Nov. 1, 1966 H. W. WIANT 3,282,539

RECOVERY SYSTEM

Filed Dec. 23, 1964 2 Sheets-Sheet 1

FIG. 1

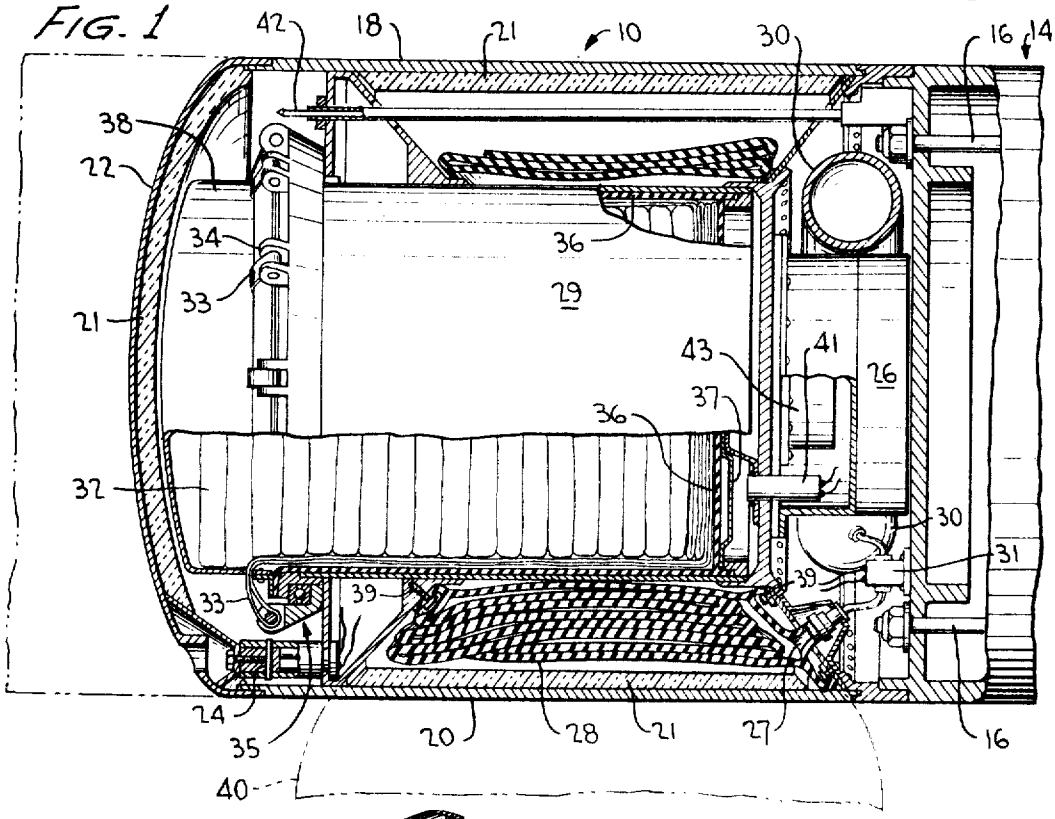
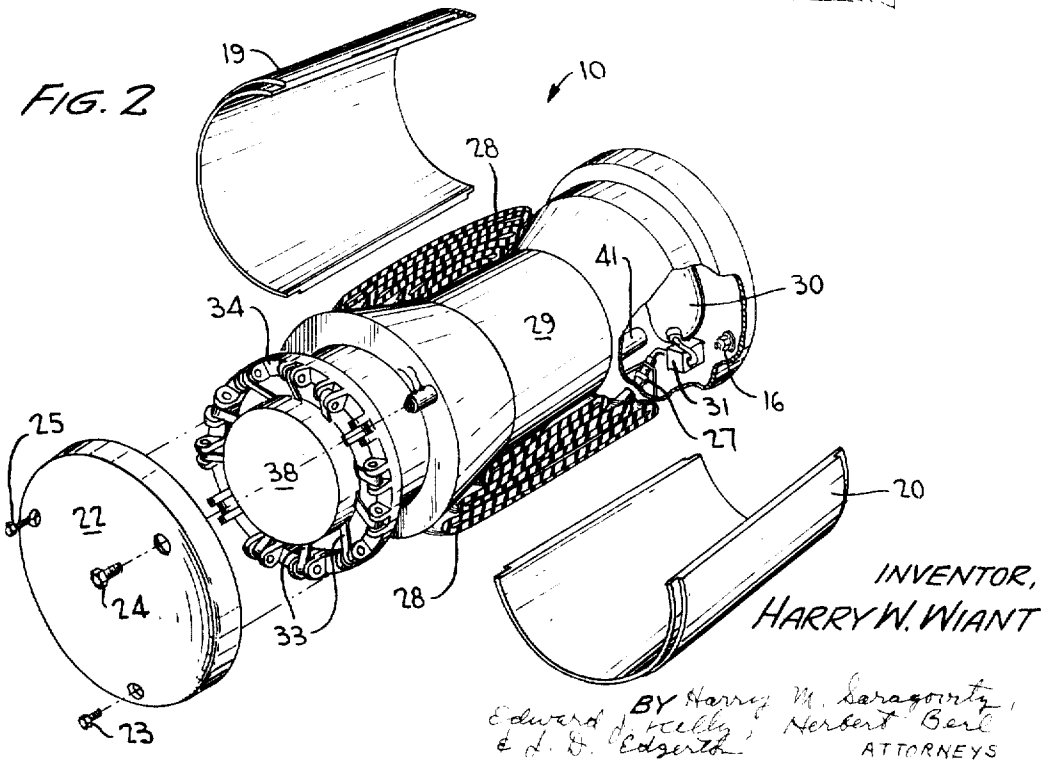


FIG. 2



INVENTOR,
HARRY W. WIANT

BY Harry M. Saragovitz, Edward J. Kelly, Herbert Berl & D. D. Edgerton
ATTORNEYS

Nov. 1, 1966 H. W. WIANT 3,282,539

RECOVERY SYSTEM

Filed Dec. 23, 1964 2 Sheets-Sheet 2

FIG. 4

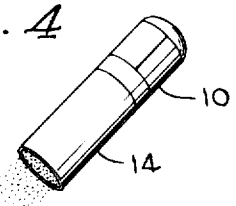


FIG. 5

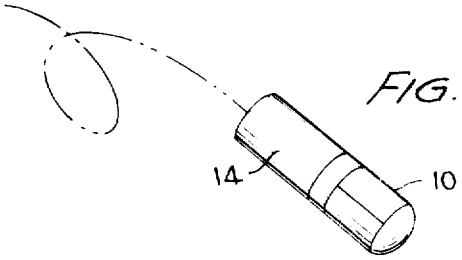


FIG. 6

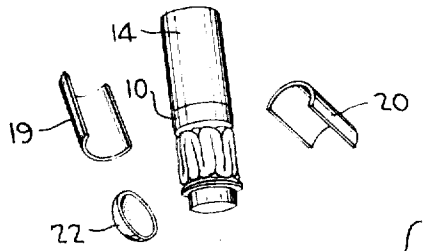


FIG. 3

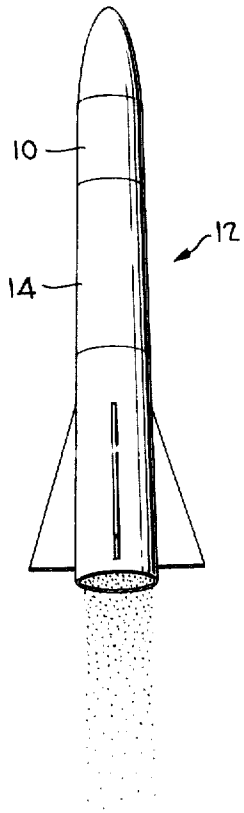


FIG. 8

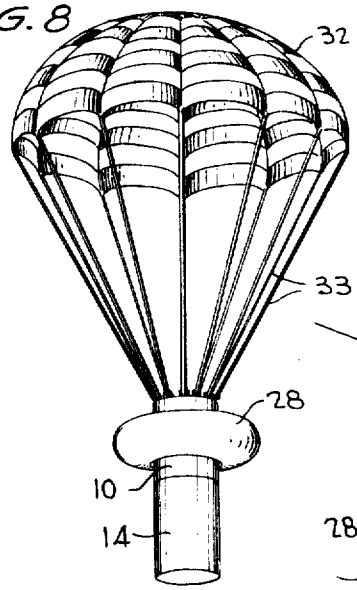


FIG. 7

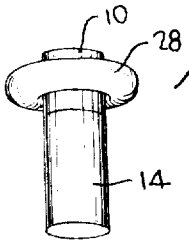
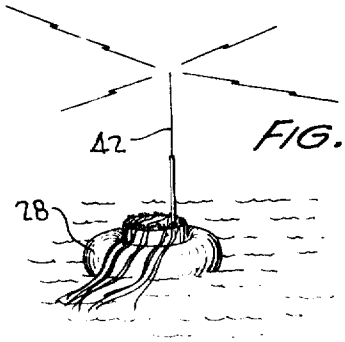


FIG. 9



INVENTOR,
HARRY W. WIANT

BY Harry M. Saragovitz,
Edward J. Kelly, Herbert Berl
& J. D. Edgerton

ATTORNEYS

United States Patent Office 3,282,539 Patented Nov. 1, 1966

3,282,539

RECOVERY SYSTEM

Harry W. Wiant, Itasca, Ill., assignor, by mesne assignments, to the United States of America as represented by the Secretary of the Army

Filed Dec. 23, 1964, Ser. No. 420,836
4 Claims. (Cl. 244—138)

The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment to me of any royalty thereon.

This invention relates generally to missile recovery systems and more particularly to a method and apparatus for the recovery of special purpose test capsules deployed from a rocket-powered carrier vehicle at high altitudes.

Test capsules deployed at high altitudes, i.e., in the range of 300,000–400,000 feet, are subjected to various environmental conditions encountered in re-entry flight. In addition, deceleration loads resulting from aerodynamic braking, recovery parachute opening shock forces, and water entry are primary considerations in the design of a recovery system of adequate structural integrity and operational reliability.

The capsules have a generally cylindrical shape, and depending on the specific deployment from the carrier vehicle, and in order to have a particular position and orientation in space, their basic configuration will be blunt nose, spin stabilized and powered or low drag nose cone and powered or low drag nose cone, fin stabilized and unpowered.

Since the capsule configuration will vary it is necessary that the recovery system be a modular unit so that it can be attached to the test capsule without interfering with the instrumentation or other equipment. Also, the system must result in a capsule configuration which will not cause deviation from the intended flight path.

In order to accomplish the intact recovery of the test capsule, it is necessary that the system provide for deceleration of the capsule so that recorded date can be telemetered to surface or shipboard installations, that it reduce the water impact velocity to a safe amount to minimize damage to equipment, that it provide floatation to buoy the capsule until recovery is accomplished, and further that it provide means to aid in location of the capsule after water impact.

To attain a position in space with a given orientation during a test, certain of the deployed capsules will be "spun-up" to impart gyroscopic stability to the capsule. If spin of the capsule is maintained after the test and during re-entry, the gyroscopic forces will try to preserve the original capsule orientation in space. Thus, during re-entry the capsule's longitudinal or spin axis will be inclined to its flight path at large angles of attack. As lower altitudes are encountered with increasing density, possible asymmetric areodynamic forces resulting from combined effects of boundary-layer thickening toward the trailing end of the capsule, Magnus life due to spin, and flow separation at either end of the body may cause the capsule to precess about a transverse axis resulting finally in a tumbling motion along its flight path.

A conventional parachute deceleration system is necessary to accomplish the telemetering of data during capsule descent and to lower the water entry velocity to a reasonable value. An initial deceleration and stabilization system is need which will provide deceleration of the capsule from approximately Mach 2.0 to an acceptable velocity at which to deploy the parachute. The initial decelerator must also provide sufficient capsule stability prior to recovery parachute operation to obviate the possible tubling motion of the capsule during re-entry.

It is therefore an object of this invention to provide a method and apparatus for recovering test capsules deployed at high altitudes.

Another object of the invention is the provision of a recovery system which will decelerate and stabilize a test capsule during re-entry.

A further object of the instant invention is the provision of a recovery system which employs an initial decelerator, a final decelerator, and location equipment contained within a single package for attachment to a test capsule to be recoved.

Still another object of the invention is to provide a recovery system wherein the initial decelerator further serves as a means for floating the capsule after water entry.

According to the present invention, the foregoing and other objects are attained by a recovery technique that utilizes an integrated recovery package attached to the capsule to be recovered. The recovery package comprises an inflatable balloon, which encircles the periphery of the package, and serves as the first stage decelerator and the floatation device, and a ribbon type parachute which serves as the final decelerator. The balloon is stored around a can containing the parachute and is inside a set of doors which comprise the outer skin of the package. The doors are held in position by a parachute can cover which is held in place by motar bolts. An antenna and radio transmitter combined with beacon light, dye markers, and shark repellant comprises the location equipment.

The specific nature of the invention, as well as other objects, uses and advantages thereof, will clearly appear from the following description and from the accompanying drawing, in which:

FIG. 1 is a detailed side view of the recovery package mounted in a rocket.

FIG. 2 is a partially cut-away exploded perspective view of the invention.

FIGS. 3 to 9 are a sequence of views showing the recovery technique according to the invention.

Referring now to the drawings wherein like reference numerals designate identical or corresponding parts throughout the several views, and more particularly to FIGS. 1 to 3 wherein there is shown a recovery package generally indicated at **10** installed in a rocket **12**. The recovery package is attached at one end to capsule or rod **14** containing test equipment by a suitable bolted interface connection **16**. The outer skin **18** of the package consists of a plurality of jettisonable part cylindrical doors, the preferred embodiment having at least two such doors as **19** and **20**, more clearly shown separated from the package in FIG. 2. A thin protective coating **21** of an insulating material is applied to the inside of the doors and the primary cover to insulate the recovery package against high heat inputs that may be encountered after deployment from the carrier vehicle and during re-entry. The doors form the outer wall of the balloon storage compartment and are held in position by a primary parachute can cover **22**. The cover **22** is held in place by a separable connection such as mortar bolts **23**, **24**, and **25**, which are actuated by an aneroid switch (not shown) preset for an altitude of 40,000 feet and located in an electrical control system box **26** at the rear of the package. The control box, which forms no part of the invention, also contains other barometric switches, batteries, pyrotechnic time-delays and like components common in parachute and recovery systems.

An inflatable, bladderless, toroidal balloon **28**, which encircles the periphery of the package, provides the most efficient first stage decelerator and flotation device from the standpoint of bulk, weight, reliability, and simplicity of operation. In addition to providing drag for deceleration when inflated at high altitudes and adequate buoyancy

for floatation after water enry, the toroid also supplies important aerodynamic stability prior to parachute deployment. The stability feature is particularly important if the capsule is at large angles of attack or is tumbling during descent.

The balloon **28** is stored around parachute can **29**, secured at its inner periphery to the package framework at **39**, and inside the package skin **18**. The balloon is inflated from an air cylinder **30**, by means of a valve assembly **31**, preferably an electrically ignited, explosive type valve, and through a filler **27**. The balloon is constructed of either a nylon or Dacron base fabric coated with a polymer such as neoprene or Hypalon. Other materials could be used, however these materials have been found to provide a single ply balloon that has a low rate of air leakage, is resistant to creasing, retains its physical properties at elevated temperatures and is adaptable to uncomplicated construction techniques.

A FIST ribbon type parachute **32** is the final stage decelerator. The parachute is contained in a protective casing **36** within can **29** and has its risers or shroud lines **33** secured to a parachute attach ring **34**. The ring is shown in FIG. 1, to be rotatably connected to the recovery package by means of a swivel bearing connection **35**. The swivel mounting is necessary to prevent fouling of the shroud lines in the event the capsule is spinning during parachute deployment.

A separate cover **38** protects the parachute prior to its deployment after removal of the primary cover **22**. Cover **38** is attached to the can **29** by small screws (not shown) which are sheared by the force of the parachute ejection at deployment.

After the toroidal balloon **28** has been inflated and has assumed the desired drag shape, partially shown by dotted line **40** in FIG. 1, a pyrotechnic time-delay or other timing device of approximately 10 seconds' duration, or a backup system using a preset aneroid switch at 22,000 feet located in control system box **26**, will signal mortar **41** to eject the parachute. As shown in FIG. 1, mortar **41** acts on baffle plate **37** and the base of casing **36** to eject the casing and parachute **32** from can **29**.

The FIST ribbon parachute will decelerate the test capsule to a safe water impact velocity of approximately 50 feet per second and will provide an adequate descent time above 20,000 feet for data transmission.

To aid in pinpointing the location of the floating capsule, antenna **42**, in conjunction with a suitable radio beacon **43**, in FIGS. 1 and 9, will be erected by a mortar (not shown) or pneumatically, by utilizing the compressed air in tank **30** shortly after water entry. The antenna will push aside the ribbons of the parachute if it should blanket the antenna and thereby erect through the parachute.

In addition to the radio beacon, an effective dye marker is used to assist search parties in locating the floating capsule. Since the toroid is designed to support the capsule in the water for approximately 48 hours, a shark repellant is employed at this time to prevent sharks from attacking and puncturing the floatation balloon.

A better understanding of the recovery system according to the invention may be had with reference to FIGS. 3 to 9. The recovery operation begins by arming a first aneroid switch upon separation of the capsule from the carrier vehicle **12**. The capsule free falls as in FIG. 5 until it reaches an altitude of 40,000 feet and is descending at a speed of Mach 2.0, at which time the aneroid switch actuates the mortar bolts to accomplish cover separation shown in FIG. 6. The toroidal balloon **28** is then inflated as in FIG. 7, and after the capsule has been stabilized and decelerated to a deployment speed of approximately 450 feet per second at 25,000 feet, the parachute **32** is ejected. The capsule, with the parachute distended shown in FIG. 8, is further decelerated to a safe water impact velocity of about 50 feet per second and during this phase of the descent a sufficient data transmission period is provided. Upon water entry shown in FIG. 9, radio antenna **42** is erected, and the dye marker and shark repellant are dispensed.

It will be apparent that the embodiments shown are only exemplary and that various modifications can be made in construction and arrangement within the scope of the invention as defined in the appended claims.

I claim as my invention:

1. A recovery package for retrieving a special purpose test capsule deployed from a rocket-powered carrier vehicle at high altitude over water comprising:

(a) a plurality of releasable doors forming the skin of said package,

(b) means attached to said package interiorly of said doors for containing a second stage decelerator,

(c) said containing means and said doors forming a compartment therebetween,

(d) a first stage decelerator stored in said compartment and secured to said containing means,

(e) a separable cover member enclosing said second stage decelerator and retaining said doors in position, and

(f) said first stage decelerator providing means for stabilizing said capsule during descent and providing means for floating said capsule in the water.

2. The recovery package according to claim **1** wherein:

(a) said first stage decelerator is an inflatable bladderless, toroidal balloon, and

(b) said second stage decelerator is a FIST ribbon type parachute.

3. The recovery package according to claim **2** wherein said parachute is secured to said containing means by a swivel connection to thereby prevent fouling of said parachute during deployment thereof in the event the capsule is spinning.

4. In a system for recovering a rocket test capsule deployed at high altitude over water, a recovery package attached to said capsule comprising:

(a) first means, comprising an inflatable toroidal balloon encircling said package for initially decelerating and stabilizing said capsule during re-entry,

(b) second means, comprising a ribbon-type parachute, secured to said package interiorly of said first means, for finally decelerating said capsule prior to water entry,

(c) third means contained in said package adapted to activate upon water entry for locating said capsule,

(d) said first means also providing means for floating said capsule after water entry,

(e) a plurality of releasable door members comprising the skin of said package and enclosing said balloon prior to inflation thereof, and

(f) a cover member separably connected to said package, said cover member enclosing said parachute prior to deployment thereof and holding said door members in position, said cover member being adapted to separate from said package automatically at a predetermined time, whereby upon separation of said cover member said door members are released thereby allowing for inflation of said balloon.

References Cited by the Examiner

UNITED STATES PATENTS

2,887,055	5/1959	Bagdanovich et al.	102—50
3,053,476	9/1962	Mohar	244—1
3,181,809	5/1965	Lobelle	244—1
3,221,656	12/1965	Sutten	102—34.1

References Cited by the Applicant

UNITED STATES PATENTS

2,452,783	11/1948	Nebesar.
3,061,249	10/1962	Chipperfield.

FERGUS S. MIDDLETON, *Primary Examiner.*

ALFRED E. CORRIGAN, *Examiner.*