Investigations Into High-Intensity Projectile Equipment For Net Trapping Geese[1]

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A goose trapping program initiated in Oklahoma and Texas in 1957 encountered numerous setbacks as a result of inadequacies of the projectile net equipment then available. This equipment was essentially that of Dill and Thornsberry (1950), with modifications described in the U. S. Fish and Wildlife Service manual, Guide to Waterfowl Banding (1956). The recommended propellant for this assembly is black powder, usually grade FFG.

Principal objections to the equipment used in 1957 were the short cannon holders, which allowed water leakage, and the use of black powder, which as well as the residue that it leaves in the barrel, is highly hygroscopic. This characteristic often results in damp charges even when there is no direct wetting, and in rusting and pitting of the cannon bores, which presents a constant maintenance problem. The first consideration in this study was the use of a less hygroscopic, cleaner-burning propellant. Other considerations included a design which would protect the powder charge from dampness and also a reduction in both the size and number of parts in the assemblies to facilitate handling in the field.

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Two alternative equipment designs were planned for experimentation. The first was a modification of the Dill and Thornsberry unit for use with Dupont Bulk Smokeless powder. The final design was highly satisfactory and, combined with a lightweight nylon net constructed of 2½ in.-mesh gill netting of No. 6 cord, provided ease of handling and maintenance with extreme efficiency of capture. The details of this unit have been reported by Marquardt (1960).

The second alternative was to modify the design of Miller (1957). The Miller assembly was designed for bulk smokeless power and incorporated a number of novel features. In this design a cylinder (projectile) is projected off a piston supported by a ¾ in. rod. The powder charge is placed at the distal end of the piston. This placement of the powder charge protects it from rain and as Miller pointed out, in the firing position the projectile forms a bell-dome which protects the powder charge even in the event of inundation.

The first unit tested differed from the original Miller design primarily in having a shorter projectile and 0.010 in. clearance between the piston and projectile wall instead of the original 0.030 in. clearance. However, the difference in wall clearance apparently was significant, for the test projectile burst with a charge of 75 grains of bulk smokeless powder.

The projectile of the second test unit was reinforced with a belt of seamless tubing 3 in. long with a ¼ in. wall. The piston was drilled ¾ in. x 1½ in. to contain the powder charge. The powder charge was contained in a rubber balloon into which was inserted a Hercules electric squib. Other changes included the shortening and adding of a spade-like foot to each of the holder stakes. Wooden recoil boards were found to be insufficient and were replaced with ½ in. steel recoil plates. This assembly developed a muzzle velocity of approximately 167 ft./sec. and a muzzle energy of 3160 ft./lbs. with a charge of 75 grains of bulk smokeless powder. Three of these units were used with an 80 ft. x 35 ft. lightweight nylon net and performed adequately until prevailing field conditions necessitated increasing the powder charge to 85 grains. Following this firing it was discovered that the ¾ in. rod supporting the piston had bent and the projectile could no longer be seated on the piston.

The piston and supporting shaft were redesigned as a full diameter shaft turned down 0.040 in. except for the bearing surface of the piston and base ring. Other alterations included enlarging the powder chamber to ¾ in. X 2 in. and removal of the supporting stake in favor of a ½ in. steel recoil plate welded to the base of the projectile assembly. Two arms extending forward from the sides of the recoil plate provided for support and a means of adjusting the elevation of the projectile. With the lightweight nets these units proved adequate under all field conditions encountered and were much easier to set up than the units with stake driven supports.

Recently the State of Colorado has, through the use of floroscopy on captured geese, observed what is believed to be a disportionate number of geese carrying lead shot. The possibility exists that birds partially debilitated from shot wounds are more susceptible to baiting and subsequent capture than those which have not sustained shot wounds. Thus there appears to be a need for a method of capture which will provide an unbiased sample. One possibility appears to be the building of a faster, more powerful projectile which, combined with the already existing lightweight nets, would be capable of trapping geese in suitable locations without baiting.

Another need expressed is for projectiles capable of propelling large cord, small mesh, i.e., heavier nets with approximately the same efficiency achieved with the lightweight nets. In the case of turkeys, and possibly other species as well, the use of nets fashioned from gill netting has caused excessive defeathering and lacerations. Again the need appears to be for faster, more powerful projectiles.

In line with this objective it was decided to test the potential of the modified Miller assembly. The first test was conducted with the field units used during the previous season of trapping. The powder chamber capacity of this unit is approximately 105 grains of bulk smokeless powder. With 115 grain charges the projectile could no longer be seated properly and velocities were highly erratic. Another problem encountered which affected the consistency of test results was the severe recoil obtained with charges over 85 grains. The soil at the test site did not provide adequate resistance to recoil with the recoil plate used. In addition the recoil plate was buckled by the recoil of the maximum charges and it was difficult to seat it properly for each firing.

Accordingly, the design was modified as pictured in Figure 1. In the new model all tubing is cold-drawn seamless mechanical steel. The material for the piston shaft is technically designated as C1018 cold roll shafting. The powder chamber was enlarged to ⅞ in. X 2½ in. with a capacity of approximately 150 grains of bulk smokeless powder, including the electric squib. A double recoil plate was used, strengthened with reinforcing struts. The support stand was made of a flat plate welded to the forward recoil plate and extending forward beneath the unit. The shape of the support stand is optional. Weight of the projectile is 7¼ pounds; weight of the entire unit is approximately 37 pounds. All projectile equipment was constructed by Bollinger Machine Works, Stillwater, Oklahoma.

In the second test two large steel plates were buried behind the recoil plate of the projectile assembly to provide a larger recoil surface. As the size of the charges increased even this proved inadequate for a stable base and velocities obtained from individual firings showed inconsistency. The test was concluded at 145 grains of bulk smokeless powder. No part of the modified assembly showed signs of failure.

The results of the two tests are given in Figure 2 and Table 1. The velocity and energy data were derived from standard ballistic physics formulae. The curves presented in Figure 2 were fitted by eye and therefore provide approximate values. In the results of the first test the values given for charges of 85 and 95 grains are based on single firings. In the results of the second test the values given for 105 and 145 grains are based on single firings. The energy values given in Table 1 are based on the curves in Figure 2. All data should be considered approximate and are intended primarily for comparative purposes between tests discussed herein. The differences between equal loads in the two tests is attributed to changes in the powder chamber capacity.

The test results indicate that the modified Miller assembly described herein has the potential for much higher energies than those presently being obtained in field use. How these increased energies can be interpreted, in terms of net extension, is not known at the present time. However, the following comparisons are suggestive. The smallest net used to date is 30 ft. X 40 ft., weighs approximately 15 pounds, is restrained by four 5-pound drags, and has a leading-edge projection of about 60 ft. when carried by 2 Dill-type projectiles developing 2,380 ft./lbs. of energy each. The large net is 35 ft. X 80 ft., weighs approximately 35 pounds, is restrained by five 5-pound drags, and has a leading edge projection of about 65 ft. when carried by 3 Miller-type projectiles developing 3500

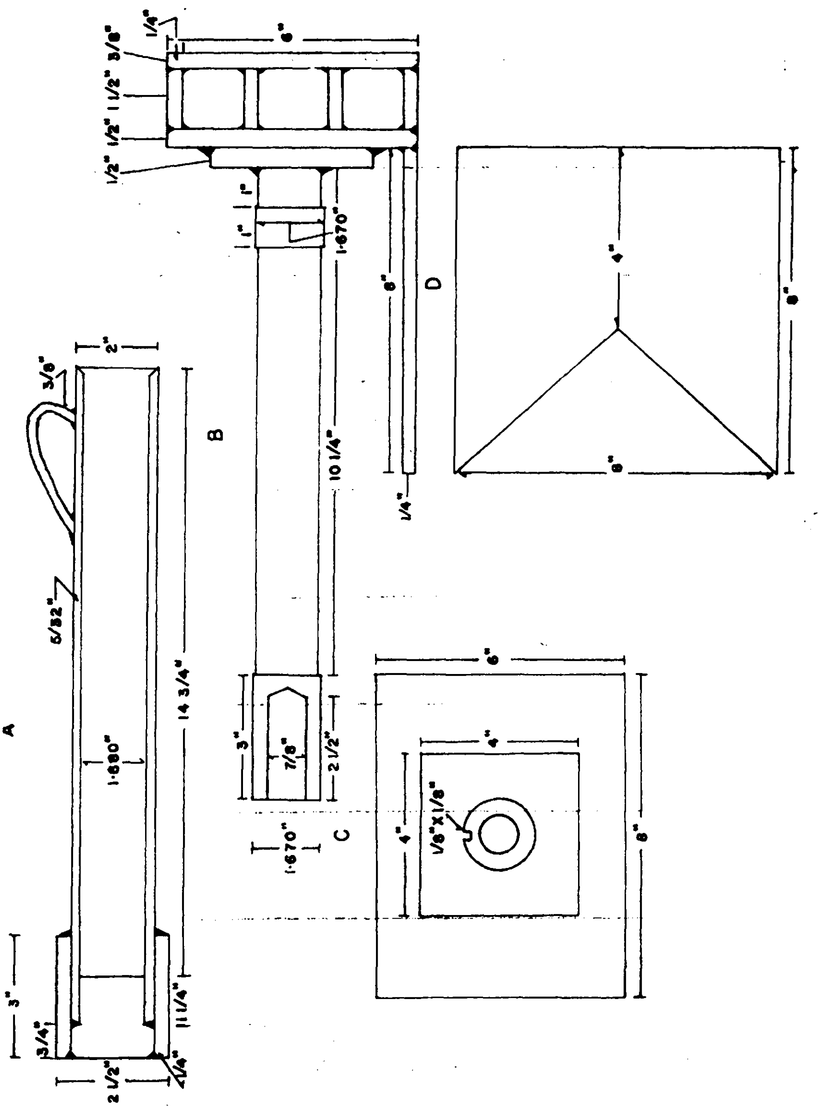

Figure 1. Modified Miller Assembly.

A. Side view of projectile (sectional view).

B. Side view of piston, shaft, base ring, base plate, recoil plates, and support stand (sectional view).

C. End view of piston, base plate, and forward recoil plate.

D. Bottom view of support stand.

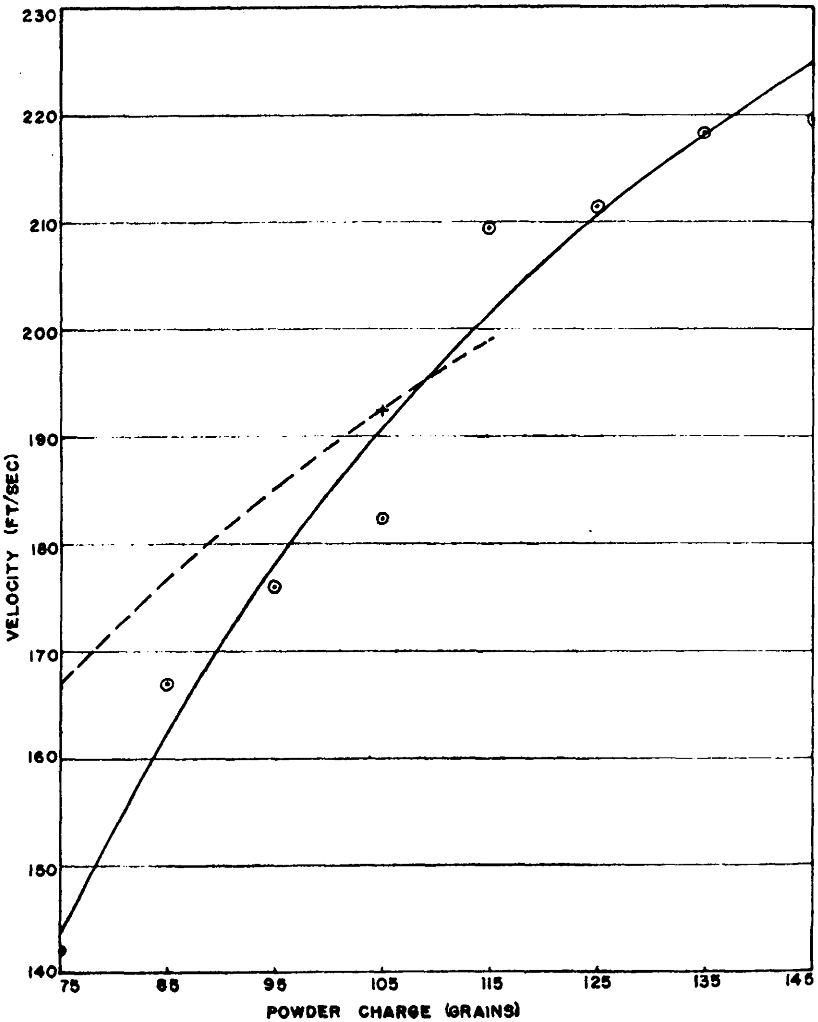

Figure 2. Calculated muzzle velocities for the modified Miller assembly.

Test. 1 — — + — —
Test. 2 ——— ⊙ ———

ft./lbs. of energy each. It would appear that with the largest charge tested in the Miller assembly, either of these nets should have a leading edge projection of 100 ft.; the smaller net might exceed this appreciably. It would probably be advisable to reduce the weight of the restraining drags for such long-distance projection. For projection over normal distances, (30 to 40 ft.), with heavy nets the rate of extension should be considerably more rapid than that obtained by 180-grain black powder charges in a Dill-type assembly. This would be expected from the slightly higher velocity (1.1 X), higher muzzle energy (1.8X), and greater inertial resistance of the heavier Miller-type projectile.

TABLE 1. MUZZLE ENERGIES OF THE MODIFIED MILLER ASSEMBLY BASED ON THE VELOCITY CURVES GIVEN IN FIGURE 2.*

Test	Powder type	Powder wt. (grains)	Squib	Projectile wt. (pounds)	Muzzle energy (ft./lbs.)
**	Black (FFG)	180	Atlas	5	3187
1	Smokeless	75	Hercules	7.25	3140
1	"	85	"	7.25	3529
1	"	95	"	7.25	3877
1	"	105	"	7.25	4198
1	"	115	"	7.25	4486
2	Smokeless	75	Hercules	7.25	2333
2	"	85	"	7.25	2991
2	"	95	"	7.25	3589
2	"	105	"	7.25	4133
2	"	115	"	7.25	4599
2	"	125	"	7.25	5043
2	"	135	"	7.25	5384
2	"	145	"	7.25	5735

* Powder chamber in Test 1 was ¾ in. X 2 in. and in Test 2 was ⅞ in. X 2½ in.

** Dill-type assembly, offered for comparative purposes.

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