May 17, 1966 W. E. HERRMANN 3,251,301

MISSILE AND LAUNCHER SYSTEM

Filed Sept. 12, 1962 6 Sheets-Sheet 1

FIG. 1

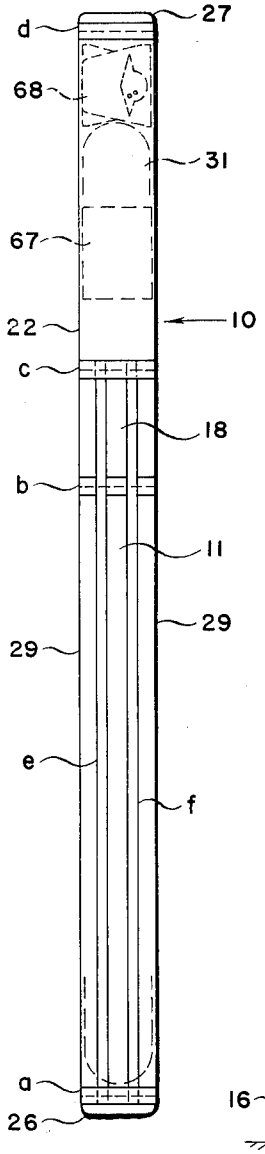
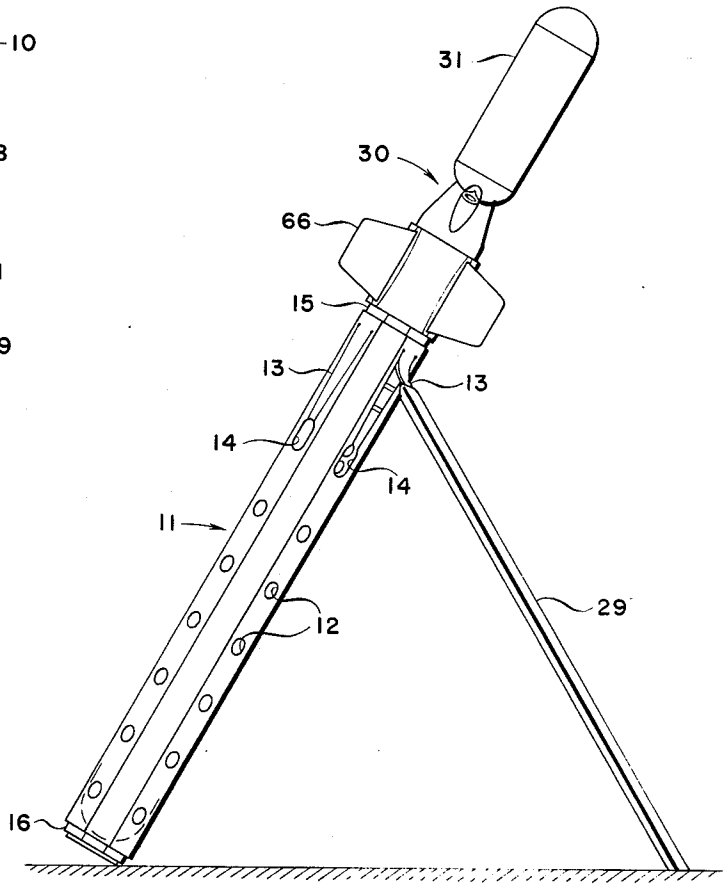


FIG. 3



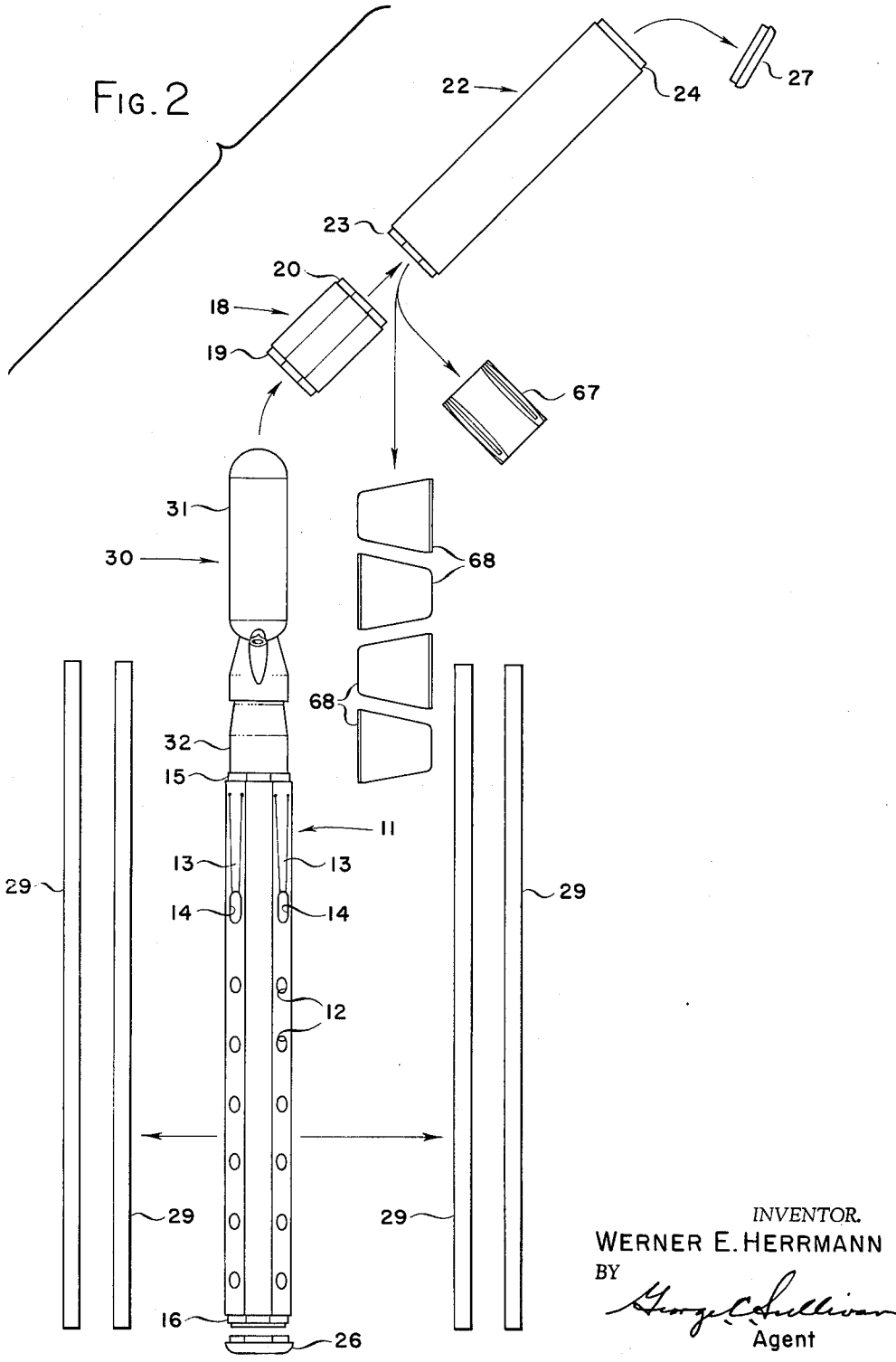
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MISSILE AND LAUNCHER SYSTEM

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FIG. 2



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MISSILE AND LAUNCHER SYSTEM

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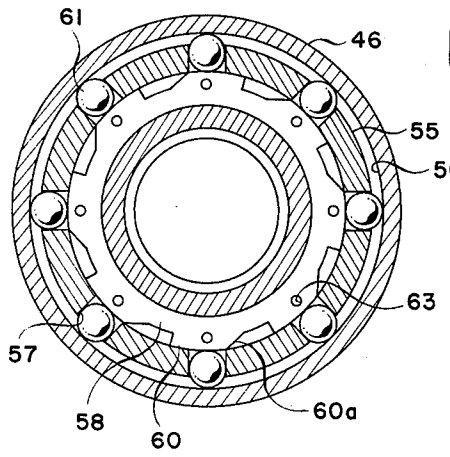


FIG. 6

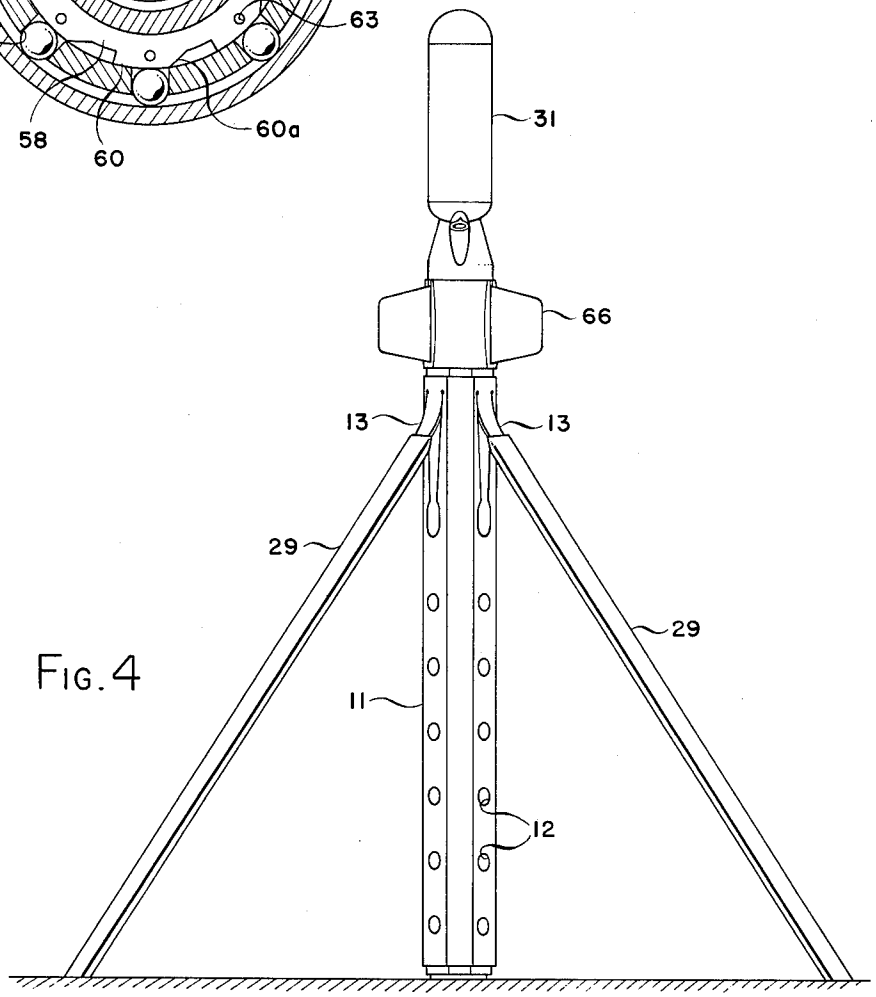


FIG. 4

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MISSILE AND LAUNCHER SYSTEM

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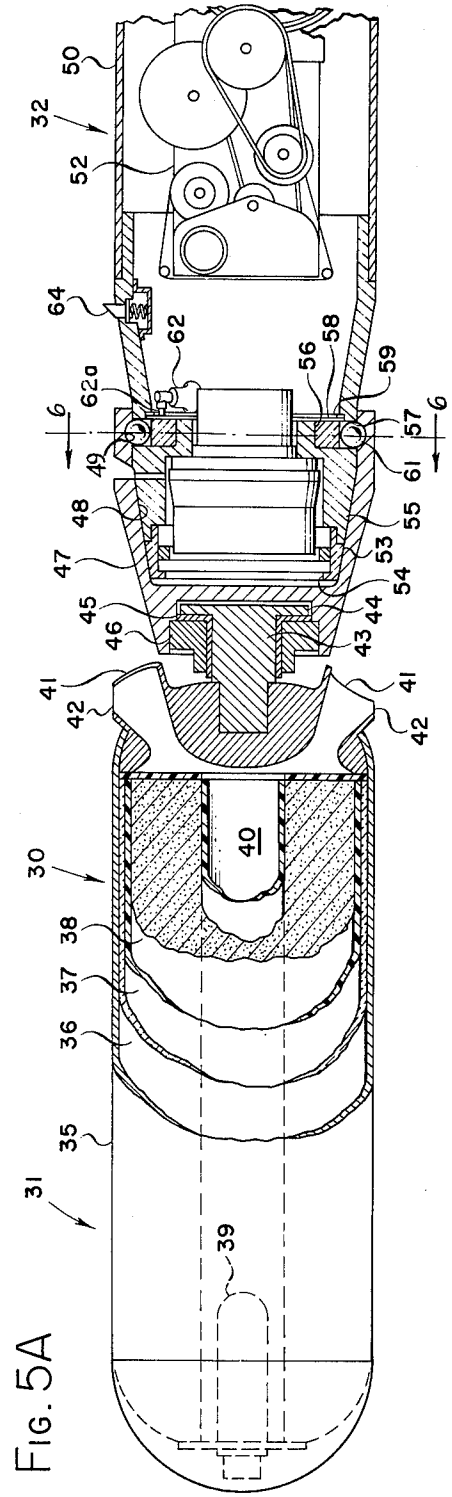


FIG. 5A

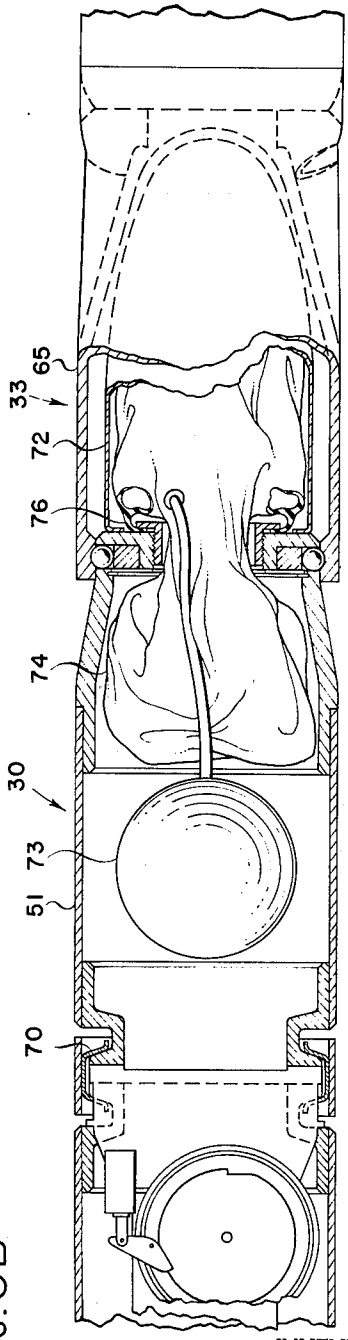


FIG. 5B

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MISSILE AND LAUNCHER SYSTEM

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FIG. 7

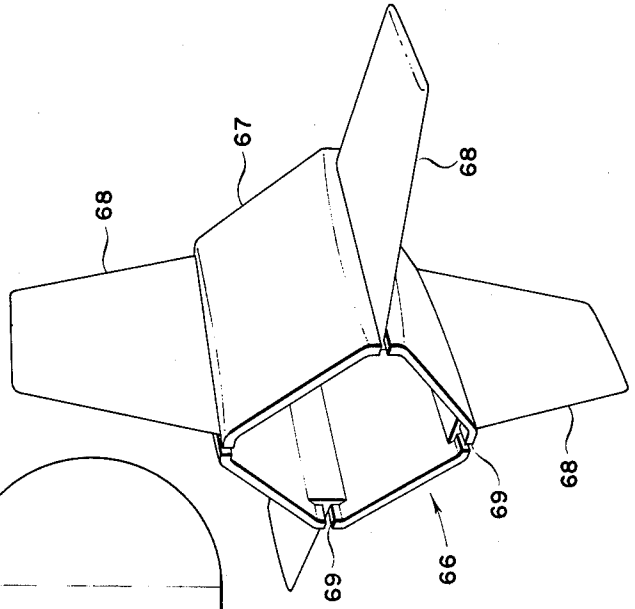
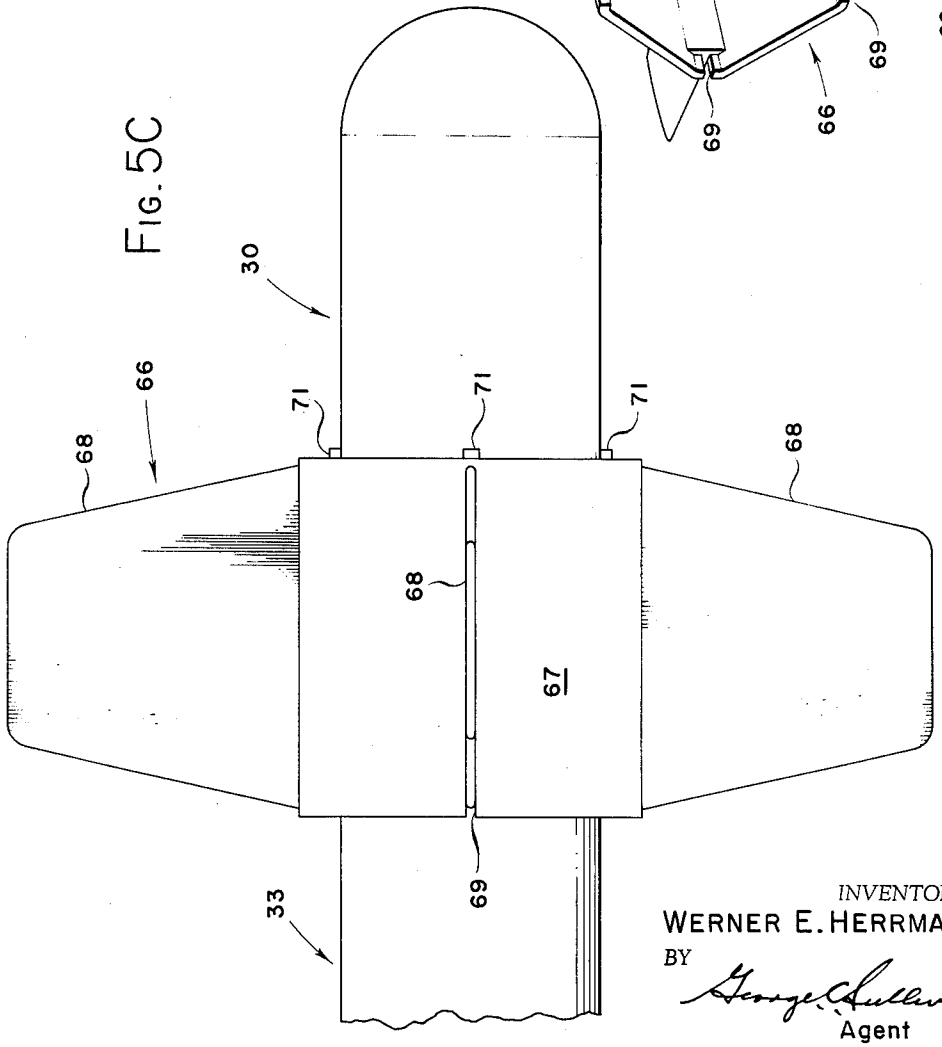


FIG. 5C



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MISSILE AND LAUNCHER SYSTEM

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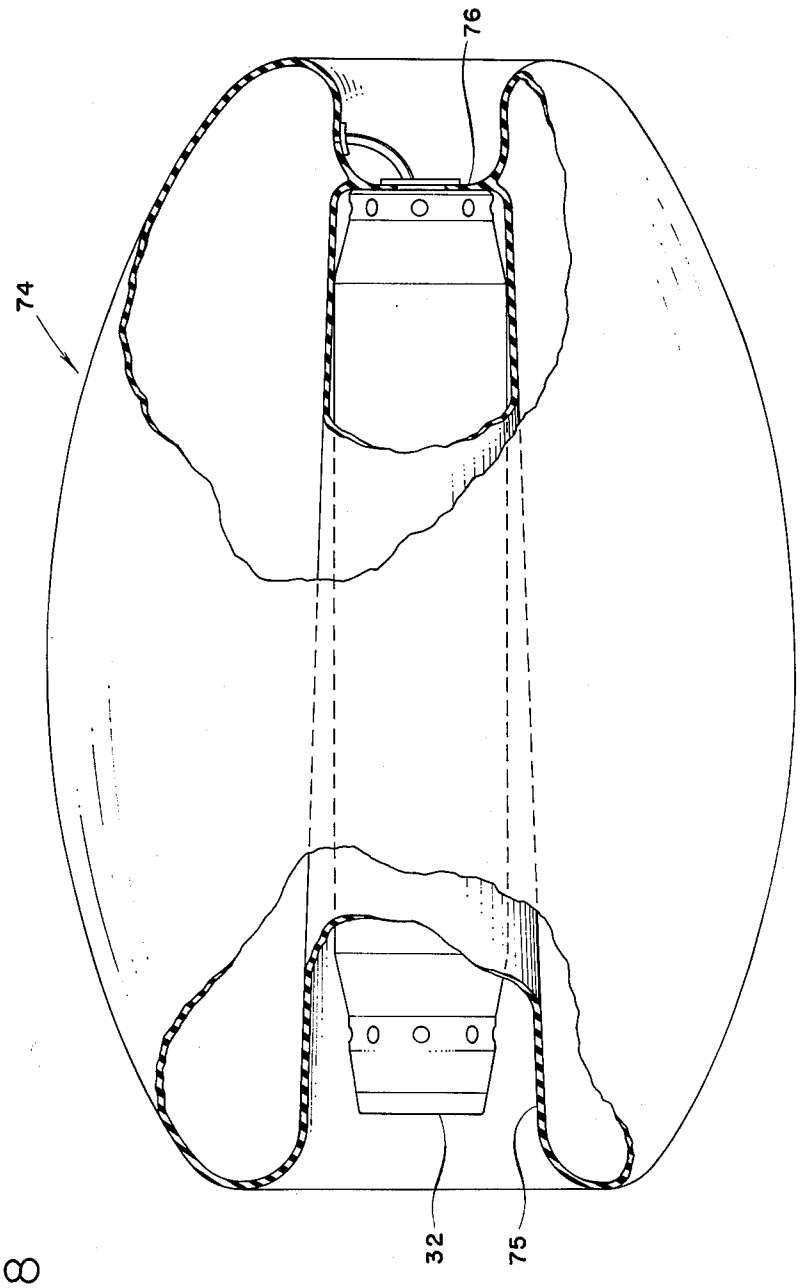


FIG. 8

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United States Patent Office 3,251,301
Patented May 17, 1966

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MISSILE AND LAUNCHER SYSTEM

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Filed Sept. 12, 1962, Ser. No. 223,100
7 Claims. (Cl. 102—49)

This invention is directed to a missile and launch system and more particularly to an improved multi-purpose missile and compace launching system therefor.

The invention described herein provides various improvements over a basic invention which is a subject of patent application Ser. No. 51,621, filed August 24, 1960, now Patent No. 3,124,072 and entitled "Missile Propulsion."

Combat troops in battlefield operations have been universally presented with the problem of accurately and quickly obtaining intelligence information concerning enemy activities in support of their own tactical operations. The acquisition of such information in a readily useable form with minimum expense and personnel training have been particular problems. Additionally, the ability to achieve such information without substantial risk to personnel has been a virtually insoluble problem.

The existence of equipment of the character described in the referenced patent application provided a major step forward, particularly in the art of battlefield intelligence gathering. However, various aspects of such devices provided major problems for ultimate utility. For example, the providing of troops utilizing such equipment with facilities for stowing that equipment and with adequate launching capabilities, together with the development of certain structural means within missile itself have been points of concern. The maintenance of flight stability and the ability to recover the payload without destructive effect thereto have also presented difficulties. It is an object of the present invention to provide a system which is capable of providing small combat units with a self-sufficient, rapid and economical means for obtaining reliable battlefield information from enemy occupied areas.

Another object is to provide a missile and launch system capable of facilitating the acquisition of immediate day and night photographic intelligence to detect current enemy activities, supplement map data and substantiate the findings of other intelligence systems.

Yet another object is to provide a system capable of locating potential targets, supporting fire adjustment and assessing damage in target areas in a rapid and relatively inexpensive manner.

A further object is to provide a missile and launch system having operational simplicity, relatively light weight and including all necessary components to complete the assigned mission.

A still further object is to provide an intelligence gathering missile and launch system including means for recovery which substantially prevents damage to payload upon impact.

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

FIGURE 1 is an elevational view of a missile and its launching equipment stowed for transport;

FIGURE 2 is an exploded view of the launching equipment, the missile remaining in its launcher;

FIGURE 3 is a view of the missile and launching equipment assembled for launching the missile at an angle;

FIGURE 4 illustrates the launcher assembled with the missile for vertical launch;

FIGURES *5a*, *5b* and *5c* show longitudinal cutaway views of various portions of the rocket assembly in a preferred embodiment;

FIGURE 6 is a section taken along line 6—6 of FIGURE *5a* to illustrate the missile separating mechanism;

FIGURE 7 is a perspective view of the missile fins in assembled condition; and

FIGURE 8 is a cutaway of the recovery balloon in deployed condition.

The missile and launcher of this invention generally comprise a self-contained launching means and a rocket stowed within such means for transportation purposes, the missile being adapted to be launched therefrom. The rocket including propulsion and recoverable sections adapted for separation at predetermined operational instant, and recovery means adapted to surround the recoverable portion preliminary to its recovery impact.

More specifically, FIGURE 1 illustrates the preferred embodiment of the carrying and launching apparatus of the invention, the missile and the fin assembly being enclosed in their stowed positions within the launcher. The launching means is illustrated more specifically in the exploded view of FIGURE 2.

The complete assembly in its transportable condition is indicated in FIGURE 1 by the numeral **10**. The assembly **10** includes a launching tube **11** (shown more clearly in FIGURE 2) which comprises the main portion of the transporting means. The launching tube **11** is preferably of a generally hexagonal configuration, although other structural configurations, e.g., round, may be readily utilized. It preferably includes a plurality of perforations **12** longitudinally spaced along alternate flattened portions of the tube. A plurality of tabs **13** are provided adjacent one end of the launching tube **11** and adapted to be flexed outward for the attachment of support legs. Access perforations **14** may be provided for the gripping and flexing outward of the free end of the tabs **13**. The smallest internal diameter of the launching tube **11** is dependent upon the external diameter of the rocket stowable therein and launchable therefrom. It is a requirement that the tube be of sufficient diameter to facilitate free longitudinal movement of the rocket therethrough, but that it be sufficiently small to prevent excessive lateral movement of the rocket during transport phases. The launching tube **11** may be recessed at its upper and lower extremities **15** and **16** to facilitate the adaptation of connecting or cover means. The tube is preferably fabricated from a light weight, but sturdy material such as aluminum or plastic.

A mid case **18** is usually provided and adapted for juxtapositioning with respect to recessed portion **15** of tube **11**. The mid case **18** has an external configuration similar to that of the launching tube **11** and normally includes recessed portions **19** and **20** at its extremities. An upper case **22** adapted to be juxtapositioned against recessed portion **20** of the mid case **18** is preferably of a square cross sectional configuration and includes an internal area sufficiently large to accept a fin and collar assembly in knocked down condition, to be described later. The upper case **22** usually includes recessed portions **23** and **24** at its lower and upper extremities, respectively. Case caps **26** and **27** are provided to cover the respective lower and upper ends of the case or carrying assembly throughout transport and storage phases.

When each of the case sections and the caps are juxtaposed longitudinally with respect to one another in the manner illustrated in FIGURE 1, attachment means indicated as *a*, *b*, *c* and *d*, of a conventional nature such as tape, metal bands, etc. are disposed about the juxtaposed recessed portions to prevent separation of the sections during transportation. It is, of course, possible to facilitate such connections without the described recesses. Additionally, conventional lock means upon the various case portions may be provided to prevent separation

under conditions of stress where such are deemed necessary.

A plurality of legs or stanchons **29** are provided for the support of the launching tube during launching phases of operation. The legs **29** are preferably of substantially triangular cross sections configuration and are usually of a length approximating that of the launching tube **11** plus the mid case **18**. The legs **29**, when stowed for transportation purposes (FIGURE 1) are normally positioned externally of the launching tube **11** and the mid case **18** so as to cover the perforations **12** and the tabs **13** and prevent the entrance into the launching tube of foreign matter. The legs **29**, when so stowed, are normally over-wrapped with tape, as at *e* and *f*, or otherwise retained by conventional means. Longitudinal tapes covering open regions between the legs **29** and the launch tube **11** may also be provided. Pull-cords are normally provided with all tapes to facilitate easy disassembly from the FIGURE 1 condition and rapid and convenient launching set-up.

Prior to the assembly of the described launching and transport apparatus, a missile (described below) is inserted therein and a fin and collar assembly in disassembled condition is inserted into the upper case **22**.

In preparation for launching procedures, the assembly being initially in the stowed condition of FIGURE 1, disassembly is first accomplished by removal of the connecting means, e.g., by pulling pull cords in the tapes, thereby allowing the upper case **22**, the mid case **18**, the case caps **24** and **26** and the legs **29** to be removed. In the event that a launch at an angled trajectory is to be accomplished a pair of adjacent tabs **13** are bent outward and legs **29** are inserted thereover in the manner illustrated in FIGURE 3. The trajectory angle may be varied by adjusting the angular spread between the launching case **11** and the legs **29**.

A vertical launch may also be accomplished by affixing all 4 of the legs **29** over the respective tabs **13** in essentially the manner illustrated in FIGURE 4.

This launching apparatus may be reused an indeterminate number of times.

The missile portion of this invention was described in a basic configuration in the above referenced co-pending patent application. The rocket of the present invention as illustrated in detail in FIGURES *5a*, *5b* and *5c* is generally indicated by numeral **30** and includes a first rocket **31**, a payload portion **32** and a second rocket **33**. The first rocket **31** is preferably rotatable and removably connected to the payload portion **32**. The payload portion **32** is usually similarly rotatable and removably connected to the second rocket **33** at its opposite extremity.

The major portion of first rocket **31** is constructed in a basically conventional manner. An elongated case **35** includes an insulation **36** and the combustion inhibitor **37** concentrically disposed therein and a conventional solid propellent grain **38** disposed intermediately of the combustion inhibitor. An igniter **39** of conventional configuration is disposed internally of a longitudinal channel **40** intermediate of grain **38**. A plurality of nozzles **41** (2 being shown in the present configuration) are provided at the after end of the rocket **31** and are directed outward and rearward. The nozzles **41** are preferably canted at a predetermined angle to impart spin to rocket **31** during its operation. Additionally the nozzles **41** are sometimes scrafed at the locations indicated as **42** to prevent interference between their outer extremities on the launching structure. Rigidly attached to the after extremity of the rocket **31** upon the longitudinal axis thereof is a bearing extension **43** having a peripheral flange **44** affixed thereto. Surrounding the outer surface of the extension **43** and disposed over the forward surface of the peripheral flange **44** is a bearing material **45** such as the materials commonly and commercially known as nylon, Teflon, or other similar materials having structural and lubricating qualities. Surrounding the bearing extension **43** and the bearing material **45** in bearing relation is an outer bearing journal **46**. Rigidly attached to and extending rearwardly from the bearing journal **45** is a housing **47** including an inner cavity **48**. An annular channel **49** is defined in the inner cavity **48** of the housing **47** adjacent the after extremity of the housing **47**, the channel **49** being adapted to accept locking means for locking the rocket **31** and the payload portion **32** in longitudinally disposed relation.

The payload portion **32** generally includes a forward section **50**, which usually carries the payload, and a rearward section **51**, which normally includes the recovery means. Although the payload is not a portion of this invention, a camera mechanism **52** is shown to illustrate the adaptability of the present invention to photographic reconnaissance purposes. The forward section **50**, when adapted to photographic purposes as herein illustrated, includes a protective shield **53** over the lens of the camera **52**, the shield **53** having a perforation **54** through its extremity to facilitate accomplishment of photographic procedures therethrough. The shield **53** is attached to a housing **55** and is therewith adapted for insertion within inner cavity **48** of housing **47**.

The housing **55** includes therein an annular groove **56** and a series of radially extending perforations **57**, best shown in FIGURE 6. A slotted lock ring **58** is retained in the annular groove **56** by means, for example, of an expansion type lock ring **59** and such that a series of lands **60** upon the outer periphery of the slotted ring **58** slidably engage the periphery of the annular groove **56**. The land peripheries bear against a series of balls **61** disposed within radial perforations **57**, thereby causing the balls **61** to become engaged within the annular groove **49** of the housing **46** and preventing relative axial movement between the rocket **31** and the payload portion **32**. Each of the lands **60** is provided with a ramp **60***a* on one side thereof to facilitate the movement of the balls **61** radially outward as the ring **58** is rotated by appropriate tool means, thereby accomplishing the locking. A squib means or other conventional actuator means **62** and detent means **62***a* engageable with holes **63** (FIGURE 6) in lock ring **58** are provided for rotating said ring responsive to a predetermined signal. This rotation will be sufficient to allow the balls **61** to fall into the regions between the lands **60**, thus disengaging the balls **61** from the annular groove **49** and allowing separation of the rocket **31** from the payload portion **32**. During the firing sequence of the rocket **31** relative rotation between rocket **31** and payload portion **32** may be facilitated at both the bearing **44** location and between the housings **46** and **55**, the balls **61** acting as a bearing in the latter event.

Detent means **64** is also sometimes provided on one end of the forward section **50** to prevent removal therefrom of the fin assembly hereinafter described. The detent means may be of the illustrated spring loaded character or of other conventional construction, e.g., including retraction means responsive to a predetermined signal or condition.

The second rocket **33** and the rearward section **51** of the payload portion **32** may be constructed in a manner similar to or identical with that explained with respect to rocket **31** and forward section **50** of the payload portion **52**. Alternatively, it is sometimes not necessary that the journal bearing relationship be included. As illustrated, the rocket **33** includes a tail skirt **65** which is completely hollow in order to accept payload recovery means or other matter desired to be stored in that location. The rocket **33** is separable from the payload portion **32** in the same manner as described above with respect to the rocket **31** and the payload portion **32**.

A fin assembly **66** includes a collar **67** and a plurality of fins **68**. This assembly is shown in its disassembled condition in FIGURE 2, in its stowed position in FIGURE 1 by broken lines and, for purposes of clarity, it is illustrated in perspective in FIGURE 7. The fin as-

sembly is provided for flight stability purposes, particularly during the initial phase of launching and prior to firing of the retro-phase hereinafter described. The fin collar **67** is provided with the series of slots **69** through which the fins **68** are inserted after their removal from the upper case **22** and prior to launching.

As shown in FIGURE *5b*, the forward and rearward sections **50** and **51** of the payload portion **32** are preferably intermediately connected thereof by a conventional U clamp **70** or similar means to facilitate accessibility to the interior of the payload portion.

Referring now to FIGURES *5b* and 8, the rearward section **51** usually has payload section recovery means stored therein. Although parachutes and similar equipment may be readily utilized in this respect, the preferred recovery means is illustrated as being stowed in a removable nose section or shield **72**. This recovery means, which may be referred to as a recovery balloon and which is illustrated in its deployed condition in FIGURE 8, is actuated by a conventional pressure means **73** responsive to a predetermined signal controlled by any conventional time delay, sequencing, or similar apparatus. The recovery balloon **74** is preferably fabricated from a flexible and substantially non-stretchable material which is highly resistant to chafing, tearing, puncturing, etc. Materials such as plastic or rubber impregnated fabric may be utilized in this respect. Actuation of the pressure means **73** during inflation phases of operation causes separation of the shield **72** from the balance of the rearward section **51** as the recovery balloon **74** is expanded. The shield **72** is usually made from a paper product or similar material which will burst or move forward away from the rearward section **51** responsive to balloon expansion, any bond or other retaining means between the shield and the rearward section being parted by the force so applied. Continued expansion results in an ultimate configuration substantially as illustrated in FIGURE 8. It will be noted that therein the external periphery of the recovery balloon **74** is substantially ovoidal, a tapered channel region **75** axially intermediate of the balloon **74** being disposed about and extending beyond both ends of the payload portion **32**. The tapered characteristic of the channel **75** facilitates pressurized deployment of the recovery balloon **74** without substantial structural interference. A lip portion **76** interiorally of the channel **75** may be provided for clamping the recovery balloon **74** to the after end of the rearward payload section **51**. Although the recovery balloon **74** is illustrated as being generally ovoidal it is sometimes preferred that a spherical cross-sectional configuration be utilized. It is also desirable upon occasion that the balloon not be fully inflated in order that the tendency of the recovered package to bounce upon ground contact will be dampened. The ends **76** and **77** of the recovery balloon **74** should extend beyond the ends of the payload portion **32** a distance sufficient to insure that a landing upon either end of the payload section will not result in a direct impact of the payload section with the landing terrain.

Operationally, a launching of the missile for a penetration mision, i.e., including retro-phase operation, is begun with the launching mechanism in the position essentially as illustrated in FIGURE 3. The rocket **30** is inserted into the launch tube **11** until such time as it bottoms on stop means (not shown) provided for that purpose in launch tube **11**. At this juncture the first rocket **31** is protruding from the launch tube **11** and the major portion of the payload portion **32** and the second rocket **33** are disposed within the launch tube. The fins **68** are inserted within the slots **69** of the collar **67** and the fin assembly is slipped over the first rocket **31** into the position illustrated in FIGURE 3. The ignition of propellent grain **38** is accomplished by igniter **39** such that thrust and a rotational moment are imparted to

rocket **31**. The thrust is transmitted through the extension **43** and the bearing **44** to the payload portion **32** via the detent balls **61**. It is then transmitted into the rocket **33** via similar balls in the after detent and release portion. Hence, forward movement of the rocket **31** results in the ultimate movement of the entire rocket assembly. Since the interior of the fin collar **67** is of diameter greater than the external diameter of the payload portion **32** and the forward portion of the rocket **33**, those portions of the rocket **30** move through the fin assembly **66** until such time as the fin assembly is engaged by the stop means **71** upon the after end of the rocket **33**, the fin assembly **66** being then carried with the balance of the rocket **30** throughout this initial boost phase and trajectory. This launch or boost phase of rocket **30** is stabilized both by the rotation of the rocket **31** and by the action of the fins **66**. At a predetermined instant while the rocket **31** is still thrusting, the actuator means **62** rotates the slotted lock ring **58** such that the balls **61** slip inward into the regions between the lands **60**, thereby allowing the rocket **31** to move from engagement with the payload portion **32**. When the rocket **31** burns out it falls away and the balance of the rocket continues on its trajectory. At a predetermined instant the rocket **33**, which is in actuality a retro-rocket, is fired. The firing of the retro-rocket **33** causes the assembly to decelerate. During this phase of operation the flight characteristics are stabilized by the presence of the fins **68**. Eventually, the thrust of the retro-rocket **33** overcomes the inertia of the assembly, stopping it in mid-air and accelerating it in the reverse direction. This acceleration causes the retro-rocket **33** and the payload portion **32** to move through the fin assembly **66** until such time as the fin assembly drops from the now rearward end of the payload portion **32** in some applications, or until the fins engage the detent means **64**. In the latter event the fins are thereafter carried in this position for stability purposes or dropped in response to a predetermined signal or condition causing retraction of detent means **64**. The drag forces on the fins assist in their ultimate removal. Simultaneously, the canted nozzles of the retro-rocket **33** cause its rotation with respect to the payload portion **32** upon the interconnecting ball detent mechanism, thereby stabilizing the retro flight. Also at a predetermined instant the camera mechanism **52** becomes operational and photographs of the terrain thereunder are taken.

Prior to burn-out of the retro-rocket **33** its separation mechanism is actuated and the retro-rocket moves away from the payload portion **32**, the payload portion **32** continuing on its new trajectory.

At a predetermined instant during the descent of the payload portion **32** the pressure means **73** is actuated and the recovery balloon **74** is deployed. Upon landing of the payload portion **32** with the recovery balloon **74** so deployed this segment of the rocket **30** may be recovered and the intelligence information in the payload portion utilized in any desirable manner.

When the rocket is to be launched vertically, it is sometimes expedient to use a single rocket, rather than one on either end of the payload portion. In such event either of the rockets **31** or **33** may be utilized.

It will be apparent from the description that the payload portion **32** of this rocket assembly will be reuseable when recovered. It will also be apparent that the basic invention described herein may be utilized for a variety of end uses with various types of payloads.

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. A missile comprising:
a payload portion having a first and a second end,
a first rocket being connected to the first end of the payload portion and being used for propelling the missile along a predetermined first trajectory,
a second rocket being connected to the payload portion second end and used for propelling the missile along a predetermined second trajectory,
both the first and second rockets being rotatable with respect to and removable from the payload portion,
means on the first and second rockets for rotating the rockets relative to the payload portion, and
means for stabilizing the rocket in both the first and second trajectory and being reciprocally mounted on the payload portion and movable into proximity of the second rocket when the first rocket is fired and movable into proximity of the first rocket when the second rocket is fired.

2. The missile of claim 1 wherein
(a) said payload portion is provided with recovery means actuable to substantially surrounded said payload portion following separation of said rockets therefrom.

3. A missile comprising:
a payload portion having a first and second end,
a first missile-propelling rocket rotatable and removably connected in pulling relation to the payload portion first end,
a second missile-propelling rocket rotatably and removably connected in pulling relation to the payload portion second end,
means being disposed on the first and second ends of the payload portion for separating the first and second rockets,
the first and second rockets each including an annular groove,
the separation means including a plurality of balls retained in engagement with the rocket grooves by a ring means, the balls being movable radially inward to disengage the payload portion and the rockets and responsive to rotation of the ring means, and a means for rotating the ring means, and
a recovery means being stored in the payload section for deployment after separation of the second rocket.

4. The missile of claim 3 wherein said recovery means is a balloon stored in one end of and within the major diameter of said payload section and for expanding into a shape radially surrounding and longitudinally overextending the ends of said payload section.

5. The missile of claim 4 wherein said balloon is of substantially ovoidal external configuration when employed.

6. The missile of claim 4 wherein said balloon is retained adjacent one end of said payload portion and includes means defining a longitudinal channel when deployed within which said payload portion is disposed, said channel means being flared outward from said attachment to the opposite channel means extremity.

7. A missile comprising
(a) a first pull rocket adapted to initiate missile flight and to spin throughout its operation,
(b) a payload portion having a first end connected to said first rocket,
(c) bearing means between said first rocket and said payload portion to facilitate relative rotation,
(d) separation means mounted in the payload portion responsive to a predetermined first condition for separating said first rocket and said payload portion,
(e) a second rocket connected to a second end of said payload portion and adapted to substantially reverse missile flight direction upon attainment of a predetermined second condition,
(f) fin means positioned upon said second rocket during an initial portion of said missile flight and separable from said missile during said reverse flight,
(g) bearing means between said second rocket and said payload portion to facilitate relative rotation,
(h) a second separation means mounted in the payload portion responsive to a predetermined second condition for separating said second rocket and said payload portion, and
(i) balloon means stowed in one end of and within the major diameter of said payload portion for surrounding said payload portion upon attainment of a predetermined third condition.

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