insure safe launcher operation regardless of what the shooter does to the trigger while he is functioning the launcher. The firing-mechanism-actuating-slide-bar can be seen in the rear broken-out section of the stock. An interlock is provided so that it will snap in front of the hammer when the hammer has been fully cocked. This prevents the hammer from falling in the event the trigger is pulled while the barrel is open. When the barrel is closed, a barrel extension engages the interlock and causes it to rotate out of engagement with the hammer with the hammer thus putting the launcher in a fireable position. In addition, a safety is provided which also snaps in front of the hammer. The safety can be noted by the protruding tang seen in the lower right view.

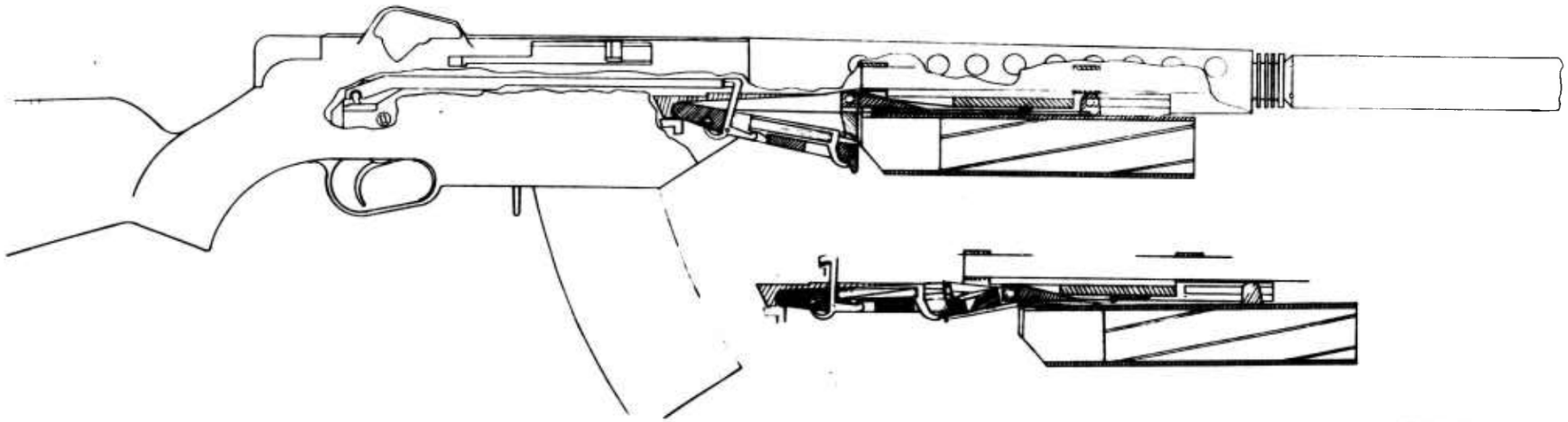


FIGURE 3

Figure 3 describes a folding breech, pump forward device. This concept would offer a system which would utilize the cartridge impulse to keep the barrel cocked. This is accomplished by the means of the firing impulse acting on the cartridge case and causing it to bear against the vertical folding breech face. Since the barrel is pinned to the folding breech block, the barrel can't come open while the impulse is present. Decay of the impulse allows the barrel to be pumped open while at the same time recocking the firing mechanism. The striker is contained in one of the folding links and it is cammed rearward to its seared position as the breech face is pulled forward and rotated upward. Since impulse is the locking mechanism, an external barrel lock will not be required.

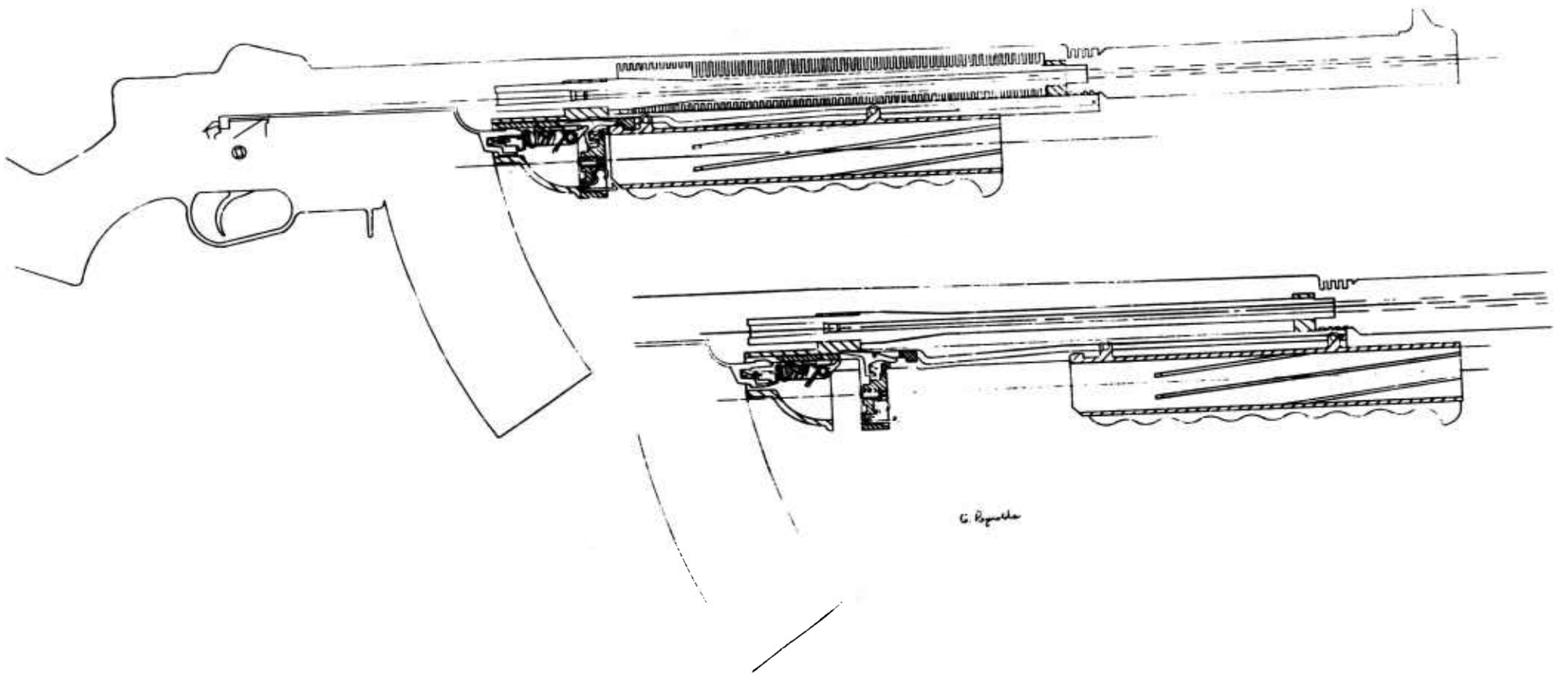


FIGURE 4

The next concept is described in Figure 4. It describes a launcher which would have a sliding breech and a pump forward barrel. Here, as in Figure 3, the system draws upon the impulse of the round to keep the barrel locked during firing. Since a mechanical lock is not required, the mechanism is operated by merely pumping the barrel forward. This motion provides for automatic recocking of the hammer and allows for extraction and ejection of the cartridge case. A cam track is provided in the receiver in which the barrel moves. As it is pumped forward, it pulls the movable breech block with it during its initial motion, at which time the barrel is cammed down slightly. This allows the barrel to disengage from the breech block and continue to move forward by itself.

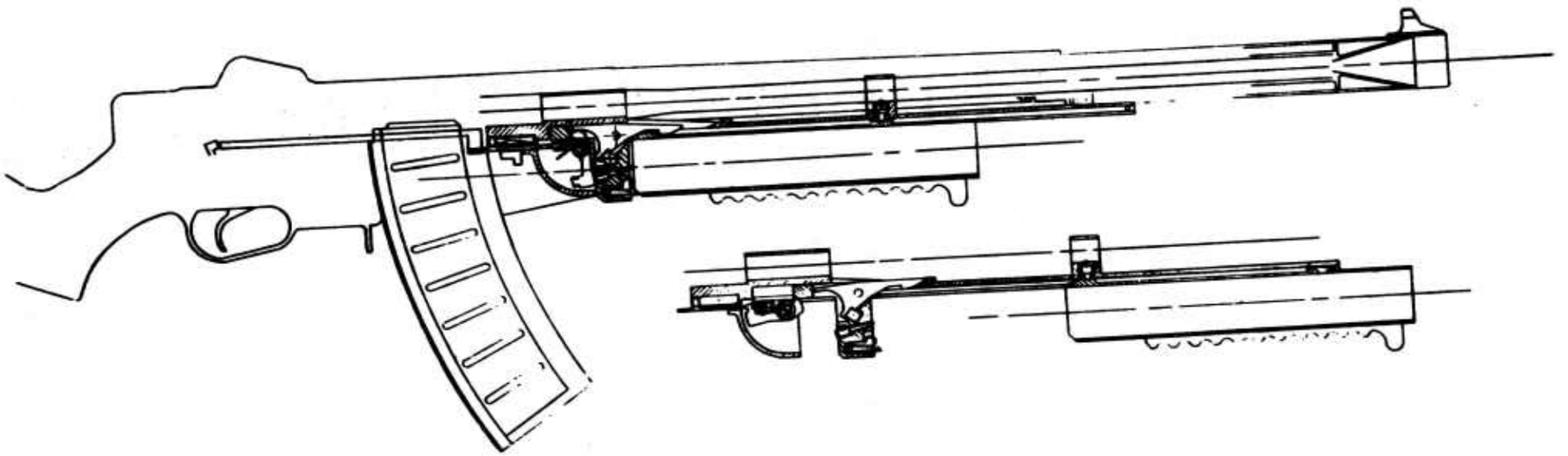


FIGURE 5

With an eye toward increasing the rate of fire and ease of operation, Figure 5 was drawn around the principle that the forward movement of the barrel would unlock the breech and also resear the firing mechanism. This concept depends upon firing impulse, as did the last two figures, to keep the barrel locked during firing. With decay of the impulse, the barrel is manually pushed forward while at the same time pulling the moveable breech block with it. A mechanical internal latch is forced to disengage from the barrel which had constrained the breech block, and allow the barrel to move forward performing extraction and ejection of the spent case.

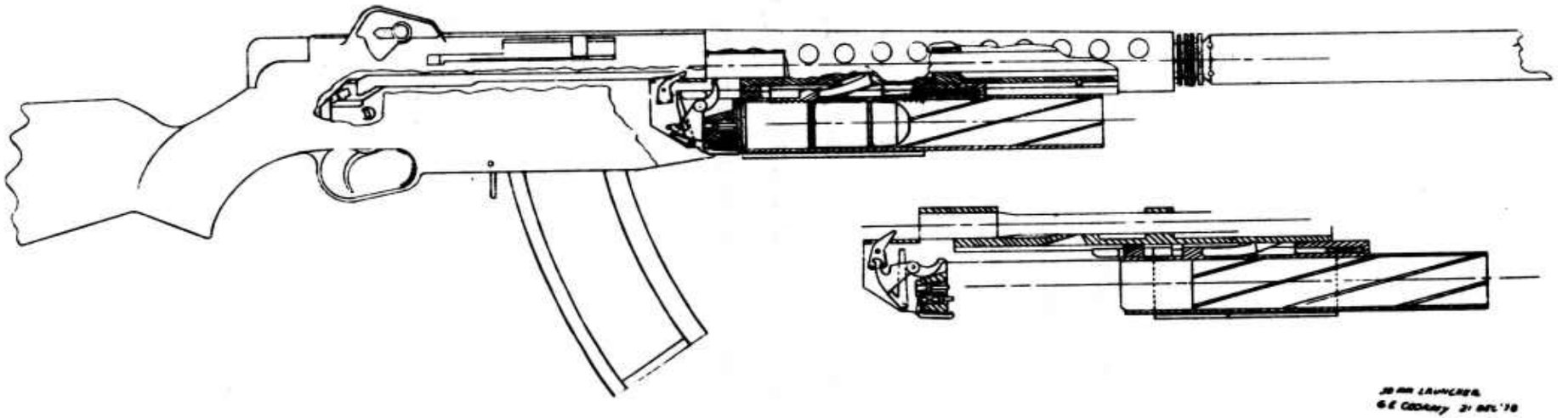


FIGURE 6

In keeping with the same theme of reducing the number of physical motions required for the operation of the launcher, Figure 6 employs the use of a sliding hand grip to perform some of the work. Operation is performed by sliding the grip forward at which time disengages the barrel lock and recocks the hammer. The barrel lock can be noted just above the projectile. After a minimal amount of forward motion of the grip, the barrel and the grip travel forward together and allow the cartridge case to be extracted and ejected. An interlock and a "Browning" sear, as described earlier, can be noted in this concept.

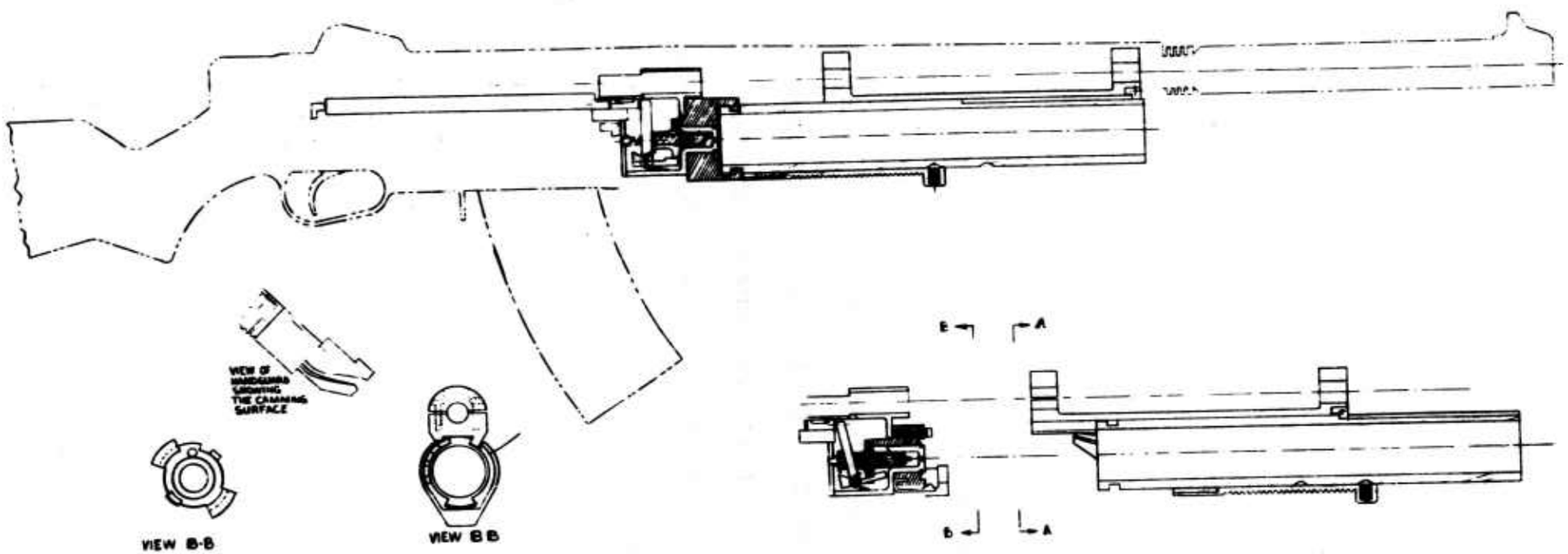
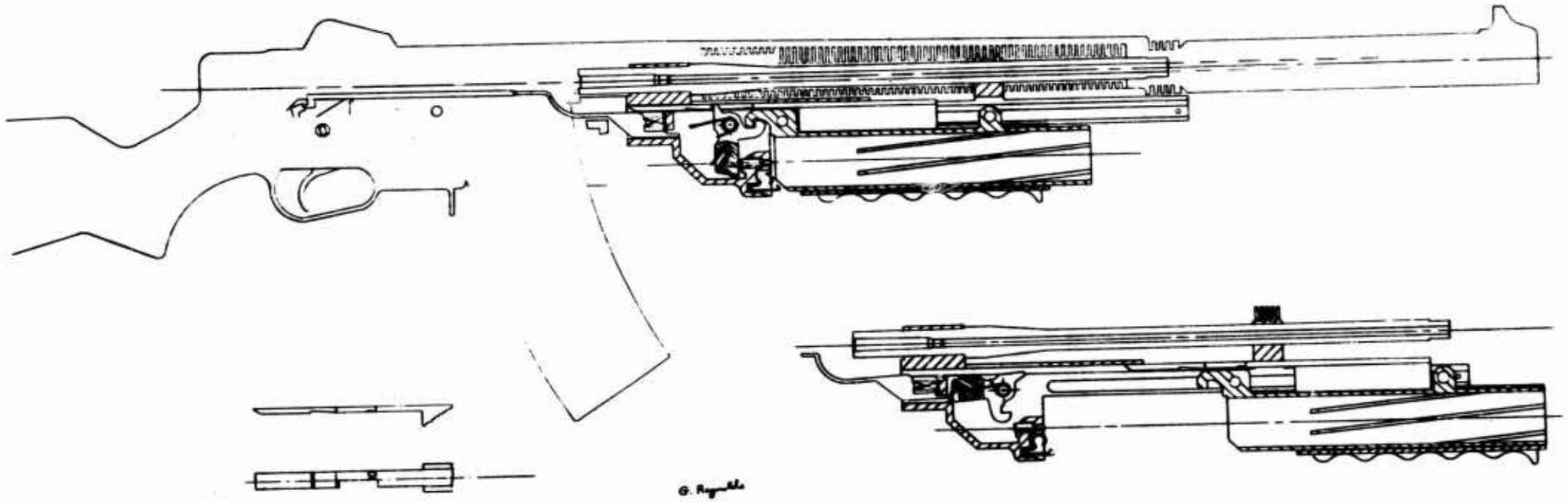


FIGURE 7

The concept described in Figure 7 incorporates the use of a sliding grip, pump-forward barrel but uses a fixed, rotating breech block. The sliding grip, through the use of a cam surface, unlocks the barrel while simultaneously researing the firing pin. As was noted in some of the previous concepts, the sliding grip moves independently up the barrel during a short length of the overall barrel movement.



SLIDE EXTENSION

FIGURE 8

Figure 8 is another concept which uses the sliding grip, pump forward barrel principle. As the grip is pumped forward the hammer is rotated out of its locked position up to its seared position. It should be noted that the hammer performs many of the launchers operations. It provides for recocking, barrel locking, and searing, both primary and secondary.

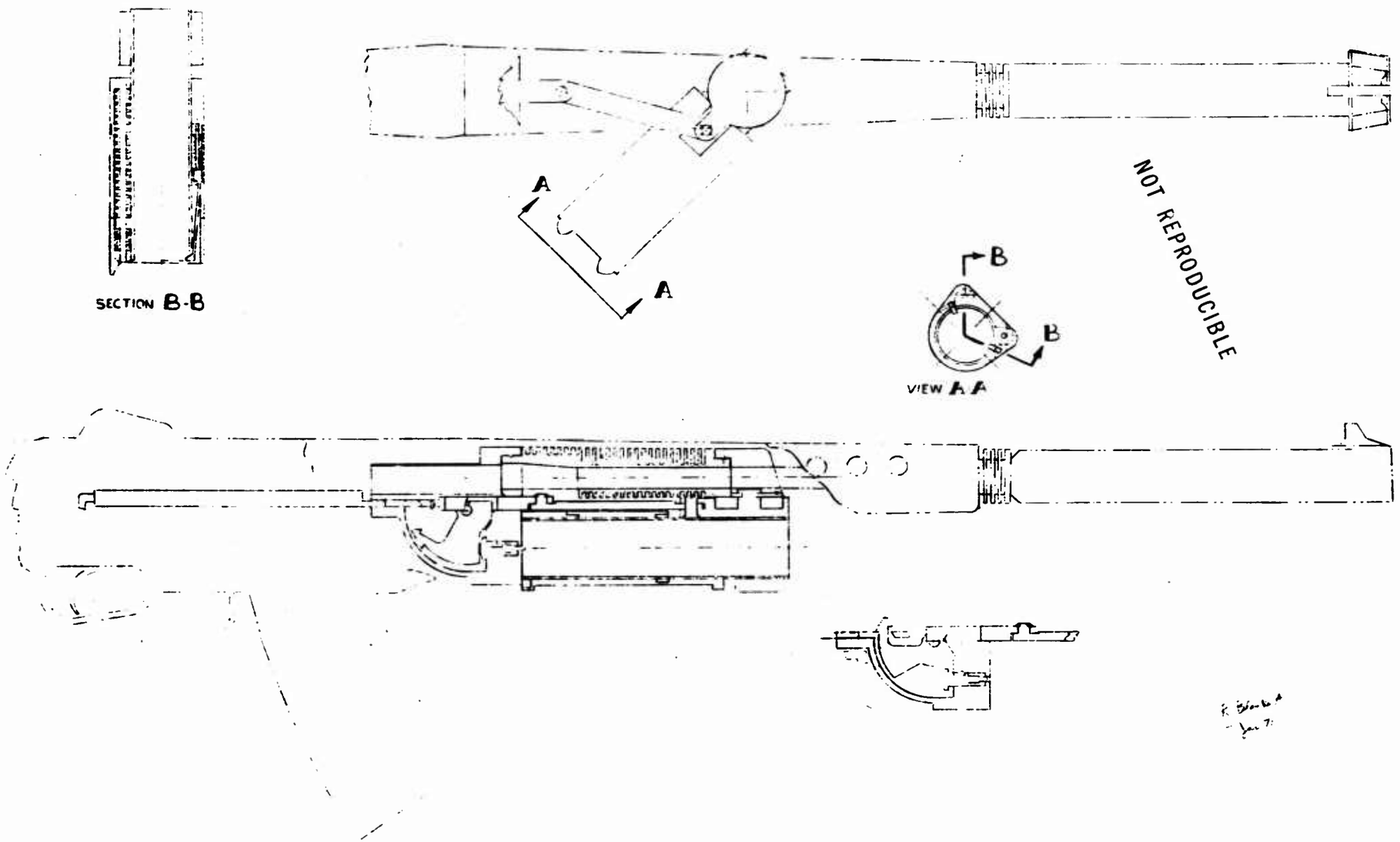


FIGURE 9

Figure 9 is another concept which incorporates a sliding grip in the operation of the launcher. However, the major difference between this concept and previous figures is that this sliding grip is used for barrel locking and extraction and ejection of cases. The grip is pushed forward, thus unlocking, and the barrel is pivoted either right or left. The pivoting action also recocks the hammer as described in the top view, and the bottom right view. Here again the primary and secondary searing notches can be seen on the hook of the hammer. Section B-B describes the barrel lock, on the left, and the extractor/ejector/headspace control device as noted on the right.

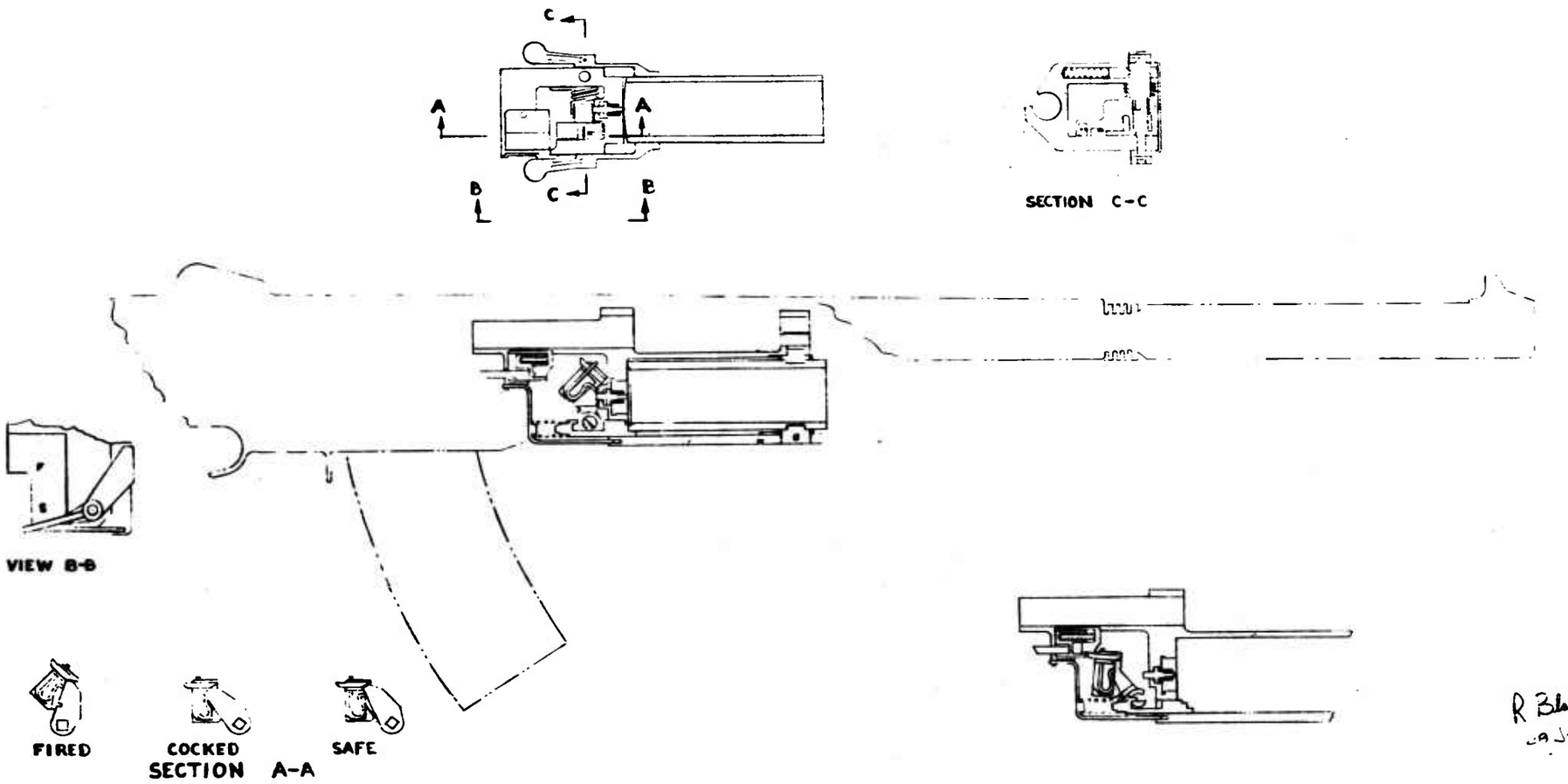


FIGURE 10

Another approach to a side pivoting launcher is shown in Figure 10. Side pivoting launchers can provide for a compact device while at the same time requiring minimal arm motion. This concept would be operated by first depressing the winged handles, as can be seen in the top view. This unlocks the barrel while also recocking the hammer. The barrel can then be pivoted either right or left and thus allowing for extraction and ejection.

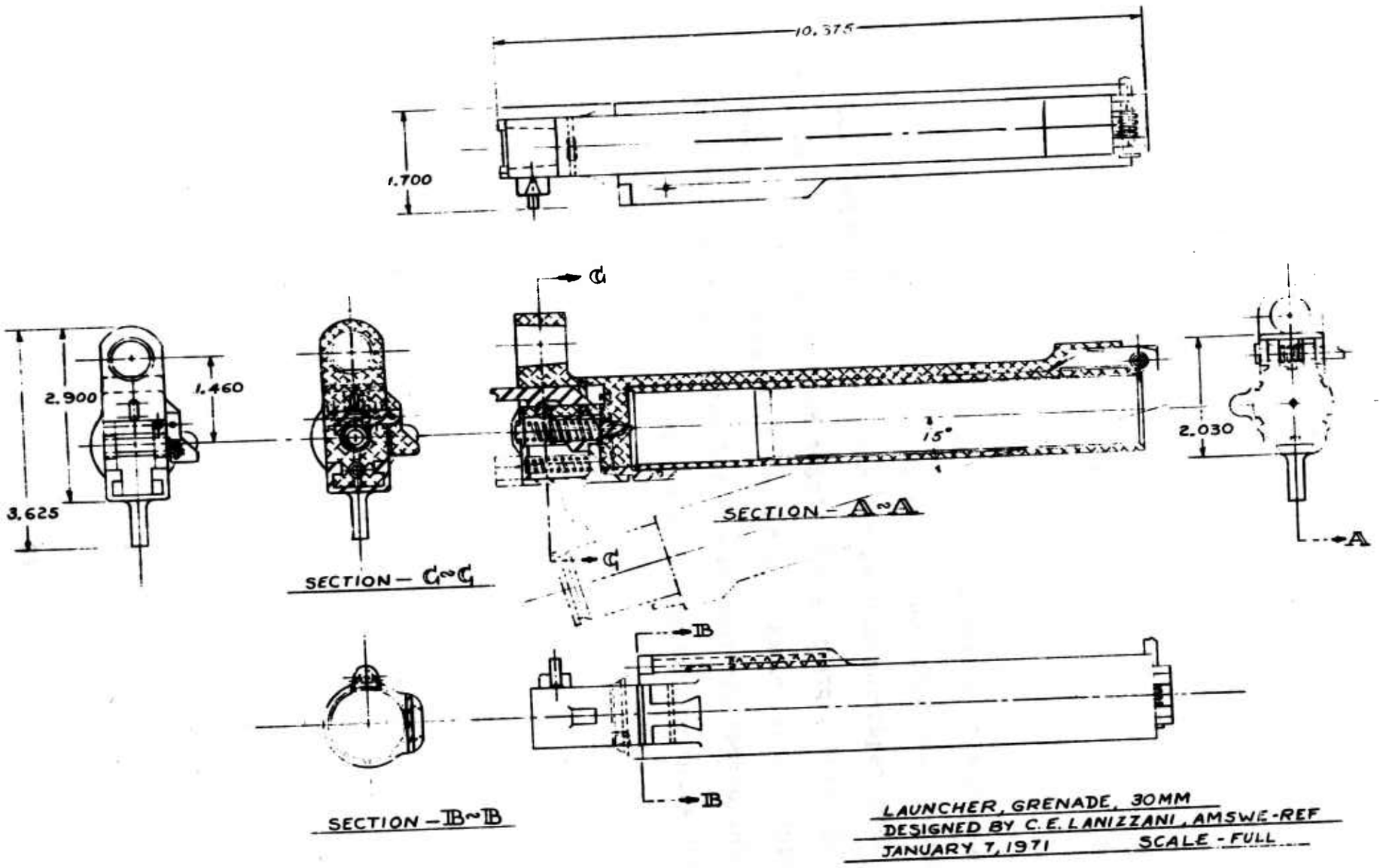

10.375
1.700
2.900
1.460
3.625
SECTION – C~C
15°
SECTION – A~A
2.030
A
B
B
SECTION – B~B
LAUNCHER, GRENADE, 30MM
DESIGNED BY C.E. LANIZZANI, AMSWE-REF
JANUARY 7, 1971
SCALE - FULL

FIGURE 11

Figure 11 describes a drop-barrel launcher concept. In the center view, there is a curve handle which projects downward. This is the charging handle, which when pulled to the left, or rearward, unlocks the barrel and also recharges the firing pin. When unlocked, the barrel drops down thus allowing for extraction and ejection of the spent case. The spring loaded extractor/ejector can be noted in the bottom view. Spring loaded plunger keeps the charging handle to the rear while the barrel is open, thus eliminating an extra motion in closing the barrel.

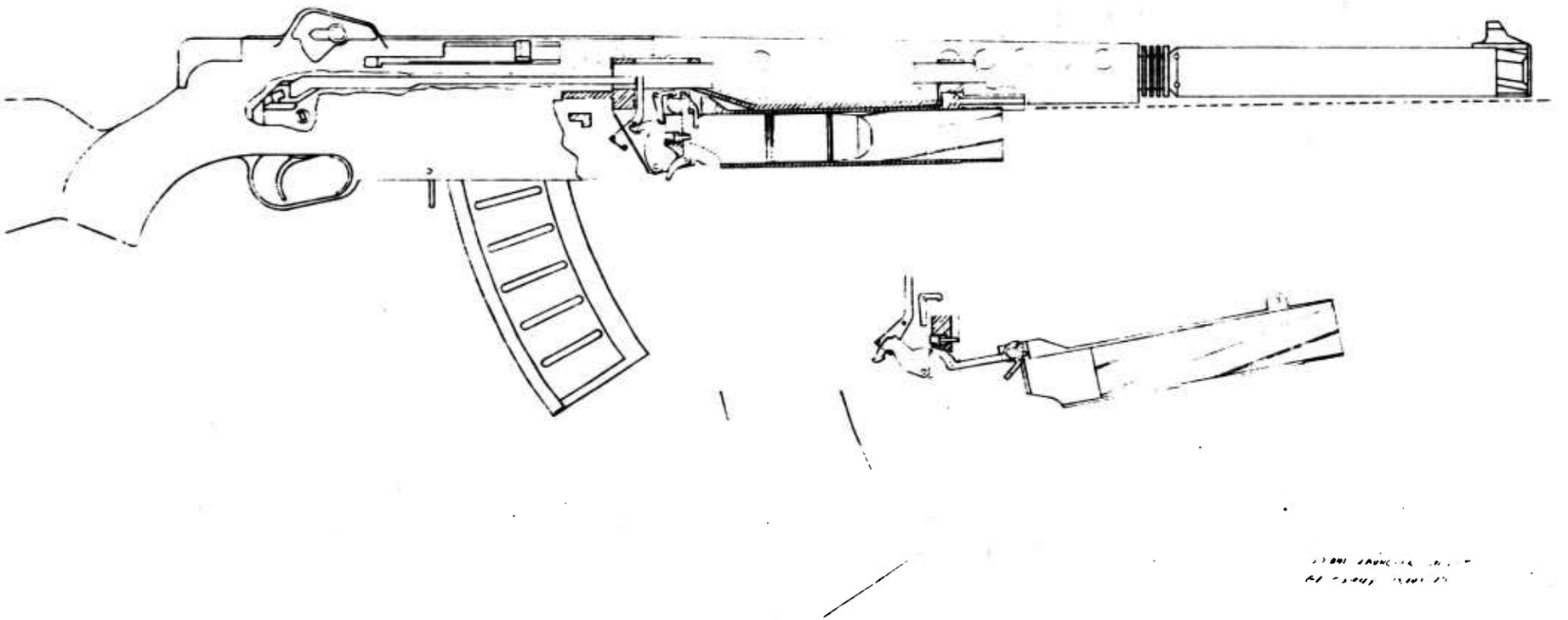


FIGURE 12

Figure 12 was aimed at optimizing the human engineering aspects of the launcher design. The pump forward motion, as previously described, was combined with a drop barrel approach to give the hybrid combination of both. Also, as previously described, this system utilizes the grenade firing impulse to keep the barrel locked thereby eliminating the need for an external mechanical barrel lock. In one sweeping motion, the barrel is moved forward and down while simultaneously recocking the hammer and effecting extraction and ejection. The extractor/ ejector, which is mechanically operated, can be noted in the chamber area in the lower right hand view. This system also incorporates the use of the "Browning" searing idea. In addition, a mechanical interlock has been incorporated to keep the barrel closed during non-fired conditions. When the hammer is allowed to fall, it disengages this lock and also strikes the firing pin. A safety, which is not shown, similar to that used on the M1 Rifle is envisioned as being operational. Finally, it should be noted that sufficient room is provided to load a grenade cartridge while the rifle magazine is in position.

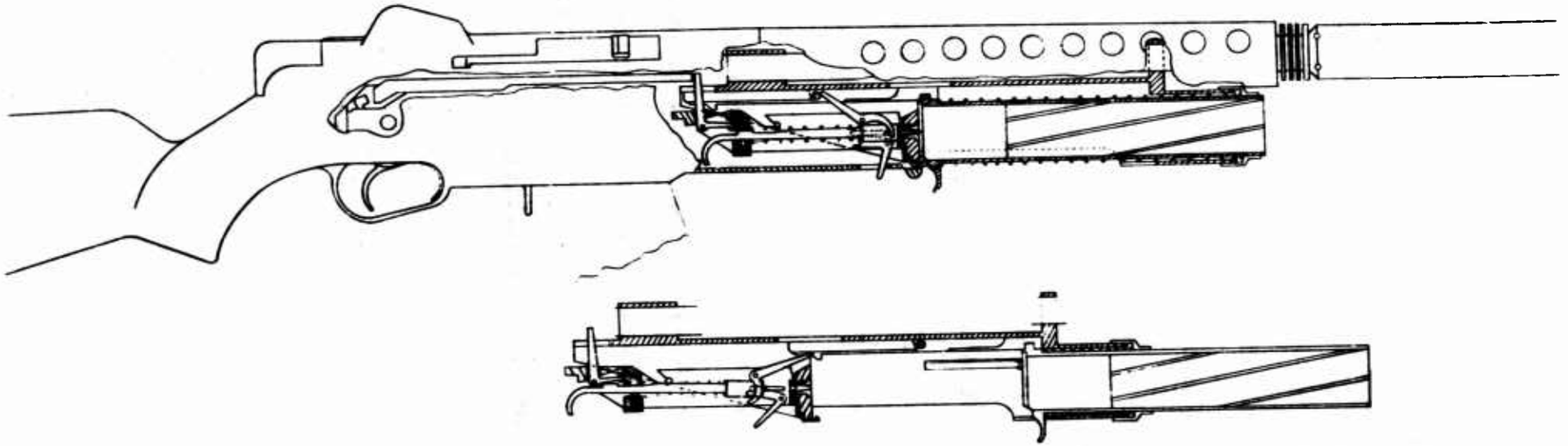


FIGURE 13

The desirability of a completely automatic version always seems to be high in the mind of the user. Figure 13 is one approach to meeting this requirement. This mechanism would rely on the engraving forces of the projectile to pull the barrel open during the firing cycle. As the barrel is accelerated forward, it also automatically resears the firing mechanism, and extracts and ejects the case. A fixed ejector is located on the movable barrel extension. This same barrel extension rotates the hammer causing it to be researed during the forward motion of the barrel. The barrel remains in the open position awaiting the next round. In addition, this concept was designed around the modular principle so that the entire firing mechanism can be easily removed for maintenance or repair.

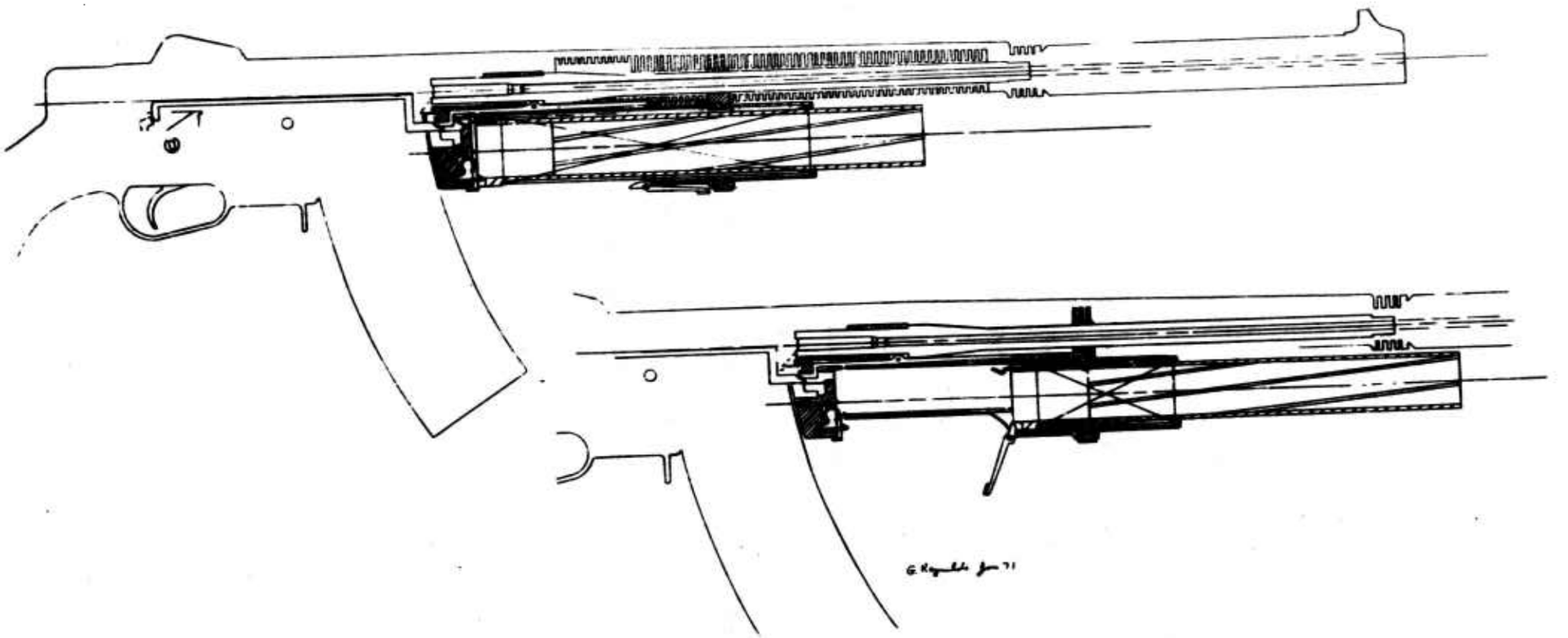


FIGURE 14

Figure 14 describes another semi-automatic launcher concept. It too relies on the engraving forces to operate the barrel. However, this approach is somewhat different from Figure 13 in that this one is fired from the so-called "Open-Bolt". When the trigger is pulled, the barrel and the cartridge case are set free to accelerate rearward. The cartridge impacts on a fixed firing pin which causes detonation and subsequent barrel operation. It is envisioned that the projectile engraving forces will pull the barrel open during its forward motion. As the barrel opens, it leaves the cartridge case in the fixed breech ready for ejection, and the barrel is retained in the fully forward position. The small lever seen in the lower right view which is hanging down below the chamber, is a manual round extractor. This would be functioned only when it was desirable to remove an unfired cartridge. A leaf spring, which serves as a round retainer, can be noted right above the manual extractor.

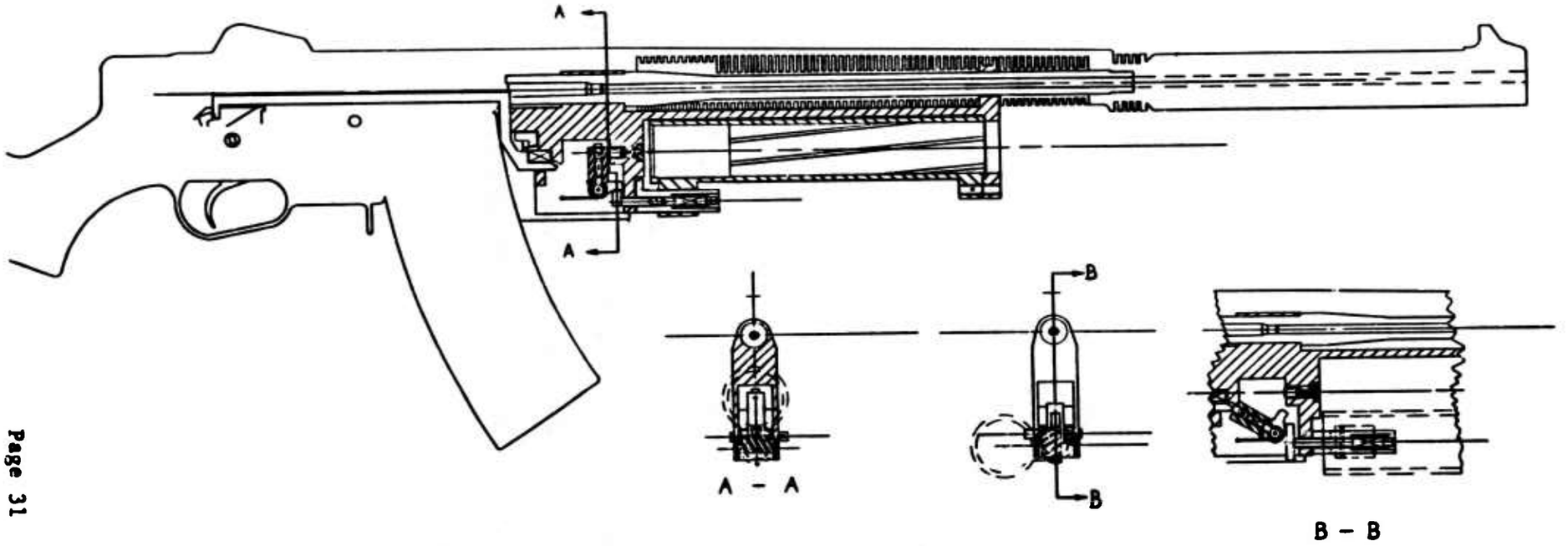

A
A
A - A
B
B
B - B

Figure 15 was designed around the approach of providing a compact configuration while at the same time reducing the amount of arm stretching. This concept is, in essence, a single shot revolver. To operate it, the barrel is pulled slightly to the rear and then can be pivoted down either to the left or to the right. In the bottom right view, the dotted barrel is shown pivoted to the lower left. Rather than pivot about a vertical axis, this concept pivots about a lower, horizontal axis. As the barrel is revolved, a connecting linkage cams the hammer back to its searing position. This type of concept would require the use of a spring loaded extractor/ejector similar in nature to that used on the M79 grenade launcher.

APPENDIXES

LAUNCHER CONCEPT EVALUATION CRITERIA

SAFE OPERATION
PRIMARY SEARING
SECONDARY SEARING
FIRING PIN ENERGY
FIRING PIN WITHDRAWAL
ROUND RETENTION
BARREL HOLD-OPEN
EXTRACTION
EJECTION
LOCKING
SAFETIES

RELIABILITY
MAINTAINABILITY
WEIGHT
BULK & HANDLEABILITY
EASE OF OPERATION
DURABILITY
RIFLE INTERFACE
SIMPLICITY & COST
EASE OF MANUFACTURE
DISPERSION CHARACTERISTICS
HEADSPACE CONTROL

CONCEPTUAL LAUNCHER CONFIGURATIONS