

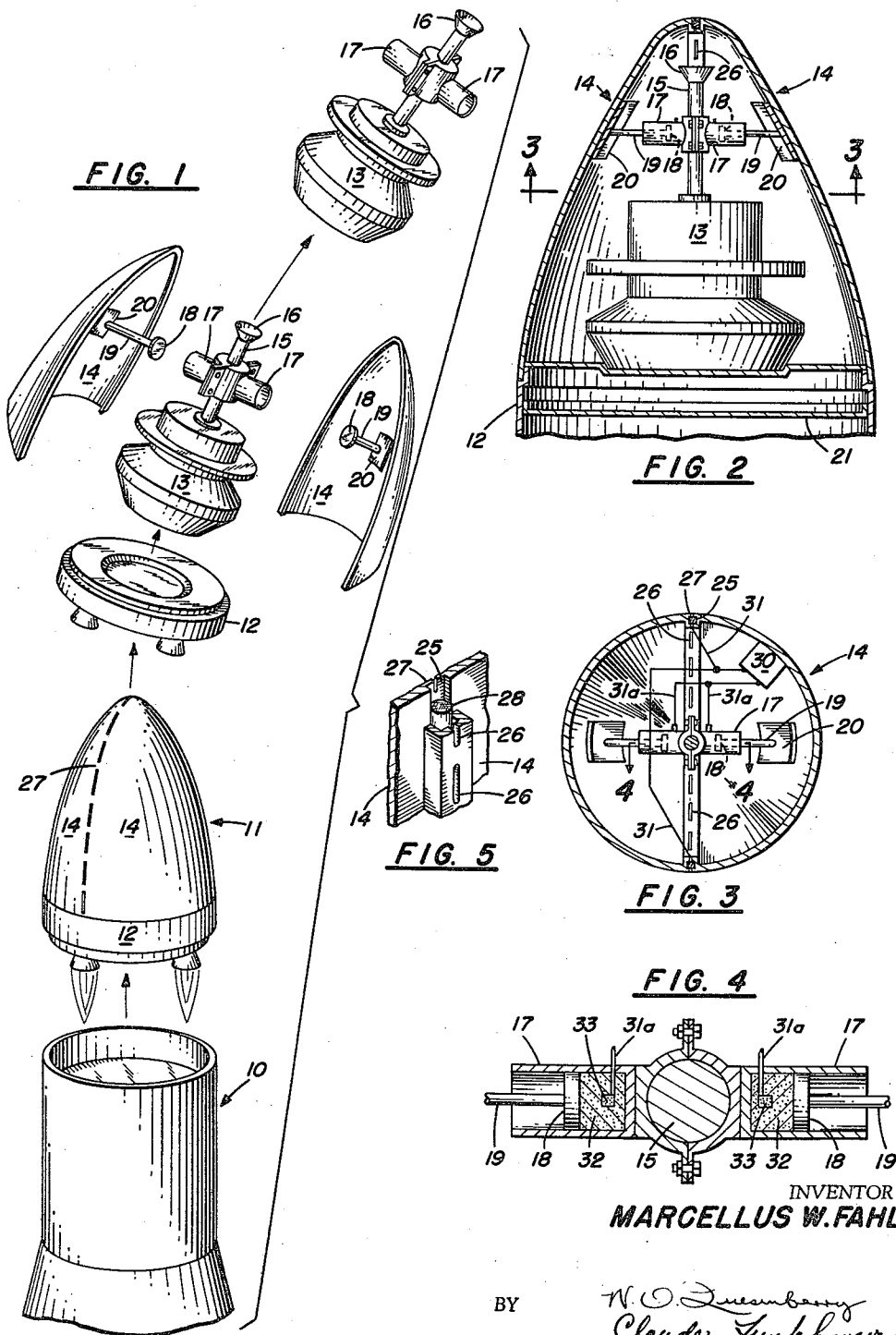
Dec. 25, 1962

M. W. FAHL

3,070,018

NOSE CONE EJECTION SYSTEM

Filed Feb. 27, 1961



1

3,070,018

NOSE CONE EJECTION SYSTEM

Marcellus W. Fahl, Oakland, Calif., assignor, by mesne assignments, to the United States of America as represented by the Secretary of the Navy
Filed Feb. 27, 1961, Ser. No. 92,110
2 Claims. (Cl. 102—92.5)

This invention relates to a protective cover for a projectable body and more particularly to a removable nose cone suitable for use on a missile or space vehicle.

Present day developments in the field of missiles and rocketry often require that a device be projected into a ballistic trajectory at extremely high speeds or, in some instances, it is required that highly delicate instruments be placed into a satellite type of orbit. Many times it is required that such equipment, during the latter portions of its flight path, be exposed to the outer atmosphere so that measurements may be taken, an antenna be able to function, a portion of the vehicle be ejected or other similar operation be performed. In many of these instances it is required that the equipment be protected from adverse conditions as it is projected through the atmosphere of the earth. For example, a sounding rocket may contain in its forward portion any of a number of forms of highly sensitive upper atmosphere measuring devices which will function properly only if suitable protective means are provided to surround the aforesaid equipment during the early portions of its flight through the relatively dense and contaminated lower layers of the earth's atmosphere. At a suitable time during the flight of such a vehicle it is required that such protective covering be removed so as to enable the equipment to function properly.

While it is relatively simple to design a protective covering suitable for a missile or rocket during its exit from the atmosphere, it should be realized that a major problem is encountered in removing such a device from the missile while it is in flight. The principle method of effectuating such a removal, as known to the prior art, consists of an explosive mounting, usually including explosive bolts, which upon detonation will blow the nose cone from the main missile body so as to expose those elements protected thereby. As rockets and missiles are developed to exhibit more sophisticated characteristics and follow a more precise flight pattern this particular method as described above has become unacceptable. It has been found that the explosion which results in separation of the protective cover from the device being protected, due to the elementary Newtonian laws of motion, creates a reaction which adversely affects the range and trajectory of the missile so acted on. It will be appreciated that any means of separating the protective device or nose cone, which exerts a force thereon parallel to the direction of missile body flight will create a reaction force which, in the case of a nose cone ejected in a forward direction, would normally tend to retard missile flight.

The present invention provides a novel and improved protective cover, which in this embodiment is illustrated as a nose cone but which is not necessarily so limited. Upon predetermined signals the protective cover will be broken down into a number of segments each of which is then automatically propelled away from the missile body in a direction normal to its flight path. The latter described portion of this sequence of operations is required in many instances inasmuch as a simple segmentation of the nose cone would be ineffective to clear the resulting fragment away. Once a missile is on a ballistic trajectory the mere separation of a protective device into its component segments would not remove it from the equipment which is shielded thereby since the component segments will continue to follow the same ballistic

2

trajectory as the main body until such time as the re-entry procedure is commenced and sufficient air resistance is developed to separate the lighter portions of the main body. In the case of an orbiting satellite the separated segments would continue in the same orbit as the main body and have no tendency to become separated therefrom. Thus it is necessary that means be provided to forcibly effectuate the physical separation between the protective cover and the device being protected.

The present invention, which utilizes a shell preferably extending around the circumference of the missile body, provides a positive means of separating this protective shell into a plurality of components and then, immediately after such separation, applies a force to each component, which forces act symmetrically about the longitudinal axis of the missile body and in a plane normal thereto. It should be realized that due to the symmetry of the forces involved there will be no tendency to move the main body away from its flight path and since the forces are contained within a plane normal to the flight path there is also no tendency to either retard or accelerate the main body.

It is therefore an object of the present invention to provide an improved removable protective cover.

Another object is to provide an improved releasable protective cover for a missile or space satellite.

Still another object is to provide a nose cone that may be released by exerting forces thereon only in a direction normal to the flight path of the nose cone.

Yet another object is to provide a releasable nose cone having increased reliability of operation.

A further object is to provide a protective cover for a space vehicle that may be released without disturbing the flight path of said vehicle.

Other objects and many of the attendant advantages of this invention will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings wherein:

FIG. 1 is a pictorial representation of the operational sequence of the instant invention;

FIG. 2 is a vertical cross-sectional view of a missile nose cone incorporating the present invention;

FIG. 3 is a horizontal cross section as viewed along a line substantially corresponding to line 3—3 of FIG. 2;

FIG. 4 is a vertical cross section as viewed along a line substantially corresponding to line 4—4 of FIG. 3; and

FIG. 5 is a perspective view of one form of joint that may be used to connect adjacent nose cone sections for the purpose of practicing the present invention.

Referring now to the drawings and more particularly to FIG. 1 wherein is illustrated the operational sequence of one embodiment of the present invention, it will be observed that a rocket 10, which may be an intermediate stage of a multistage rocket configuration, is separated from the final stage configuration 11, which may consist of a rocket engine 12 and a nose cone therefor constructed of two semi-paraboloid pods joined in a manner to be more fully explained hereinafter. Contained within the nose cone assembly may be, for example, a satellite type device which it is desired to place into a carefully determined and precalculated orbit. At a certain point, determined by means not illustrated herein, it will be desired to remove the nose cone assembly and separate the rocket motor from the satellite assembly. Inasmuch as it is usually desirable to effectuate nose cone separation shortly after burn out of the final stage engine, it will be understood that separation must be accomplished in such a manner that the trajectory of the satellite assembly 13 will remain undisturbed by any resultant reaction forces.

According to the present invention, the nose cone is constructed of a plurality of symmetrical segments 14 positioned radially around the satellite assembly or other device which it is desired to uncover. For purposes of illustration, the nose cone assembly is shown as two semi-paraboloid segments 14. However, the instant invention comprehends the use of as great a number of segments as may be desirable for particular applications. Each of these segments 14 may be connected to each other and to the base assembly 12, which in the present embodiment is the last stage rocket engine in such a manner, as will be explained in detail later, that they may be physically separated one from another without causing any forces to be exerted on the assembly. As was mentioned earlier, in the case of either a ballistic missile following a free flight trajectory or a satellite in orbit, the mere separation of nose cone segments will not cause them to fall away from the main assembly. The extreme altitude of operation at which separation normally occurs presents an essentially perfect vacuum and, therefore, provides no resistance to a body moving therethrough. Thus, even after separation is accomplished the component parts of the nose cone assembly will continue to follow the ballistic trajectory or the orbit, as the case may be, of the main body. It is therefore required that some means be provided for physically ejecting the cover from the protective device and in accomplishing such ejection in a manner that will have no effect on the vehicle path.

The instant invention accomplishes the desired result by exerting forces on the nose cone segments 14, which forces act symmetrically in a radial plane normal to the flight path of the main vehicle. Thus, the reaction component of these forces, to the extent that they are equal in magnitude, will cancel out and have no effect on the vehicle trajectory.

Mounted physically on the satellite assembly 13 at any convenient location, shown in this illustration as mounting post 15 for antenna 16, are two diametrically positioned cylinders 17. These cylinders are adapted to receive pistons 18 which fit slidably therein and are rigidly attached by means of piston rods 19 to mounting plate 20 contained within each of the nose cone segments 14. When it is desired to cause separation to occur, a force may be generated within each of the cylinders 17 which will cause pistons 18 to move outwardly in a radial direction therefrom. Thus the nose cone segments 14 will be propelled in an outward radial direction. By means to be described hereinafter, equal forces are generated in each of cylinders 17 so that equal forces will be transmitted to both the nose cone segments causing them to move outwardly with identical speeds and identical momentums. Therefore, the reaction forces transmitted to rod 15 will be equal in magnitude and disposed 180° apart in direction, therefore cancelling each other in their effect on satellite 13.

The particular relationship between the two nose cone segments 14, the satellite 13 and the piston assemblies 18 is also illustrated in FIG. 2 which is a detailed cross section of the nose cone assembly prior to separation.

Referring now to FIG. 3 it will be seen that the two halves 14 of the nose cone assembly are joined together such that a U-shaped indentation 25 exists along the surface of the joint. As is shown in more detail in FIG. 5, this U-shaped indentation 25 may be perforated by slots 26 to provide a degree of weakness therein. A thin outer covering is provided along the outer surface of the U-shaped indentation forming wall member 27 which serves the purpose of presenting a smooth aerodynamic exterior nose cone configuration. Within the tubular opening formed by the U-shaped indentation 25 and wall member 27 is inserted a length of conventional prima cord 28 so that, when ignited, the prima cord will cause the destruction of the joint herein described. A similar joint may be constructed circumferentially around the base assembly such that separation of the nose cone seg-

ments from the base as well as from each other may be accomplished at the desired time. The slots 26 provided along the U-shaped joint facilitate the destruction of the joint by the prima cord.

Within the nose cone configuration is provided a control unit 30 which may be any one of a number of well known types and which is subject to operation on command from the missile guidance system, not shown. The control unit 30 is of the type that will generate two signals having a short time delay therebetween. The first of these signals, transmitted through lines 31 to the prima cord, is utilized to effectuate detonation thereof and thereby result in a physical separation of the joints uniting the nose cone segments with each other and with nose cone platform 21. The second signal which is generated after a short time delay is transmitted through line 31a to cylinders 17 and is utilized to initiate operation thereof.

Referring now to FIG. 4 which illustrates in detail the operation of the piston-cylinder arrangement, it will be seen that means are provided to cause the ejection of pistons 18 from cylinders 17 on command of a signal originating in control unit 30. Any of a number of well known methods may be used to effectuate such operation. However, for purposes of illustration, a powder charge 32 is shown contained within the cylinders 17 and which may be caused to burn by the operation of detonators 33 also contained therein. At such time as a control signal is transmitted through lines 31a the detonators will explode igniting the main powder charges which upon burning will create an explosive force to drive pistons 18 from cylinders 17. These forces, by the proper selection of powder charges 32, may be designed to be equal in magnitude. This will result in each of the two pistons being expelled from the two cylinders at equal rates and thereby cause the two segments of the nose cone to be physically expelled from the local proximity of satellite 13. Such forces being of equal magnitude, will result in two reaction forces acting on rod 15, which forces are diametrically opposed with relation to each other and which thereby have no tendency to cause a movement of the rod 15 in a lateral direction. Thus, it will be understood that nose cone separation can be accomplished and in such a manner that no forces are developed which would tend to cause deviation of satellite 13 from its intended flight path.

It should be understood that the operation of pistons 18 can be accomplished by hydraulic means or by the utilization of compressed air which can be stored in suitable cylinders contained within the missile assembly. Also, to be noted is the fact that the positioning of separation means such as cylinders 17 is not critical so long as these cylinders are positioned in a radially symmetrical plane.

Obviously many modifications and variations of the present invention are possible in the light of the above teachings. It is therefore to be understood that within the scope of the appended claims the invention may be practiced otherwise than as specifically described.

What is claimed is:

1. A protective cover removal mechanism comprising in combination a protective device, a paraboloid cover therefor having a weakened portion providing a plurality of equal but oppositely oriented segments, severable fastening means for joining said segments one to another, said severable fastening means including a U-shaped member in engagement with said segments and enclosing said weakened portion, explosive means enclosed by said U-shaped member and disposed in proximate relation with respect to said weakened portion for severing said fastening means at the weakened portion upon initiation of the explosive means a centrally disposed mounting post carried by said device and disposed within the cover, a pair of cylinders mounted on said mounting post in opposition with respect to each other, a mounting plate carried by one of each of said plurality of segments, a

5

piston rod carried by and cooperating with each of the plates, a piston on each rod and movably disposed within one of each of said cylinders, and an explosive charge disposed within each of the cylinders in engagement with the piston therein for exerting an equal but opposite removal force thereon and on each of said segments with respect to its equal but oppositely oriented segment upon initiation of said charge, said force being applied in sequential timed relationship to the removal of said fastening means whereby exertion of a resultant cover removal force on said protective device is avoided.

2. A nose cone separation mechanism, comprising in combination, a projectable body, a nose cone on said body and having a weakened portion along a plane extending through the longitudinal axis thereof and providing a pair of severable portions, a support on one end of said body and having a centrally disposed recess formed therein, an orbiting device disposed within said recess, a centrally disposed mounting post carried by said orbiting device, a pair of cylinders mounted on said mounting post in opposition with respect to each other, a pair of mounting plates carried by the nose cone and connected individually to one of each of said pair of portions, a piston rod carried by each of said plates, a piston on each of said piston rods and movably disposed within each of the cyl-

6

inders, an explosive charge in each of the cylinders in engagement with the piston therein, a powder charge confined along and in engagement with the weakened portion for severing the weakened portion upon initiation of the powder charge, means including a U-shaped member for confining and maintaining the powder charge in engagement with the weakened portion, means including a detonator embedded in the explosive charge in each of the cylinders for initiating the explosive charge in time delayed relation with respect to the initiation of the powder charge thereby to forcibly move said piston with sufficient force to eject the portions from the body, and signal responsive means for controlling the initiation of said charges.

References Cited in the file of this patent

UNITED STATES PATENTS

2,609,730	Bergstrom	Sept. 9, 1952
2,654,320	Schmid	Oct. 6, 1953

OTHER REFERENCES

"Convair Plans Four-Man Space Station" Aviation Week, April 28, 1958, pages 26-28. (Copy in Library.)