

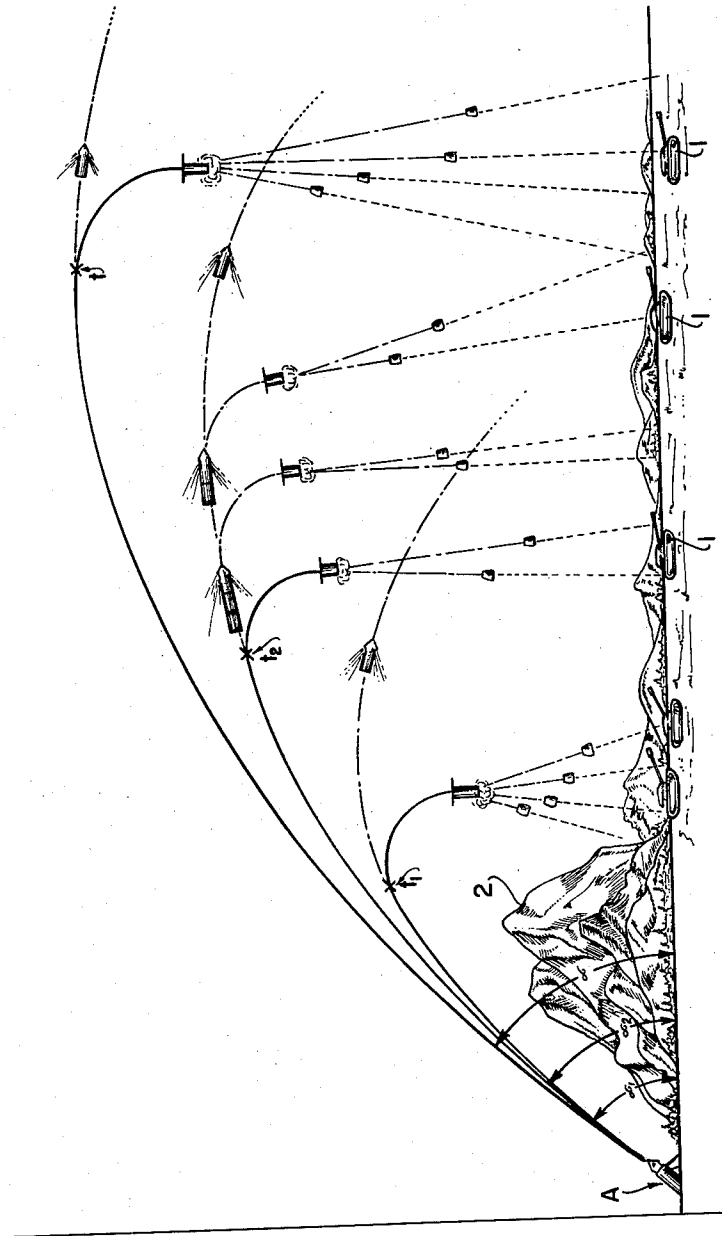
March 10, 1964

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MISSILE PROPULSION

3,124,072

Filed Aug. 24, 1960

3 Sheets-Sheet 1



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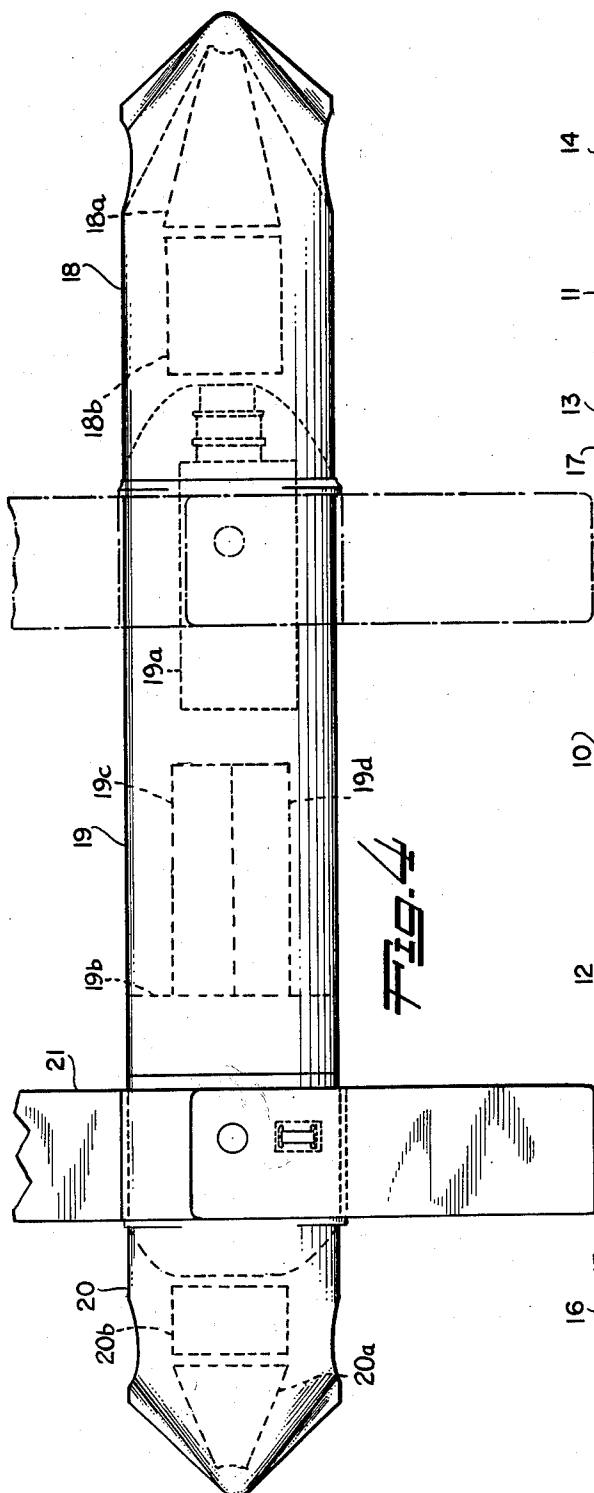


Fig. 4

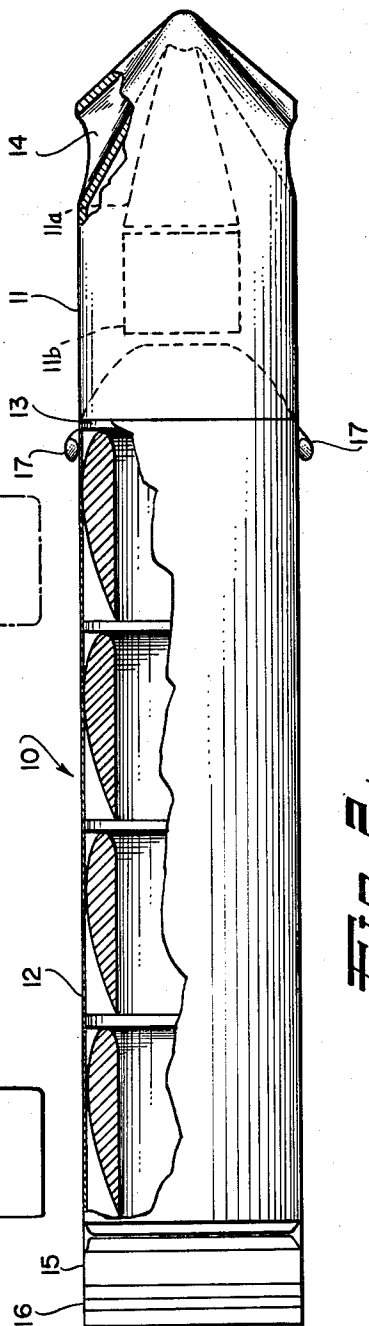


Fig. 5

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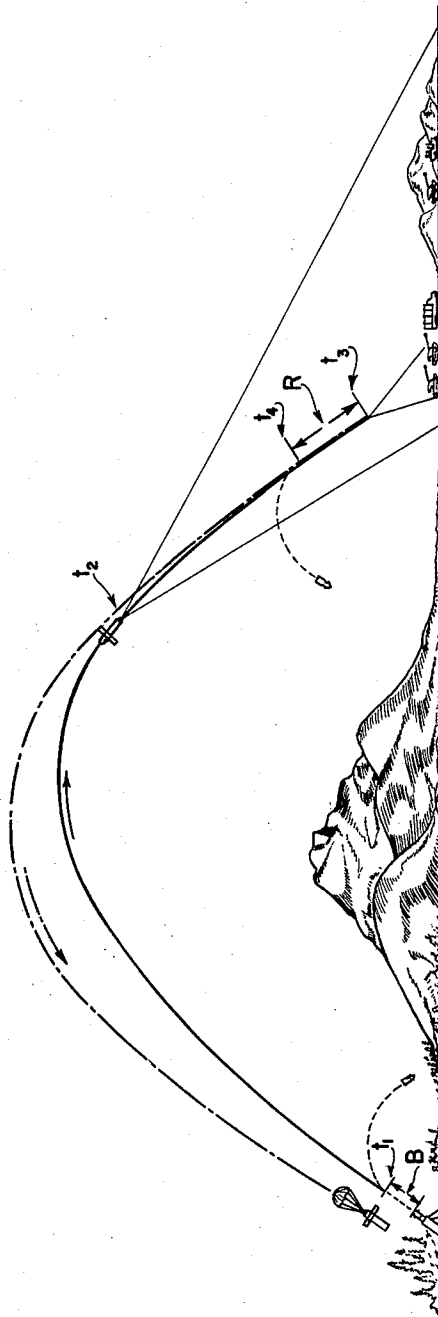


Fig. 3

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3,124,072

MISSILE PROPULSION

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Filed Aug. 24, 1960, Ser. No. 51,621

4 Claims. (Cl. 102—51)

This invention relates to propulsion systems of missiles and the like and more particularly to an improved missile which is readily adaptable as a multiple purpose weapon and utility missile.

Generally, the performance of a missile depends to a large extent on its propulsion system. For a specific missile requirement, i.e., range, velocity, cruise altitude, etc., a specially designed propulsion system is necessary. This is particularly the case on all types of ballistic missiles. Range, velocity and trajectory are directly related to the total impulse of the propulsion system. In other words, the accuracy to follow a predicted ballistic trajectory is a function of actual thrust level and burning time.

Therefore, in case of high accuracy requirements, liquid fuels have been used in order to control thrust level and especially to terminate the thrust at a given time by shutting off the fuel flow.

The liquid rocket propulsion system is generally very complex and, therefore, not always suitable for smaller inexpensive missiles. The solid fuel rocket is known to be very simple in design and handling. However, standard solid fuel rockets cannot be stopped from thrusting prior to burnout unless special provisions for thrust reversers or pressure release devices on the rockets are made. These devices complicate the otherwise simple solid fuel rocket motor. The known thrust cut-off devices for solid fuel rockets are impractical for small inexpensive missiles from the weight, handling and price standpoint.

Therefore, it would be desirable to provide a standard solid fuel rocket in combination with a suitable airframe, which would be inexpensive and yet have trajectory flexibility equal to that obtainable using liquid fuel rockets. The advantages of a single standard missile for variable ranges, and which at the same time is readily adaptable as a multiple-purpose carrier are readily obvious.

Accordingly, an object of this invention is to provide a multi-purpose missile.

Another object of the invention is to provide a missile carrier capable of being launched from various sites and having diversified warhead capability for both direct and indirect fire.

Another object of the invention is to provide a multi-purpose missile having a variable range capability combined in one versatile weapon.

Another object of the invention is to provide a standard missile which is readily adaptable for weapon launching, reconnaissance, or target acquisition.

These and other related objects will be apparent from the following description of certain preferred embodiments shown in the accompanying drawings in which:

FIGURE 1 is a missile trajectory schematic illustrating the principle of the invention,

FIGURE 2 is an elevational view in cross section of the details of the invention,

FIGURE 3 is a trajectory schematic of a short range target acquisition system utilizing the invention; and

FIGURE 4 is an elevational view in cross section showing a modification of the invention.

Jet propulsion of heavy or light missiles has more or less revolutionized practices of warfare, primarily because of the inherent advantages such as lightness, simplicity, absence of recoil, adaptability and cheapness of jet propulsion as compared with guns. The use of jet propulsion has led to the discovery of hitherto unknown principles,

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either unfeasible or impractical with conventional guns. Light and readily transportable rockets make it possible to move in close to enemy lines, or move over terrain normally impassable to normal field weapons.

The present invention is intended to exploit further the advantages of jet propulsion, employing unique construction and principles to provide superior and rapid reconnaissance and rapid and accurate fire power under adverse conditions.

Referring to FIGURE 1, the operational concept of the invention is depicted in the form of an anti-tank missile. Given intelligence as to the general location of enemy tanks 1, or other forces, and assuming a natural barrier such as the hills 2, it is desired to deliver a concentrated amount of fire power against the tanks or other forces in the vicinity. Likewise it is highly desirable to do so with the least advance warning.

Of course, it is always possible to "lob" projectiles of the proper type over the obstacle, but such a practice requires "spotting" which in the illustrated diagram is either impractical or near impossible.

Utilizing the invention however a maximum amount of fire power is delivered in rapid succession with little or no danger to the operator and support personnel. A launch site "A" is selected and knowing the general location of the enemy tanks, the operator refers to appropriate charts to determine the two variables, elevation angle α , and booster separation time t . The missile is pointed at the correct azimuth and fired.

The missile comprises a forward section in which the booster is housed and an after section containing the warhead or any diversified weapon. As an example, for illustration only, the rear section of the missile may contain a plurality of homing devices.

At the preset time t the booster is separated from the warhead case, a drag brake is activated and the warhead case comes to a near vertical position over the vicinity of the enemy tanks. When the warhead case is substantially suspended almost vertically, spin rockets or the like may be ignited causing the warhead case to spin at high rate. When the case is spinning, an expulsion device, e.g., a gas generator, compressed gas, etc., is actuated and expels the warheads in quick succession. Each missile homes on a target and is automatically guided to it.

The missile, as will be noted, employs a pull-booster system which inherently provides greater stability by moving the c.g. forward. The effective booster thrust applied to the missile can be terminated at any selected time while the booster is still thrusting, by separating the pull booster from the missile. Thus this pull boost system, using solid rockets, achieves inexpensively the flexibility of total impulse usually obtained with complex liquid rocket systems. Also as illustrated in FIGURE 1 the booster continues on its powered trajectory until burn out, while the warhead case slows and descends in the vicinity of the target. Thus the possibility of successful enemy countermeasures is considerably decreased by the decoy effect of the booster.

As best seen in FIGURE 2, a missile 10 has a forward section 11 and a rear section 12, having the separation plane 13 therebetween. In the forward section are located the propulsion components and separation controls indicated schematically as 11a and 11b respectively. Inasmuch as the details of pull type rocket motors are well-known, further description thereof is not believed necessary. U.S. Letters patent showing typical rocket motors of this type are: 2,503,271 to C. N. Hickman, granted April 11, 1950, and 2,683,415 to O. C. Wilson, granted July 13, 1954. Likewise the separation mechanism, which may be a time controlled mechanical latch, a squib type release, explosive bolts, pyrotechnic pin-puller or solenoid actuated pin-puller is believed well-known and not essen-

tial for an understanding of the present invention. Rocket nozzles 14 are located in the nose of the forward section and direct the jet thrust toward the rear to provide forward motion of the vehicle.

The rear section 12 may contain any type of warhead which is desired or called for by the particular components of the enemy forces for which the weapon is used. As an anti-tank missile, for example, the warhead may conveniently contain any of a plurality of homing devices. Illustrated, but not required, are a plurality of annular wing warhead configurations. Near the rear of section 12 is an explosive container 15 and a drag brake 16, shown in retracted position. The drag brake is extended as soon as the separation of the two sections is effected. Once the warhead is slowed down by the extended brake and is falling essentially vertical, the spin rockets 17, which are attached to the outer case, produce a high spin rate of the warhead, following which the explosive charge is ignited and expels the plurality of warheads in rapid succession. A drag parachute may be substituted for the drag brake.

Thus, it is apparent that by utilizing a single pull booster, an operator has at his command a multi-range, multi-purpose weapon, which requires merely a setting of the elevation angle and pull boost separation time and firing at the correct azimuth.

It is of course apparent that several separate warheads could be combined with the same pull booster by using a separate timer and ejectors to provide separation of each unit at predetermined times along the selected trajectory as represented in FIGURE 1.

Referring to FIGURE 3, the pull boost vehicle of the present invention readily lends itself to provide short range intelligence to the ground forces within a very short time. As depicted in the schematic, the missile is adapted for launching and recovery in substantially the same area, by utilization of a forward booster (phase B), and a retro-booster (phase R) when the intelligence surveillance period ends.

FIGURE 4 shows the composite vehicle which is a modified form of the invention to fulfill the requirements of the schematic of FIGURE 3.

A nose section 18 is similar to the forward section of FIGURE 2, and contains a pull-booster 18a and timer 18b for separation from the main body section 19 at a preset time. As is apparent from FIGURE 3, the separation takes place prior to the intelligence equipment starting point. The main body section houses the intelligence equipment which may conveniently be a small, inexpensive 16 mm. motion picture camera 19a, or a pulse type 35 mm. or 70 mm. camera with suitable optics shown schematically. The main body also contains the power supply, programmer 19d, and recovery system. The rear section 20 contains the retro-pull booster 20a and timer 20b, having slight modifications over the forward booster, as hereinafter described. A folding fin arrangement 21 is mounted on the main section for sliding movement of the fins from one end of the body to the other, depending on flight direction. Alternate configurations, for example, having fixed fins instead of folding fins, or having two sets of fins instead of one set of sliding fins, are possible.

The recovery system 19b consists of a small parachute which is housed in the center main body section and is activated by a preset altitude switch or timer 19c on the return trip. The altitude switch is normally de-energized and is energized only after the retro-booster is separated and the missile is descending toward the vicinity of the launching site.

The missile is preferably housed in a transport case, which will also be used as the launcher, by attaching rods to the front end of the launcher for support and to secure the proper elevation. In the stored position, the fins 21 will be folded alongside the missile and after launch will open and lock in the open position.

In operation and with reference to FIGURE 3, the mis-

sile, including the two rockets and main body is fired using the forward booster. At some preset time t_1 after launch when the missile has attained the required forward velocity, the booster is separated and the vehicle continues on its own trajectory. As the vehicle approaches the target area, intelligence equipment, such as a camera, starts at time t_2 and records the topography and any alien objects that appear in the field of view as it progresses toward the ground.

At the minimum preset altitude or time t_3 the retro-booster is fired, which slows down and reverses the vehicle flight direction for the return trip to the recovery site. Inasmuch as the vehicle must be slowed and its direction of flight changed from forward to reverse the retro-booster is provided with canted nozzles to spin the vehicle to maintain stability during the flight direction reversal phase. The retro-booster may or may not contain more propellant than the forward booster. At time t_4 the retro-booster is separated and the vehicle body continues on its own free flight trajectory to the recovery area.

When the return trip is initiated the fins will slide to the opposite end of the main body, to provide vehicle aerodynamic stability in the opposite flight direction without turning the vehicle. At a preset altitude the recovery parachute opens and the vehicle descends in the vicinity of the launch site.

Thereafter the film can be processed and within a matter of minutes, instead of hours, intelligence as to target acquisition is available. In-flight film processing also is possible. By comparison of the pictures with existing maps, sufficient target acquisition information is obtained for making tactical decisions.

Thus, it is believed apparent that the invention has definite advantages and multiple applications over the presently known devices.

While specific embodiments of the invention have been shown and described it should be understood that certain alterations, modifications and substitutions may be made to the instant disclosure without departing from the spirit and scope of the invention as defined by the appended claims.

I claim:

1. In a missile of the rocket propelled type, the combination comprising a main body portion, surveillance equipment mounted in the forward end of said main body portion, a rocket powered nose section attached to the forward end of said main body and having rearwardly flared exits formed therein and providing a rearwardly directed thrust, a rocket powered tail section attached to the rearward end of said main body and having forwardly flared exits formed therein and providing a forwardly directed thrust, means including said powered nose section for launching said missile, means responsive to a predetermined first condition for separating said main body from said nose section, thereby permitting said main body to proceed in free flight, means responsive to a second condition for actuating said rocket powered tail section, whereby the flight of said main body is reversed, and said missile is pulled back toward the launch site, means responsive to a third condition for separating said main body from said powered tail section, thereby permitting free flight of said main body to the vicinity of the launching site, and means contained in said main body for facilitating recovery of said main body.

2. A missile as defined by claim 1, wherein the surveillance equipment consists of a motion picture camera mounted in the forward end of said main body and which is operable after separation of said main body and nose section.

3. In a missile of the rocket propelled type, the combination comprising a main body portion, a first rocket means attached to one end of the body portion for propelling said main body portion in one direction, a second rocket means attached to the other end of the body portion for propelling said main body portion in the opposite

direction, means for detaching the first rocket means after launching and means for actuating said second rocket means following a period of free flight of the missile.

4. A missile as defined by claim 3, wherein the second rocket section is provided with canted nozzles to maintain stability of said missile when the second rocket section is actuated.

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