N.G.Y./ii22) **N.U.G. PROJECT** Group N.U.G.1
Whale Island
15th September 198?

The Director General Weapons Division,
Admiralty Offices,
Ensleigh, Bath.
(Copies to :—
The Director General Ship Department
The Director General Dockyards and Maintenance Division
The Captain, H.M.S. *Excellent*
The Captain Superintendent, A.S.W.E.
The Minister of Aviation
The Editor, *Journal of Naval Engineering*)

N.U.G. PROJECT—PROGRESS REPORT

Reference :—M.G.Y.i2) N.U.G. PROJECT—PROGRESS REPORT dated 1st September, 198?
Enclosures :—FIGS. 1, 2 and 3.

Further to our recent conversations, we can now submit the following favourable report on the completion of the design study of the above project.

General Description

2. (*a*) The N.U.G. is a dual purpose, third generation missile, being the successor to the successor to SEASLUG. The sophisticated design philosophy adopted has enabled major all-round improvements to be implemented : so that MISSILEWISE this is considered to be the Ultimate Weapon.

FIG. 1—THE MISSILE

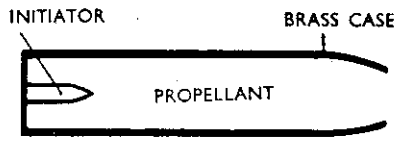

FIG. 2—N.U.G. BOOST MOTOR

(*b*) The missile (see FIG. 1) is an ogival headed wingless vehicle, utilizing Roll Rate stabilization, with a blast fragmentation warhead. Unconventionally, the missile is guided during the boost phase only, a recent major breakthrough in missile dynamics having made this possible. The duration of boost is less than 1/100th of a second, at the end of which the missile has attained a velocity of Mach 2.
(*c*) The propellant is cast, double base, extruded cordite, enclosed in a brass boost motor case (see FIG. 2).

Separation

3. The difficult problems of boost separation have been ingeniously overcome by physically restraining the boost motor. Thus separation occurs at the instant of launch, before the second stage has left the launcher.

Launcher

4. Separation and guidance problems precluded the use of the zero length launcher. A radically new approach to the problem had to be made, which resulted in the choice of a heavy tubular structure, as shown in FIG. 3. Spiral

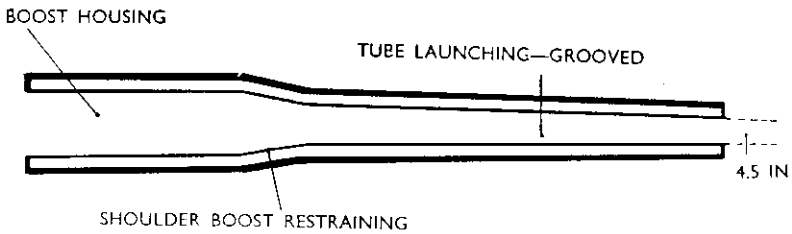

FIG. 3—N.U.G. LAUNCHER

grooves, cut internally along the length of the tube, spin the missile to impart a roll rate during boost. The missile would be aerodynamically unstable in the weathercock mode without the gyroscopic damping effects of the roll rate stabilization.

Control and Guidance

5. (*a*) The concept of roll rate stabilization dispenses with the need for an auto-pilot and conventional control surfaces. Thus the missile employs the optimum aerodynamic profile dragwise. This having a secondary advantage in that no sustainer motor is required. The missile weight is therefore almost entirely payload.
(*b*) Target information, fed to the parent installation from a tracking radar, enables a target flight path and missile trajectory to be computed for interception. This is done continuously up to the moment of launch. The launcher is accurately positioned from this information, and during boost, the missile is gathered and held on the programmed trajectory.
(*c*) During the terminal phase the missile coasts along the selected trajectory to the intercept point, where detonation is induced, either by programmed command, or proximity fuse.

Countermeasures

6. The missile is unique in that after separation it has complete immunity to radio countermeasures. Before launch, in a jamming environment, visual command link guidance is available as an alternative with only slight reduction in the missile's lethality.

Tactical Use

7. The missile can be launched from vehicle, ship or aircraft and may be deployed against air or surface targets.

Logistic Considerations

8. Despite the complex parent installation, the missile itself is simple. Although extensive training will be required to convert personnel trained in conventional missile techniques, it is considered, that the other advantages far outweigh the effect of this minor disadvantage. These same advantages are listed below :—
   (*i*) Only one tracking radar is required
   (*ii*) The missile itself is excessively simple, small, light and requires no maintenance, and with its diameter of 4·5 inches, can be stowed in bulk and easily handled.

Forward Thinking

9. Missile handling and loading equipment is at present complex, a great step forward in this respect would be obtained by the adoption of a spherical non-explosive missile. This could be loaded from the front end of the launcher, this advanced technique being known as 'muzzle loading'. With this scheme, a vastly simplified launcher, (see FIG. 4) layed and traversed by a rope and pulley mechanism, could be utilized. A sub-committee has been formed to make a pilot study of this system.

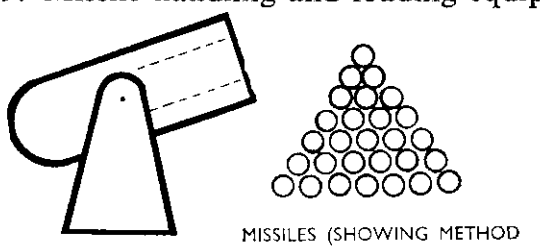

FIG. 4—N.U.G. PHASE II SYSTEM

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