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(9) FINAL REPORT on PHASE 1,

(6) SPECIAL PURPOSE INDIVIDUAL WEAPON.

HARRINGTON & RICHARDSON, INC.

(11) 17 May [redacted]63

CONTRACT NO. DA-11-199-AMC-277 (W)

(15)

(12) 21p.

DDC
RECEIVED
MAY 11 1978
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PLATE - 1
POINT FIRE WEAPON
WITHOUT LAUNCHER

1. INTRODUCTION

The Harrington & Richardson, Inc., S.P.I.W. concept is based upon firing a salvo of three projectiles simultaneously out of a single plastic cartridge case containing a single primer and propellant charge.

The three projectiles are fired through three individual light barrels, contained in a cluster within a single surrounding thin walled tube.

The ability to index the three projectiles, accurately opposite the barrels, is due to the triangular shape of the cartridge or "Tround" (triangular round) which is self indexing, that is, the user aims once, fires once and three projectiles are on the way. This gives a much higher hit probability than a three (3) shot burst, as the three projectiles form essentially a circular pattern with a 3 to 5 mil spread.

The use of the triangular plastic cartridge is based upon the Open Chamber Principle that has been developed over a period of several years. It may be seen that it eliminates most of the mechanism and malfunctions common to reciprocating bolt systems because no longitudinal chambering or extraction is required.

2. POINT FIRE WEAPON (SEE PLATE I)

The principle portions of this weapon are the frame or receiver, the cylinder and the triple bore barrel.

The weapon uses a proposed factory loaded disposable plastic magazine containing a minimum of 25 triple projectile trounds or 75 projectiles.

The ammunition is belted together by means of a double heat sealed tape giving a very strong belt which occupies a negligible amount of space.

Due to the absence of a feed spring, the magazine has an extremely long shelf life.

The weapon is loaded and prepared for firing by simply latching the magazine in place below the gun cylinder. A feed pawl, positioned under the topmost tround places it into the lower cylinder recess. With the safety off, the weapon may be fired by simply pulling the trigger after charging. Pulling the charging handle, rotates the cylinder 120° and positions the first tround opposite the barrel cluster. This action also cocks the firing pin. From this point, after firing the gas mechanism performs all further functioning of the weapon. That is, the cylinder is rotated 120° ejecting the spent case and feeding the new one. This also cocks the firing mechanism.

PLATE - 2
POINT FIRE WEAPON
ASSAULT POSITION
CONTINUOUS BELT
FEED FROM AMMUNITION POUCH

PLATE - 3
POINT FIRE WEAPON
WITH BAYONET ATTACHED
NOTE: FLAT SIGHTING BASE

If the weapon is set for "Semi-Automatic" each pull of the trigger accomplishes one discharge firing a salvo of three projectiles.

With "Automatic" setting, the weapon continues to fire at a rate of 300 to 500 rounds per minute as long as the trigger is held back. This discharges 900 to 1500 projectiles per minute.

Unlatching the magazine, permits the entire ammunition belt to be withdrawn, as the cylinder is released, so as to enable reverse rotation.

3. SPECIAL FEATURES

(a) Continuous Belt Feed

The plastic taped "Tround" permits the weapon to be used effectively in assault fire by withdrawing the ammunition from a magazine pouch as shown on plate #2. This is due to the fact that the absence of a reciprocating bolt mechanism permits a very positive feed accomplished by the rotation of the Open Chamber Cylinder.

(b) Prolonged Firing

Experience with other Open Chamber weapons has shown that there is far less heat transferred to the Cylinder than with other closed chamber weapons. This is due to the fact that the insulating qualities of the plastic case prevent heat transfer to the chamber wall sections. Another reason lies in the fact that the Open Chamber maintained in the cylinder inherently eliminates heat storage. Hence, it may be possible to sustain longer automatic bursts than with other weapons. Further studies will be continued on this point.

(c) Pointing Characteristics

Plate #3 illustrates the relatively clean, straight top portion of the weapon. Conferences with the Human Factors Engineering Laboratory at Aberdeen Proving Grounds, and with representatives of the Infantry Combat Development Board at Fort Benning, indicated the desirability of having a flat sight base for quick, natural pointing and aiming against targets of opportunity. This is possible to achieve in this salvo weapon due to the fact that it is no longer important to have a straight in-line stock which is necessary with other weapons in controlled burst fire to minimize dispersion of the three (3) shots.

PLATE - 4
S.P.I.W.
SIDE VIEW WITH BIPOD

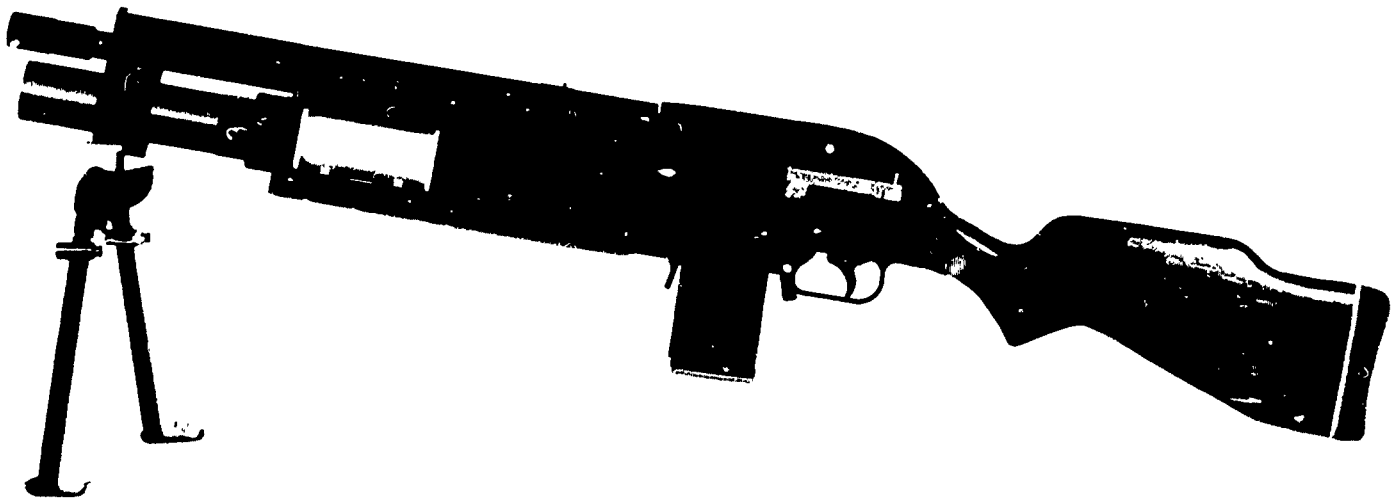

PLATE - 5
S.P.I.W.
TOP VIEW

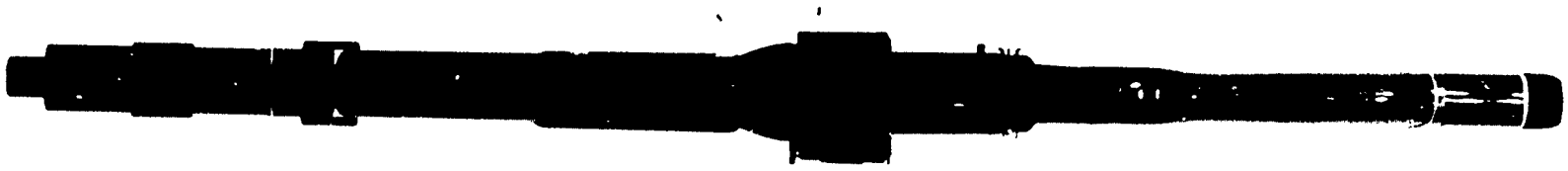

PLATE - 6
S.P.I.W.
FRONT VIEW

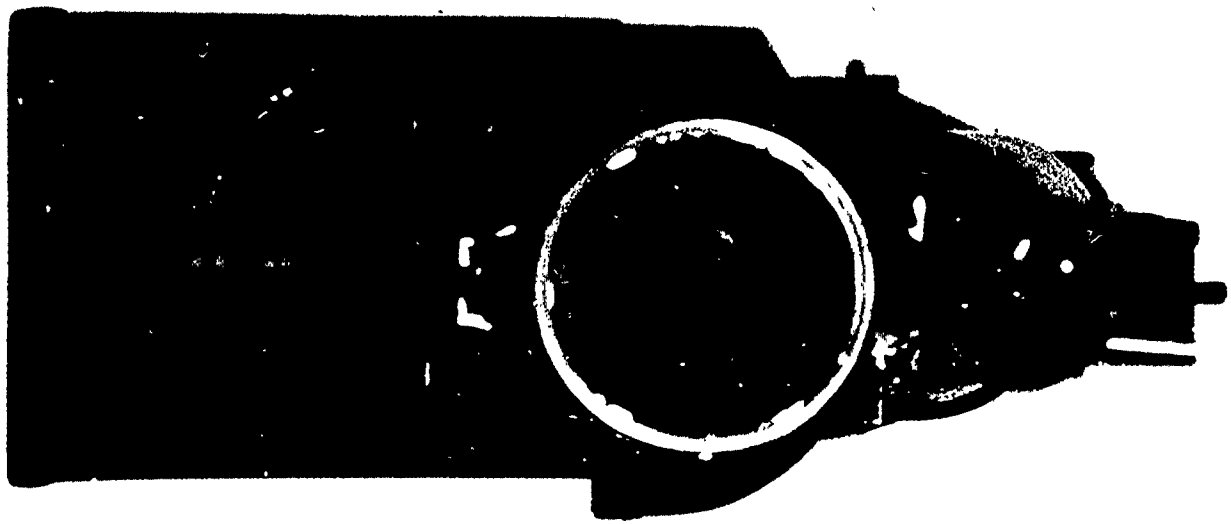

PLATE # 7
GL AT High ELEV.

GIVEN TO MAJ. SALVO
USMC 11 JUNE 1963

4. AREA FIRE WEAPON (PLATES, 4,5 & 6)

This weapon is actuated by the same trigger as the point fire weapon. A selector switch located above the trigger permits either one or the other weapon to be fired, making it impossible to fire both at the same time. A trigger safety locks the trigger in either case.

A second grenade launcher safety locks out the entire breech mechanism until it is ready for use.

The launcher itself is very simple and consists essentially of a rectangular aluminum frame and a barrel. The ammunition is contained in linked plastic adapters that are fed laterally by means of a negator spring. The trigger functions the firing pin. Upon being released, it unlatches a detent that permits the next round to be fed.

Testing at H&R, Inc. shows that this design gives complete obturation within the plastic adapter, and permits accurate firing from the shoulder at all ranges up to the maximum. It is oberved that the slight lateral shift of the center of gravity of the ammunition has no effect on the lateral shift of the center of impact even at ranges up to the maximum.

The flexibility of the linked plastic adapters permits versatility of use whereby a single round may be loaded under conditions where minimum bulk is necessary. Also, 6 or more rounds may be fired continuously from a bipod or by supporting the ammunition by hand. Minimum loading time is required as there is no breech mechanism to actuate. From one to three or more linked adapters may be loaded instantly by insertion laterally. This is the only function necessary to prepare the weapon for firing, outside of removing the safeties.

The top rifle sight is used for launcher ranges up to about 75 meters. Beyond that, a swiveling type of sight is withdrawn sideways. It permits the launcher to be fired from the shoulder at all ranges, keeping the proper sight eye relationship. (see plate #7)

WEAPON CHARACTERISTICS

WEIGHTS:

Rifle empty, magazine in place -	6.15 lbs.
25 Trounds (75 projectiles) -	.80 "
Rifle loaded -	6.95 "
Launcher empty -	1.50 "
40 m/m Round & Adapter -	.53 " each
S.P.I.W. empty -	7.65 lb.

S.P.I.W. loaded (75 projectiles & 3 grenades) 10.05 lbs.

Bore travel - 20 In.
Overall Length - 38 In.
(Without 2" stock extension)

Type of Rifle Fire - (a) Semi-Auto, Salvo of 3 projectiles each.
(b) Full Auto. rate 300-500 rds./min.
900-1500 projectiles/min.

Muzzle velocity of .217 Sabot-Flechette ammunition -4700-4900 ft./sec.

Salvo Dispersion - 3-5 mils extreme spread.

NOTE: The use of a smaller diameter sabotless projectile would permit a minimum weight saving of 1.25 lbs. on the cylinder and receiver of the rifle and would permit more ammunition to be stored in the same magazine. That is, the empty S.P.I.W. would then weigh 6.40 lbs. complete with grenade launcher.

5. ACTIVITIES IN PHASE I

(a) Point Fire Weapon

Following the users' conference at AWC on 28 February 1963, H&R, Inc. proceeded to build a mock-up as quickly as possible consistant with the proposed mechanism design. In this mock-up, the grenade launcher was relocated from the top rear position as shown in the original H&R, Inc. proposal, to the forward lower position. This mock-up was discussed with the Human Factors Engineering Laboratory on 24 March, and with representatives of the Infantry Combat Development Board at Fort Benning on 25 March, 1963. The comments of both facilities were generally in agreement, after independent evaluation. Accordingly, this contractor redesigned the entire configuration making several drastic changes. All these changes are incorporated in the present mock-up, as far as possible.

Among the major changes are:

1. Location of rifle magazine forward of grip.
2. Flat top base for targets of opportunity.
3. Alter charging method for rifle.
4. Substitute shotgun type grip for pistol grip.
5. Provide single trigger for both area fire and point fire weapon with no possibility of firing both at once.

While the mechanism design studies and mock-up construction were taking place, ballistic tests were being carried on independently.

PLATE - 8
EARLY EXPERIMENTAL SALVO
FIRING FIXTURE

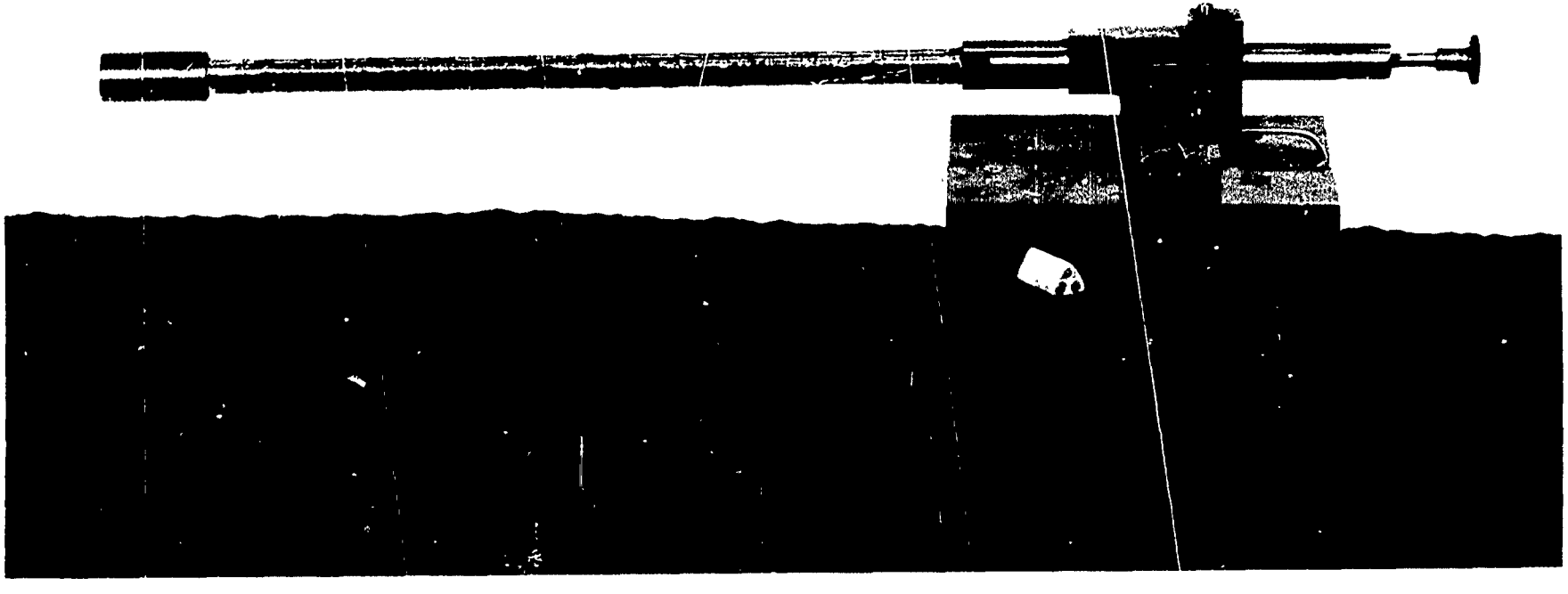

PLATE - 9
S.P.I.W. SALVO FIRING FIXTURE

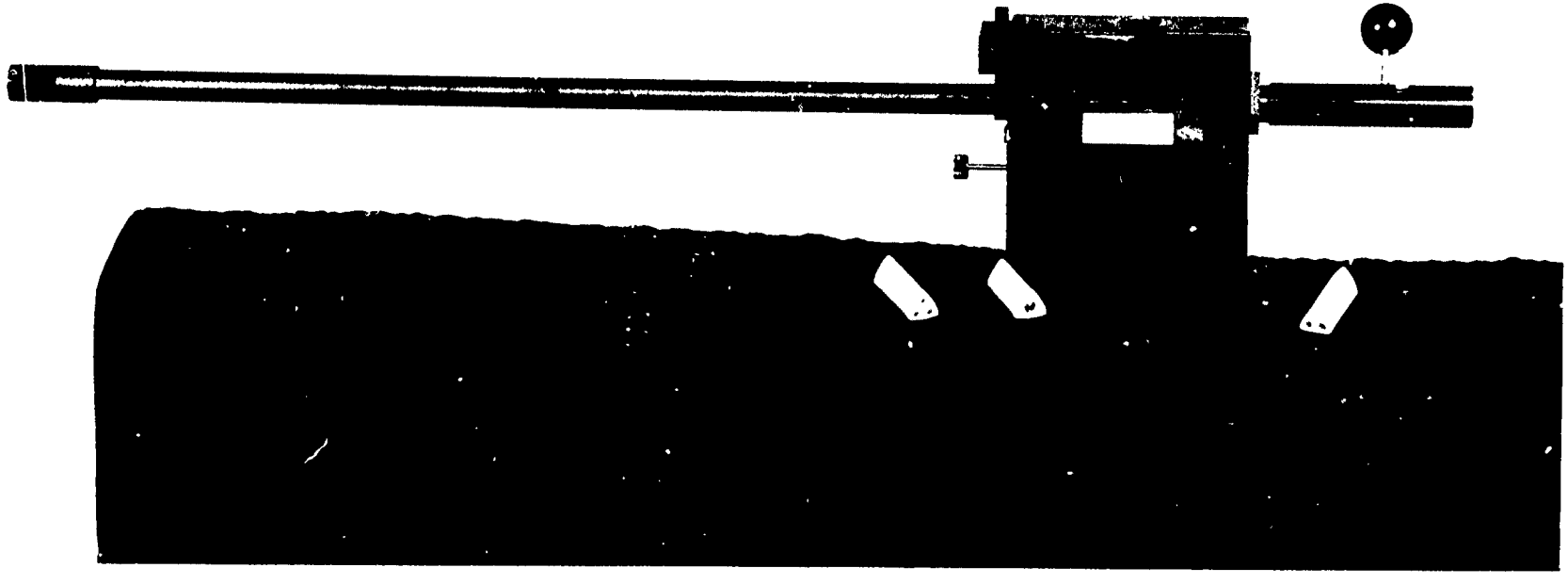

PLATE - 10
40mm GRENADE FIRING FIXTURE

In March, an available triple bore fixture, using a somewhat shorter Tround, was fired to delineate the general characteristics and parameters of the proposed S.P.I.W. Salvo Tround (see plate #8). A sufficient number of Trounds were machined out of linear polyethylene (A70 Celanese Fortiflex) to use in the early firing tests. These tests proved out the front and rear obturation characteristics,

Starting in April, firing tests began with the molded S.P.I.W. Cartridge Cases and with the firing fixture made for this program (see plate #9). Tests were conducted with various propellants in order to obtain proper ignition and burning characteristics. It was found that Hercules 2400 powder (double base) produced clean burning with loads over 50 grains. Piezoelectric gage pressure measurements showed that a load of 57 grains of 2400 produced a peak pressure of 70,000 lbs./sq. in. No sign of any case damage was shown at this pressure. In order to test the ultimate strength of the plastic case, 67.5 grains of 2400 powder was loaded (maximum capacity). This produced slight extrusion of the plastic corners into the gap between the cylinder and top strap. The indicated pressure was between 90,000 and 100,000 lbs./sq. in. The case remained intact showing no rupture marks whatsoever.

Limited firing tests with the sabot-flechette assembly, fired in triple bore salvo with 57 grains of 2400 powder, show complete sabot disintegration outside the bore within 20-30 feet. Observed patterns at 100 yards show a 3 to 5 mil extreme spread. No strippers were used in any of these tests.

(b) AREA FIRE WEAPON

In Phase I, the main emphasis of the area fire program was in ballistic tests to prove the basic reasoning that with this low pressure type of ammunition, it is unnecessary to have a reciprocating chambering system. It was believed that a simple repeating launcher mechanism could be designed as an attachment to the rifle, which would weigh between 1.0 and 1.5 lbs.

Accordingly, a relatively thin walled plastic cylindrical adapter was machined to contain the 40 m/m round. This was fired unsupported in a firing fixture (see plate #10). It was found that the plastic adapter (weighing .03 lbs.) gave perfect obturation, and was capable of withstanding several firings without any damage.

In order to determine the effect of the lateral shift of the center of gravity on the center of impact, an M79 Launcher was fitted with an M4 Mortar Sight, to enable high angle firing with shoulder support. Steel weights were inserted into 40 m/m adapters and

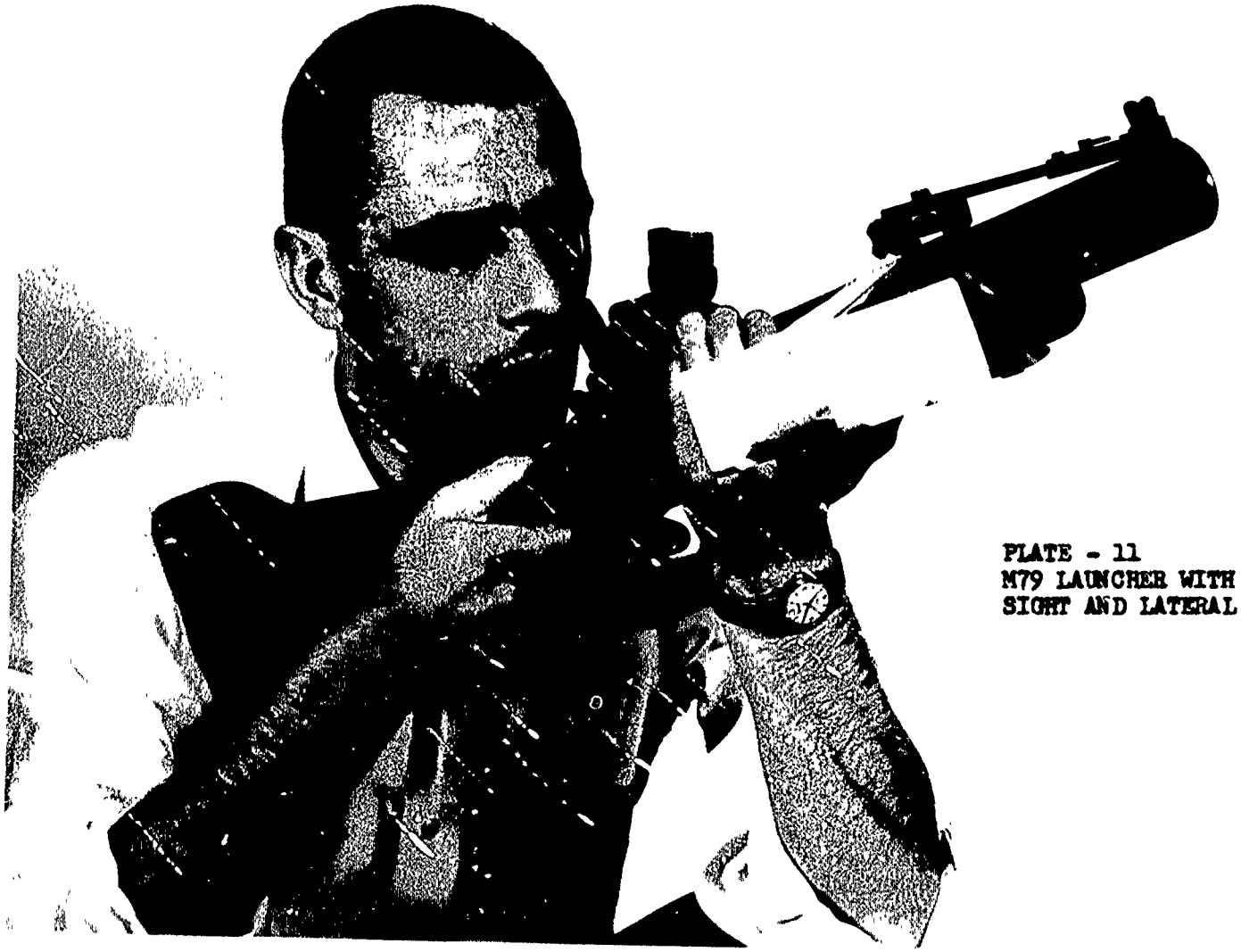

PLATE - 11
M79 LAUNCHER WITH M4 MORTOR
SIGHT AND LATERAL WEIGHTS

were taped to the side of the M79 to more than double the weight of the two rounds of 40 m/m ammunition which would extend from the side in the proposed design. Six shots were fired at a range of approximately 300 meters and the center of impact noted. (see plate #11) The weights were then removed, and the launcher was again fired with six more shots at the same range and the same sighting point. There was no difference in the center of impact from the previous six shots.

This indicates that the old T148 three chamber launcher showed a distinct pattern for each of the three shots for reasons other than center of gravity shift. It was found that the firing of plastic adapters with varying clearances around the 40 m/m projectiles, different patterns were obtained. It was also found that a closely controlled tight fit of the adapter and projectile, produces good accuracy.

6. Proposed H&R, Inc. Development Plan in Phase II

It is expected that the first complete prototype of S.P.I.W. will be fabricated, assembled and tested during August 1963.

It is contemplated that it will be tested at Aberdeen Proving Grounds during the last week of August, with the assistance of Ballistic Research Laboratory, Human Factors Engineering Laboratory, and the Army Test and Evaluation Command.

Following the initial test period, it is contemplated that all necessary redesign and refabrication of parts will take place during September and October. A second series of tests will then be conducted at Aberdeen with the assistance of the above mentioned agencies.

Following the second series of tests, the ten (10) prototypes will be manufactured and test fired so as to effect delivery by the middle of February, 1964.

Ammunition development and testing will continue throughout the entire program so as to achieve optimum quality control on all components as well as ballistic uniformity.

In view of the extremely encouraging results of firing tests obtained in Phase I, with both the point fire and area fire ammunition, and as a result of further study, this contractor believes that a much more effective S.P.I.W. system can be delivered in the same time frame, (February, 1964) by expanding the scope of work in Phase II. This expanded scope contemplates the reduction in the size and weight of the complete weapon, by reducing the

cross section of the present ammunition design. This will be investigated with both the present .217 sabot flechette assembly and with the sabotless projectile of .125 diameter.

The reduction in ammunition cross section, reduces the size of the Open Chamber Cylinder and ammunition storage magazine to a very significant extent.

It is also proposed that an extensive ballistic test program should be undertaken to prove out all basic components of the Salvo Tround, such as the plastic case and belting, under extreme temperature and storage conditions.

Several mechanisms will also be investigated concurrently to permit optimum selection within the shortest time period.

Along with mechanism and ballistic developments and tests, production studies will be conducted to minimize the time period for actual mass production if, and when required, as well as establish production costs.

Another area of investigation lies in the use of a significantly improved 40 m/m or 30 m/m projectile.

Preliminary studies conducted by this contractor, and Picatinny Arsenal indicate the feasibility of developing a boosted rocket projectile, in a relatively short time frame. This projectile would be encased in a cylindrical plastic container or cartridge case containing a small steel high pressure chamber element. The terminal velocity of this projectile would be in excess of 800 ft./sec. which would make it effective against vertical targets at 1000 meters instead of 100 meters as at present. The complete round would weigh substantially the same as the present 40 m/m round encased in the plastic adapter, and would be of approximately the same size.