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KNIFE CUTTER-BAYONET

by

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Final Report

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U. S. ARMY LAND WARFARE LABORATORY
Aberdeen Proving Ground, Maryland 21005

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The purpose of this task was to design and develop a knife cutter-bayonet which could be used as a fighting and survival knife, a bayonet, a wire cutter and a general purpose tool. Requirements such as light weight, an ability to cut both barbed wire and barbed tape and compatibility with the standard Army M-16 rifle were essential. Additional features suggested included a built-in saw, a screwdriver and a sharpening stone.

CON'T

20. ABSTRACT CON'T

Development of the knife cutter bayonet and scabbard, testing by both the contractor and USALWL and various prototype designs, form the basis of this report. Development was terminated when it was concluded that it was beyond the current state of the art to develop a single item encompassing all the features stated as essential. The report recommends that the US Army continue to issue and use the bayonet and the wire cutter as separate items.

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INTRODUCTION

For many decades Army combat soldiers have carried bayonets to be affixed to a rifle for use in close combat. Pocket knives, with a variety of tools encased, are also issued and frequently carried by soldiers. Wire cutters are also standard equipment in the Army for issue as required to cut through barbed wire and barbed tape. These tools, particularly the knife and a sharpened bayonet, are often interchangeable for various functions. Under normal conditions no particular infantryman carries all three of these tools at the same time and yet on any given operation the need to perform several different functions involving the tools is not infrequent.

For several years a Draft Proposed Required Operational Capability (DPROC) has been in-process for a multipurpose tool incorporating in one device features of the knife, the wire cutter and the bayonet. It has been referred to as a Knife Cutter-Bayonet. The document has not been finalized since no agreement has been reached as to which of the various functions should be optimized and which function has the lowest priority. Various characteristics of a multipurpose device are to some degree mutually exclusive.

The objective of this task was to design a device or devices to demonstrate what was technically feasible and in a physical model show the trade offs which could be made, thereby resolving with hardware the relative priorities of characteristics in the DPROC. This report documents the development effort.

DEVELOPMENT

The US Army Land Warfare Laboratory (USALWL) through Contract DAAD05-73-C-0564 engaged Benhof Inc, 2468 North Jerusalem Road, North Bellmore, LI, NY 11710 to design and fabricate prototype knife cutter-bayonets to meet the following specifications.

1. Capable of being positively attached to the M16 rifle and for use as a bayonet or as a probe for mines and booby traps.

2. Capable of cutting soft wire, barbed wire and metal tape barbed wire.

3. Include a sharpening device as a component.

4. Incorporate an edge capable of cutting brush, plexiglass and light metals.

5. Contain a blade guard similar to the M7 and the balance and grip required for hand to hand combat.

6. The weight of the knife must not exceed that of the M7 bayonet and scabbard (one pound).

7. The length of the blade should be no less than 5-1/2 inches or longer than 7" with an overall length of no more than 13 inches.

In coordination with staff officers of the US Army Combined Arms Combat Developments Activity, Fort Leavenworth, KS 66027, the following design priorities were selected to guide the contractor:

1. Multipurpose knife

2. Limited purpose saw

3. Wire cutter

4. Bayonet

The first phase of the development effort was a preliminary design and visualization plan for the knife cutter-bayonet. This was to be followed by an engineering design test plan and fabrication of 5 prototypes. Phase 2 would have been production of 100 knives based on a feasible prototype. These 100 knives would have served for a user evaluation.

Under Phase I, Benhof Incorporation designed a knife cutter/bayonet based on the contract specifications. The first breadboard model (Figure 1) delivered to USALWL was fabricated from an acrylic material and was used primarily to demonstrate concept and entertain suggestions for improving the basic design. At a meeting held at USALWL, it was agreed that the basic concept was within the design parameters. However, two changes were suggested to Benhof Inc; namely, the position change of the barbed cutting portion of the bayonet and the possibility of incorporating a tungsten

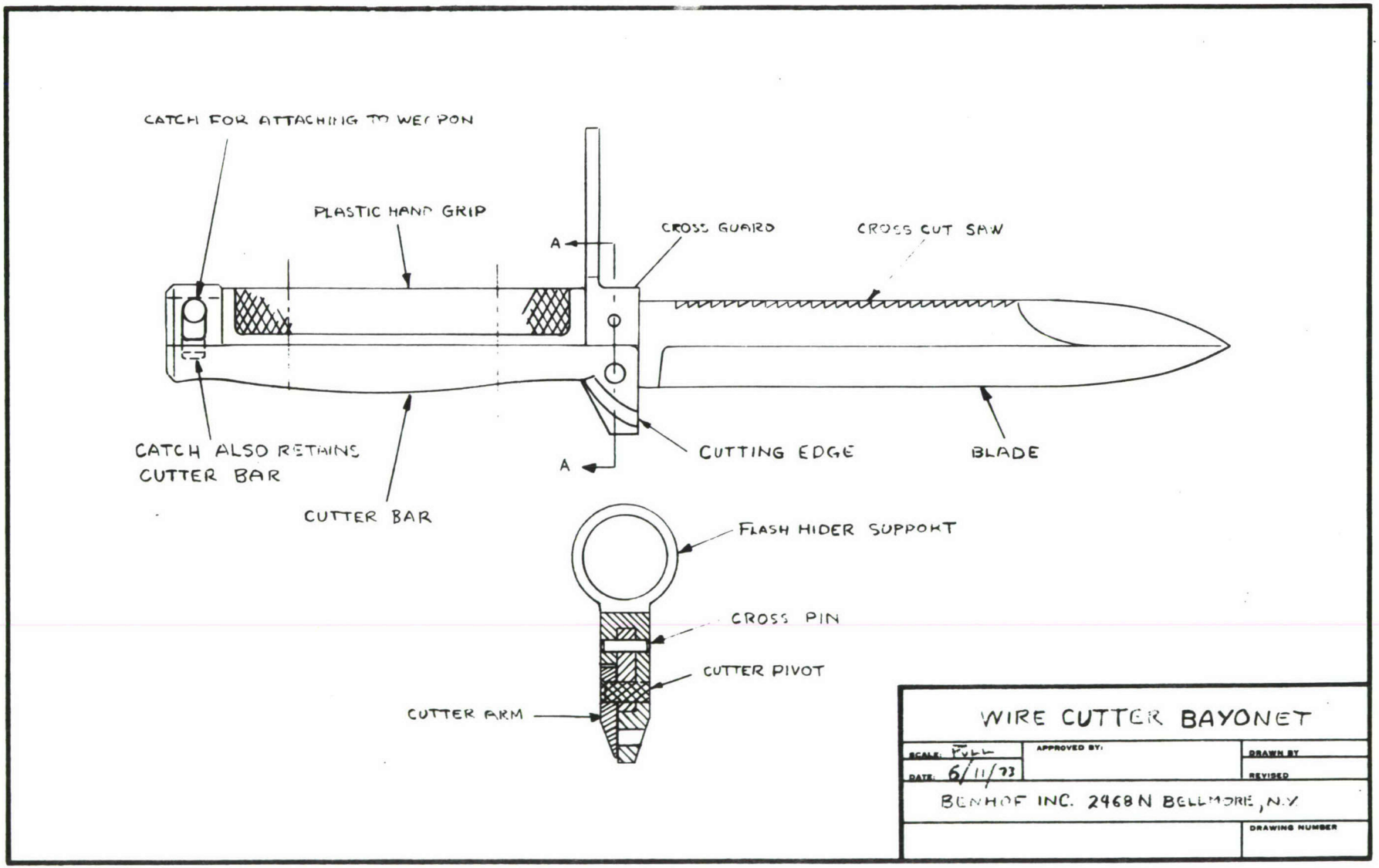


Figure 1. Breadboard model based on specification outlined in the original Contract # DAA05-73-0-5302 for development of a knife cutter-bayonet.

carbide cutting edge on the back edge of the bayonet. The original design shows the cutting edge for the barbed tape and wire at 90° to the knife blade. It was decided to position this cutting edge parallel to the knife blade as an added protection for an individual who may be engaged in hand to hand combat (Figure 2). The tungsten carbide cutting edge was proposed as a possible candidate for fulfilling the cutting requirement for material such as wood, brush, plexiglass, etc. Benhof Inc was requested to fabricate a prototype model incorporating the above changes.

The first hardened prototype knife cutter bayonet (Figure 3) was developed around the standard Army M7 bayonet. The M7 bayonet was chosen based on its solid functional design and the availability of bayonets in Army depots. The hardened prototype incorporated all the changes discussed at USALWL. In addition, the tape wire cutter substituted a twin anvil design to support the tape while cutting or shearing in place of the original tin-snip style cutter which had a tendency to bend the tape. The cutter portion of the knife cutter bayonet also functions as a cross-guard and muzzle support. A square notch was machined in the outer edge of the barbed tape cutter for shearing barbed wire. The main cutter bar is a tool-steel arm which pivots at the extended portion of the cross-guard. This arm is spring loaded and opens automatically when the latch is released. When the cutter bar is in the open position, the blade of the knife and the cross-guard act as a guide to lead the barbed tape into the cutter jaws (Figure 4). This design fulfilled most of the essential requirements but tests at Aberdeen Proving Ground revealed that double strand barbed wire could be cut only with great difficulty.

As a result of these tests, it was also decided that the overall weight was not acceptable, the flat wire cutter required redesign to prevent the flat tape from sliding during the cutting operation and cutting edges on the barbed wire cutter must be hardened to prevent edges from rolling over after a series of cuts.

Design 2, the second design change (Figure 5), did not attempt to solve all the problems discovered but was simply a redesign of the barbed wire cutter. The previous cutter design had sufficient leverage to cut through one strand of barbed wire at a time but it was awkward and time consuming to insert one strand at a time and then rotate the wire 180° to cut through the remaining strand. Benhof Inc proposed a short parrot-bill, two-stage cutter which would allow the user to insert the barbed wire completely into the cutter jaws. The cutter would incorporate a twin handle; one handle extending beyond the other by approximately 15°. When the outermost handle is compressed, one strand is cut and the travel of the handle brings it into line with the next which cuts through the remaining strand. Because of the phase-out of USALWL and the termination of the task, this idea was never pursued.

Design 3 (Figure 6) incorporated all the changes suggested by USALWL after the first two designs. Since weight was a major problem, an overall general slenderization of the cross guard was undertaken to meet the one pound requirement. In order to correct the flat wire slippage problem, the angle of the twin anvils relative to the cutter bar was reduced 10 degrees. The cutter bar was also reshaped from a straight to a long radius, thus correcting the creep problem of the barbed tape when cutting.

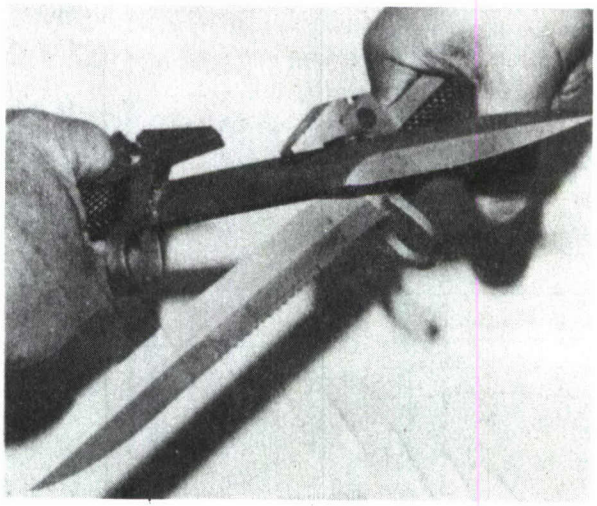


Figure 2. The ability of the forward thrust cross guard to catch an opponents blade is demonstrated here.

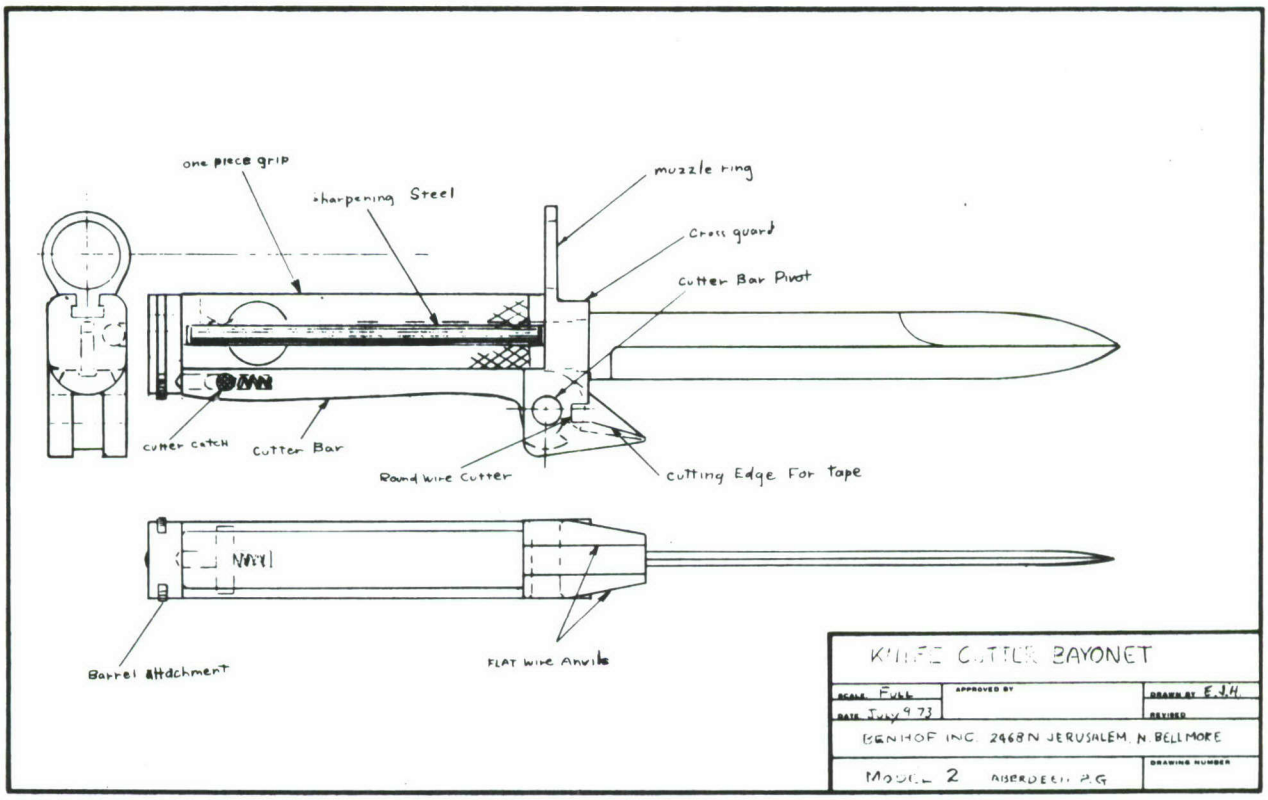


Figure 3. Design 1, Developed around Standard M7 Bayonet.

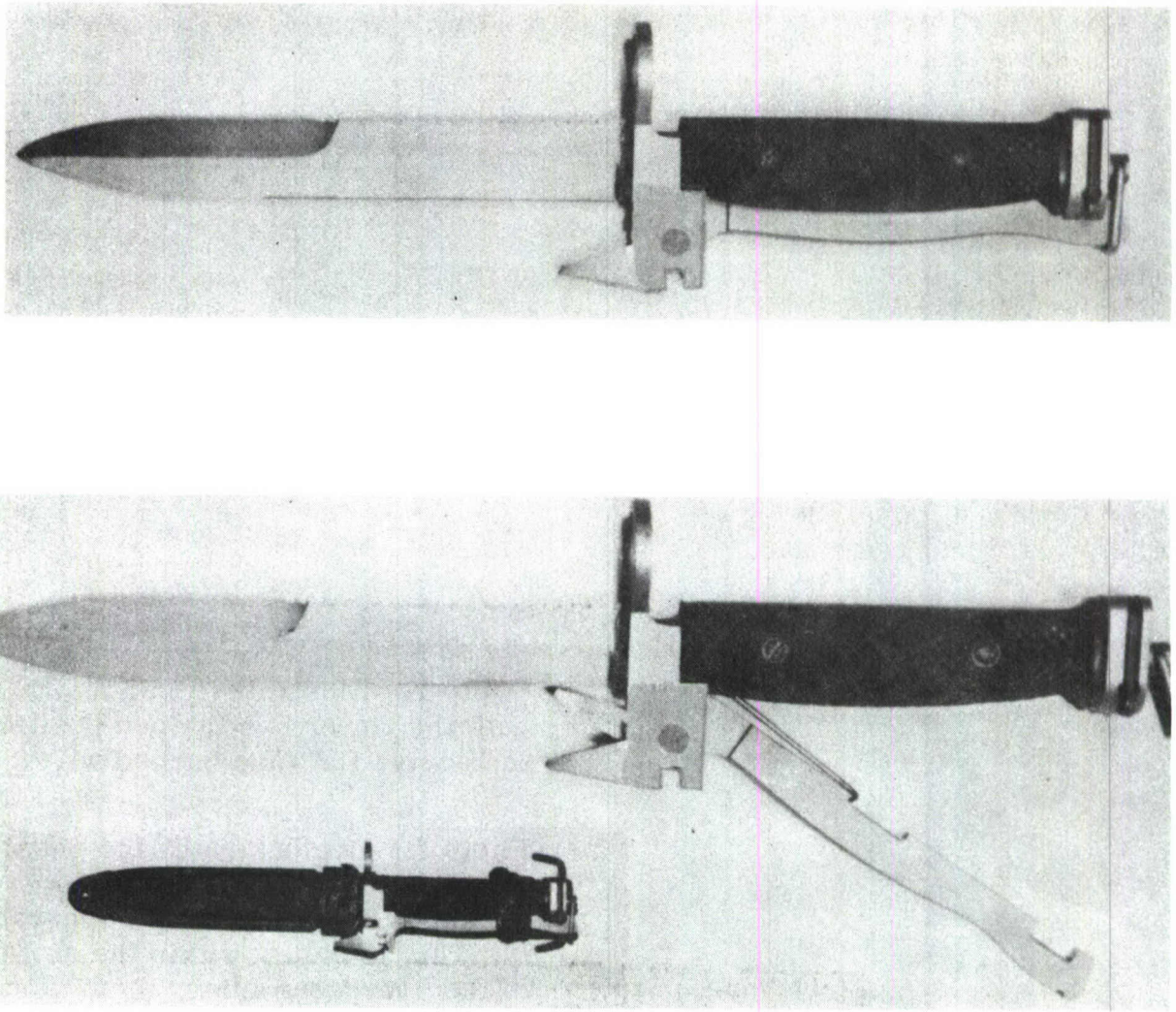
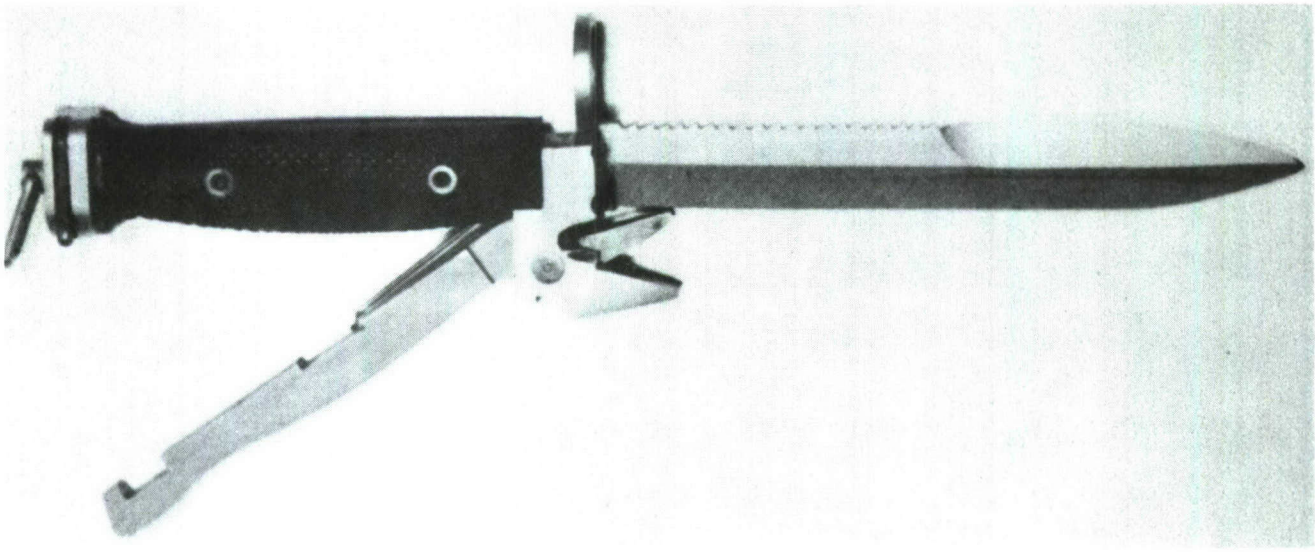


Figure 4. **Knife Cutter-Bayonet Design 1.**
Cutter bar fully open; notice how knife blade and lower jaw of the cross guard combine to guide the tape barbed wire into position.



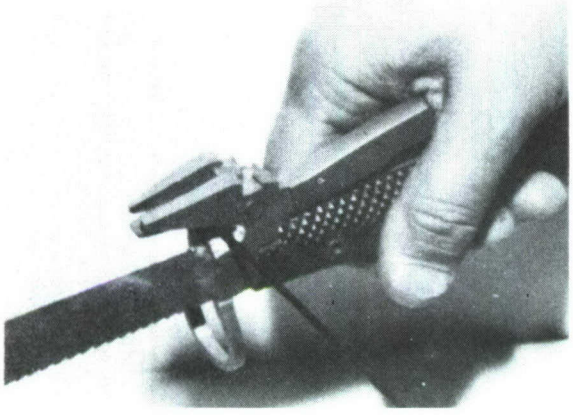


Photo 1. Illustrates Design 2 with the cutter bar in open position to receive flat tape barbed wire.

Photo 2. Demonstrates the possibility of developing a cutter to shear each strand of wire separately. This is easily within the ability of the average soldier.

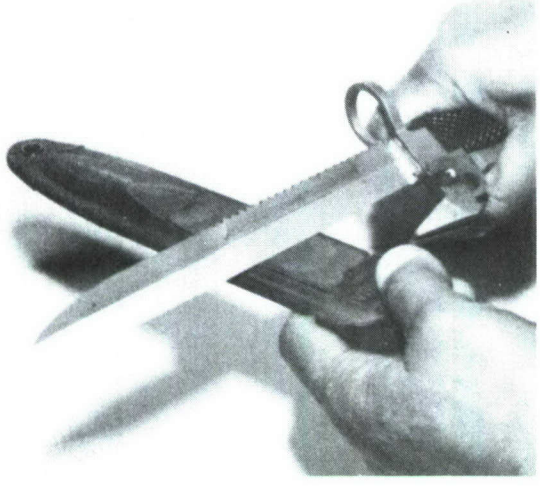
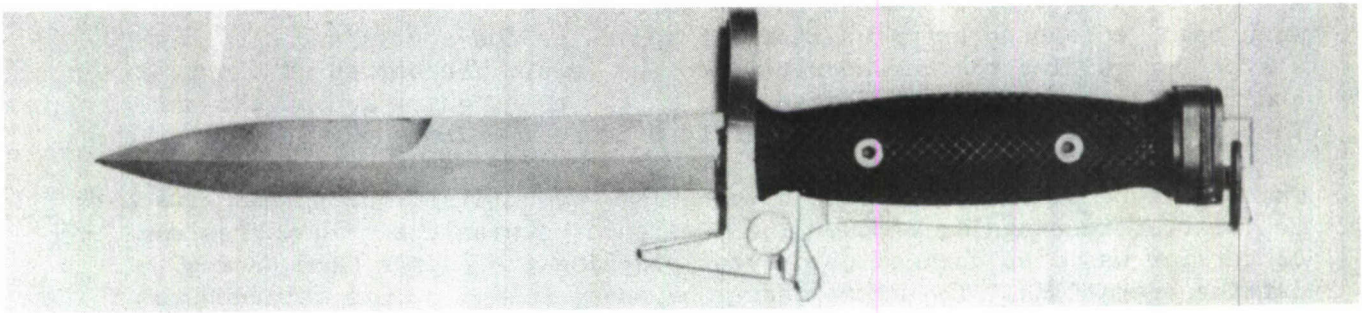
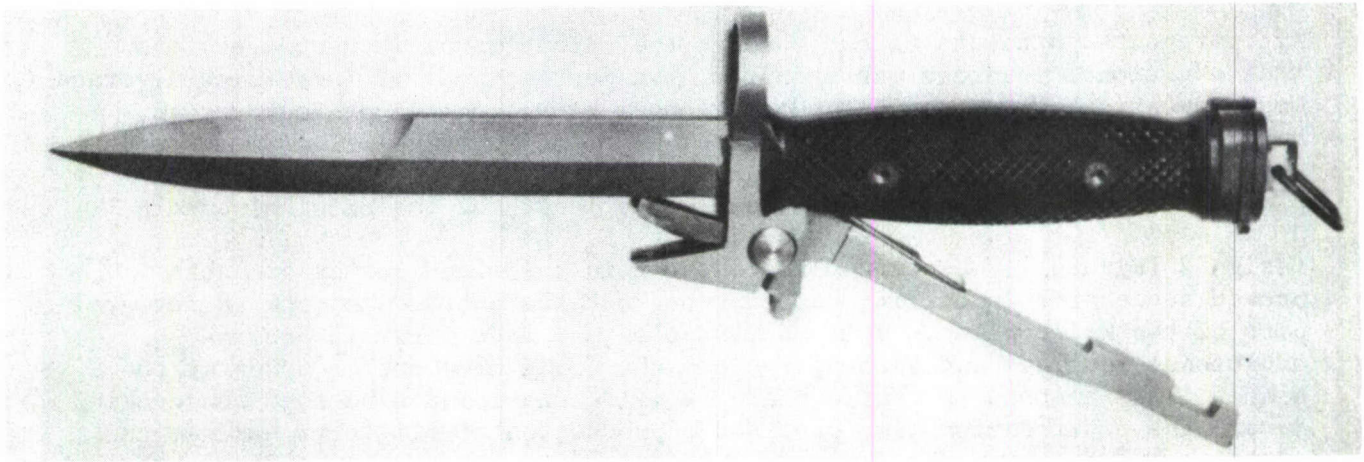


Photo 3. Demonstrates the use of the carbide coated particle whetstone. This thin steel sharpening device is epoxied to the scabbard.

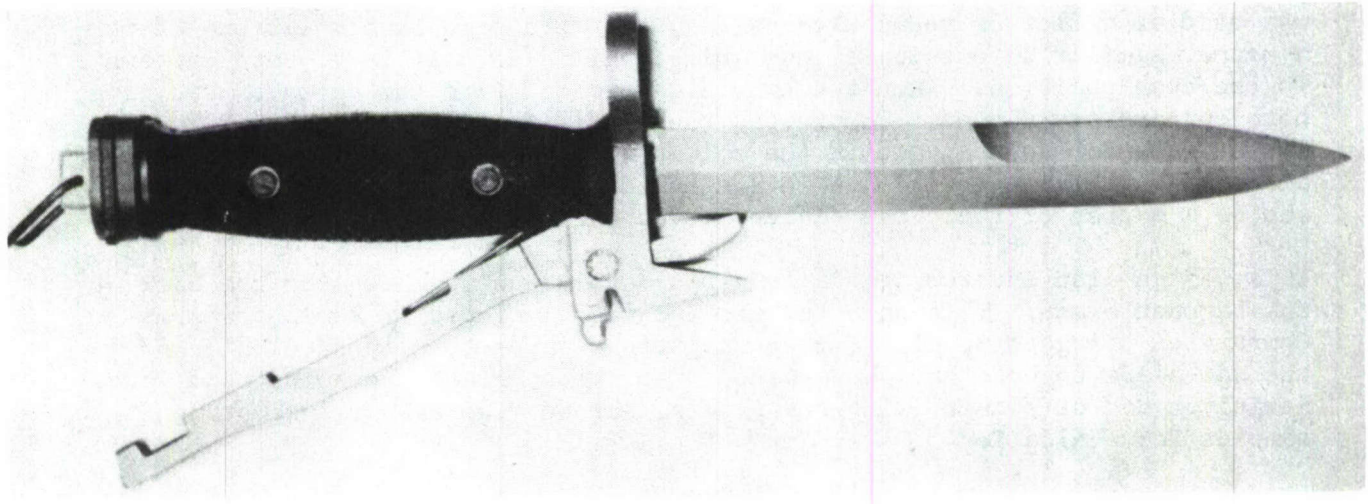
Figure 5. Knife Cutter-Bayonet Design 2
Separate Strand Wire Cutter



Design 3 is a lightened version of Design 2 but with a projection to guide round wire into the notched cutter.



Design 3 with cutter bar open - left side.



Right side view of Design 3. Note the round wire guide projection hangs down to snag the barbed wire.

Figure 6. Knife Cutter-Bayonet Design 3
Right and Left Side Views

A protrusion or stop was added to the barbed wire cutter. When the jaws were open, this stop extended at right angles to the anvils and served as a stop for guiding the barbed wire into the jaws. The barbed wire cutter consisted oa a pair of "U" shaped cuts in the cross guard and cutter bar. These cuts were 5 degrees off center to produce a sharper cutting edge.

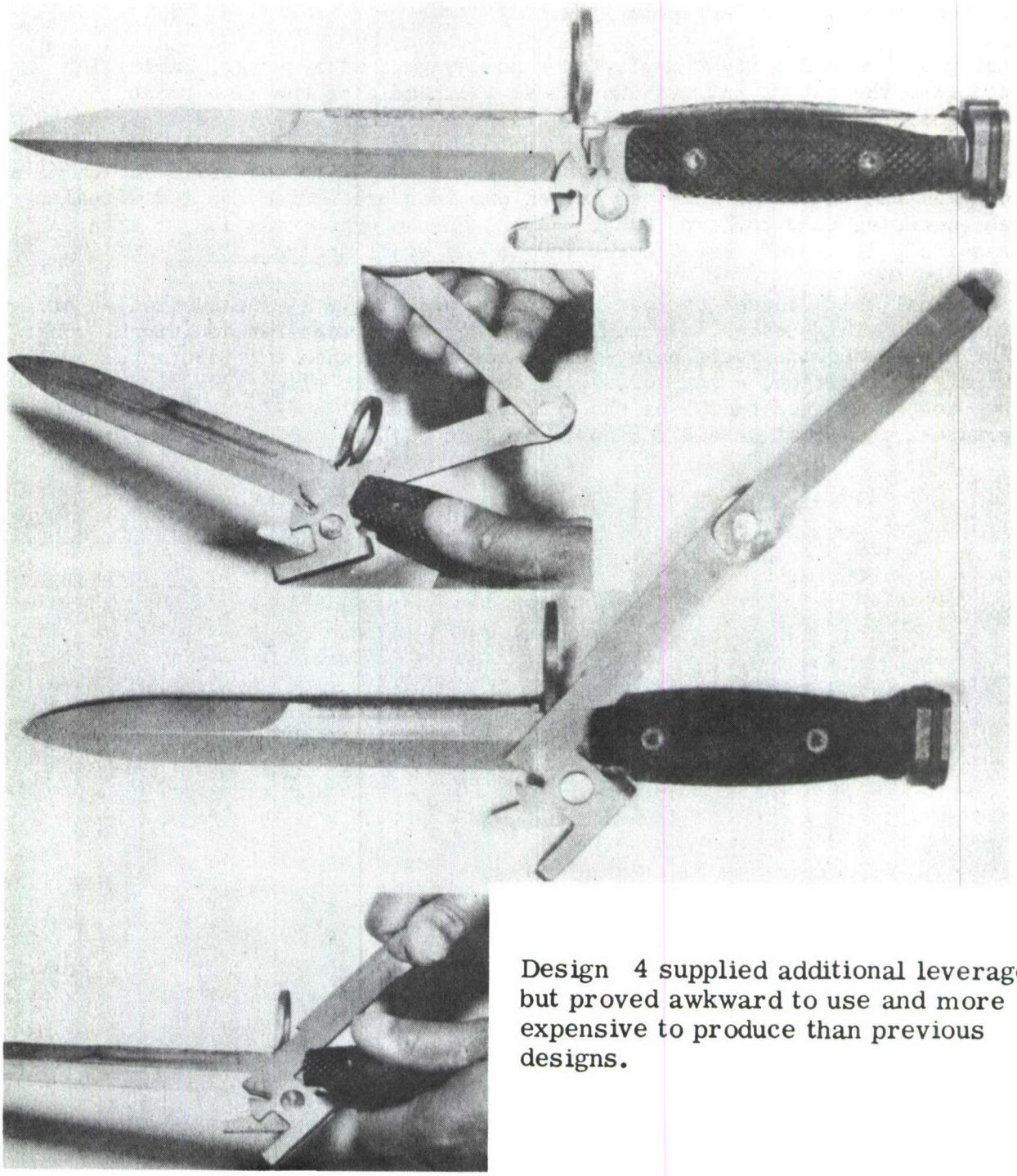
The same type of cutter bar latch mechanism was utilized but it was attached to a larger rectangular block. The clearance between the grip plates and cutter bar was also changed to prevent pinching the user's hand during cutting operations. The knife cutter bayonet, Design 3, was returned to USALWL for further testing. Although the tape cutting device worked extremely well, the barbed wire cutter was unsatisfactory. Further discussions at USALWL led to the possibility of increasing leverage in order to facilitate cutting of the barbed wire. This led to Design 4.

After repeated attempts to cut through the barbed wire, it became obvious that additional leverage was required. Various methods of increasing leverage were investigated. These included a longer handle on the present design, a screw jack principle and the accepted compound leverage principle. In an attempt to avoid a complete redesign, Benhof Inc decided to maintain the present configuration and simply double the length of the original handle.

Design 4 (Figure 7) maintained the basic twin anvil and cutter bar that proved successful in cutting barbed tape, but the cutter was made an integral part of the knife blade. This modification was made first to provide additional leverage and second, to move the round wire cutter up under the blade. This allowed the knife blade to guide the round wire into the cutting jaws. The modification also provided a production simplification since the cutter could be stamped as an integral part of the knife blade blank. The moveable cutter bar was formed from 1/8 inch flat tool steel and bent to form the twin anvils and hinge pin support. An additional 1/8 inch flat piece of tool steel was riveted to the moveable cutter bar. When the knife was used as a flat or round wire cutter, the extension handle was opened in a manner similar to opening a jack knife; this also positioned both cutters in the open position. When the handle was folded into the bayonet hand grip, both cutters are closed. To prevent the handle from going beyond 180° when opened, a stop was designed in the folding mechanism. In practice it was discovered that the additional leverage did not improve the cutting capability and as a matter of fact, the device proved extremely awkward to use.

This design also incorporated a tungsten carbide cutting edge on the back of the bayonet blade. This patented process was developed by Remington Arms Company of Bridgeport, CT. Fuzing tungsten carbide to mild steel allowed the saw blade to cut through hardened steel rods, glass, ceramic, wood, etc. Remington had difficulty with the process but was successful in coating samples for evaluation.

At this point it was quite evident that a complete redesign of the knife cutter/bayonet was required to fulfill the military requirements. The compound leverage principle was the only logical approach remaining. Benhof Inc examined the entire range of currently available bolt and wire cutters. Although leverage can be obtained using the simple long handle principle,



Design 4 supplied additional leverage but proved awkward to use and more expensive to produce than previous designs.

Figure 7. Knife Cutter-Bayonet Design 4
Cutter Bar in Fold and Unfolded Position

this method was impracticable; therefore, Benhof concentrated its efforts on the compound leverage principle.

Using a commercial right-angle compound-leverage wire cutter, Benhof Inc modified the cutter and attached it to the handle of the M7 bayonet, Design 5 (Figure 8). A new rifle attaching assembly block was designed to support the necessary pivot points, a longer cross guard was substituted and a pair of steel jaws were fabricated and pinned to the rifle attaching block. The handle of this new cutter provided protection for individuals encountering hand to hand combat. Although the cutter was larger than required, it proved feasible and led to the final design.

The final knife cutter bayonet, Design 6, was simply a miniaturization of Design 5. This Design, although promising, still requires additional work. The handle requires stiffening to prevent flexing when cutting the barbed wire. In addition, a set screw will be required to align jaws occasionally due to the limited travel of the cutter. This Design (Figure 9) showed the greatest potential of all designs tested at USALWL.

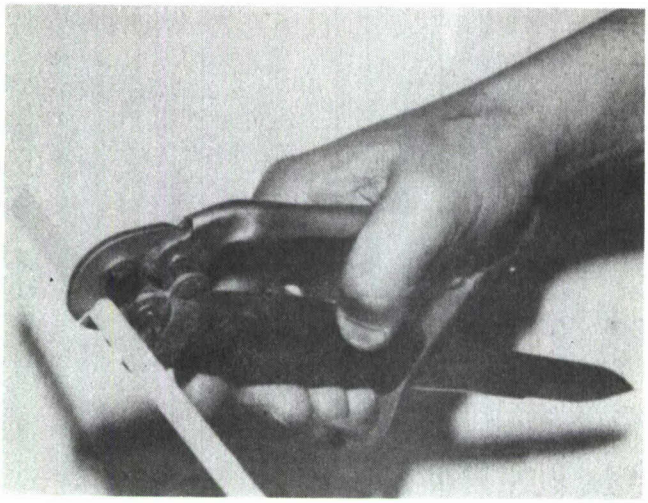


Photo 1 illustrated the Knife Cutter-Bayonet in use. Compound leverage linkage is based on the standard military wire cutters in miniature form.

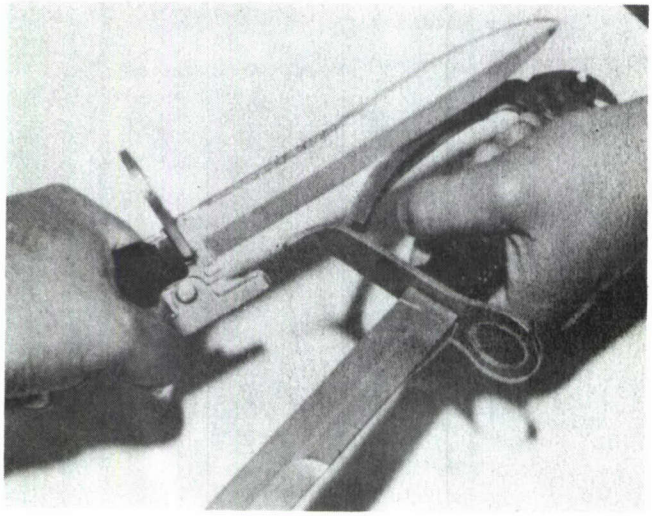


Photo 2 illustrates how well the cutter actuating handle acts as a hand guard in a combat role.

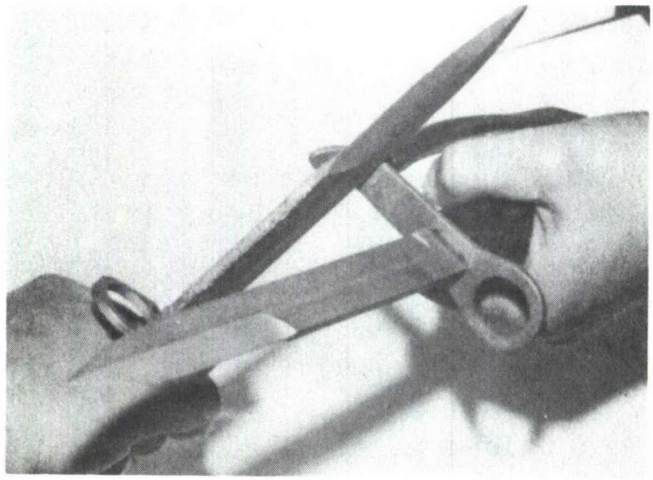
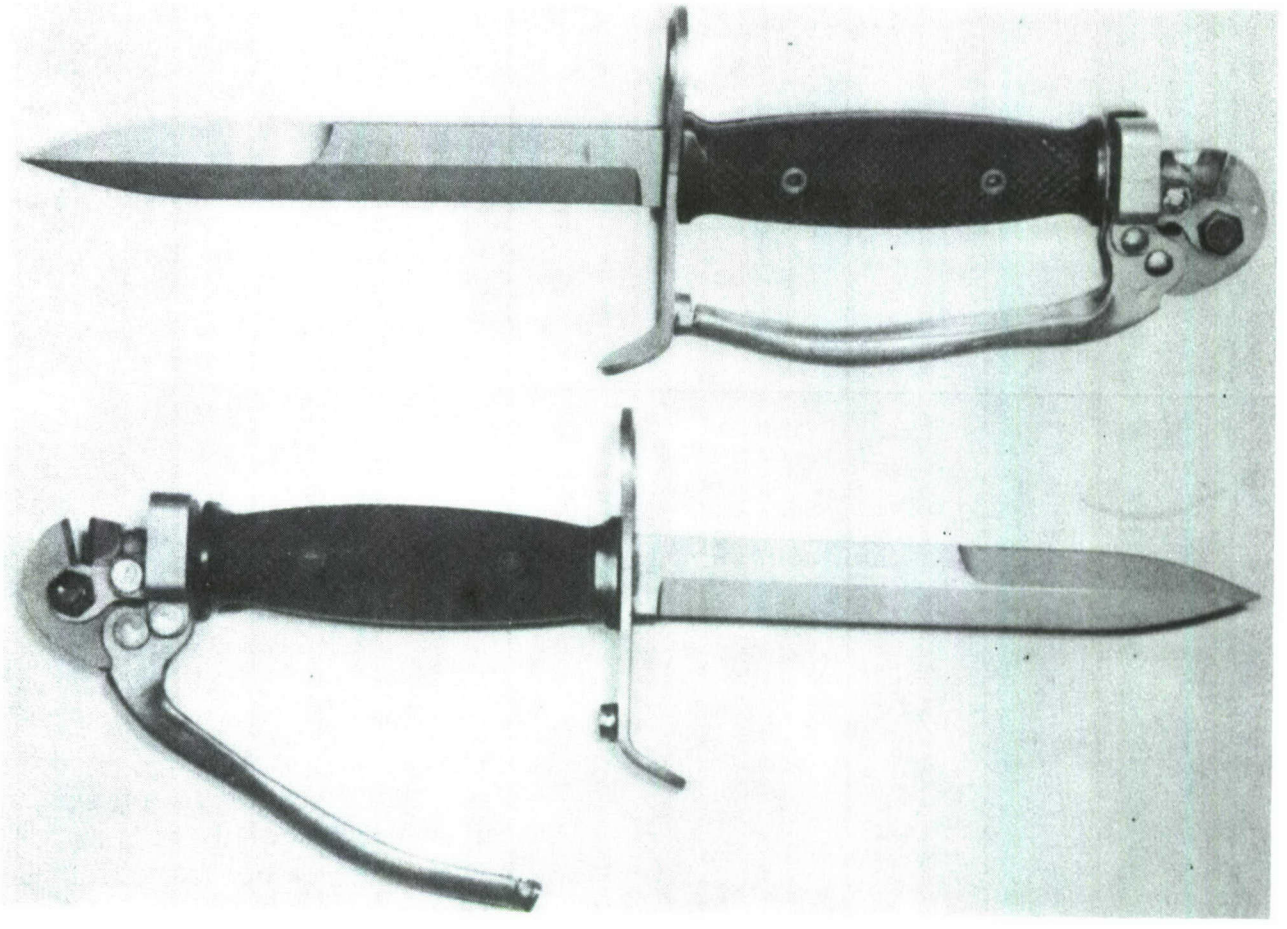
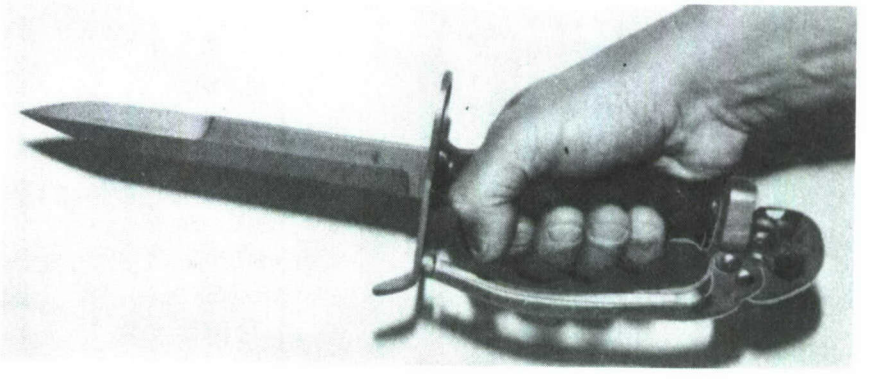


Photo 3 demonstrates how the cross guard protects the combat soldier's hand by deflecting the opponent's blade.

Figure 8. Knife Cutter-Bayonet Design 5 Salient Features



The photos above show Knife Cutter-Bayonet in closed position and with the cutter in open position.



The cutter actuating handle also doubles as a hand guard when the knife is used in a combat role.

Figure 9. Knife Cutter-Bayonet Design 6
Left and Right Hand View

Scabbard and Sharpening Device

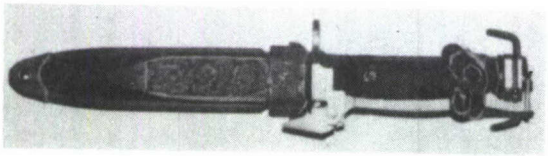
Scabbard: The Design Specifications called for the design of a scabbard to hold the knife cutter bayonet. Since a blade of the same shape and contour of the M7 bayonet was being used it was planned to revise the M1A1 bayonet scabbard where necessary. In all cases, the M1A1 bayonet scabbard required modifications.

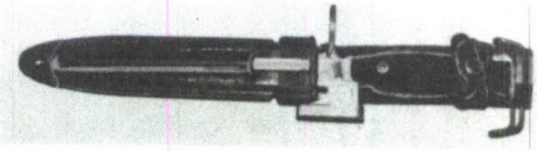
Sharpening Device: The specifications also required that a sharpening device be included with the knife cutter-bayonet. The simplest method would have been to sew an extra pocket on a leather scabbard and include a small whetstone. This makes for a very bulky scabbard, plus the fact that the whetstone is generally brittle and the leather offers little resistance to breakage. With this in mind, it was planned to supply a relatively new tungsten-carbide coated sharpening steel manufactured by Metal Masters. This device is 6 inches long by 5/16 inch diameter and weighs about 2 ounces. It is extremely effective and is virtually indestructible. A plastic pocket was epoxied to the standard M1A1 scabbard. This pocket was designed and located so that the natural resiliency of the plastic retained the sharpening steel. A similar flat chromium-carbide coated sharpening steel manufactured by Gerber Knives is available but was not used because it was too heavy. A thin section of steel flame coated with fungsten carbide particles was procured from the Oliver Company, Columbus, OH. This was ground to the proper contour and epoxied to the M1A1 scabbard. Although it is very light, strong and inexpensive, it is not as durable as the other products tested and evaluated.

Sources of Supply:

Round Sharpening Steel - Metal Masters
10837 Central Ave
So. El Monte, Calif. 91733

Flat Sharpening Steel - Gerber Co.
14200 S. W. 72nd Ave
Portland, Oregon 97223





CONCLUSIONS

1. It is not feasible within the present state of the art to produce a simple light-weight, inexpensive combination knife cutter bayonet.

2. Due to the large inventories of M7 bayonets and wire cutters, USALWL and Benhof Inc agree that it would be advantageous to the Government at this time to retain the two distinct items.

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