United States Patent

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[73] Assignee The United States of America as represented by the Secretary of the Army

[54] GYRO CONTROLLER
4 Claims, 5 Drawing Figs.

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[51] Int. Cl. F42b 15/18
[50] Field of Search 244/3.22

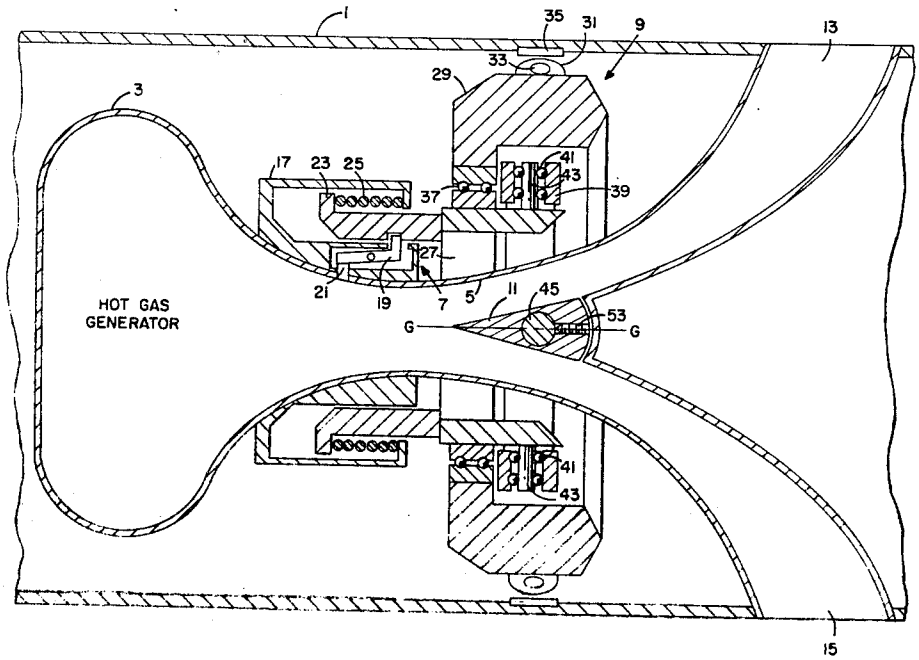
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ABSTRACT: A missile system having a gyroscope control mechanism for providing the balancing torque required to maintain a spinning missile on its predetermined flight course. The system includes a missile having a center of gravity, an axis, a throat for emitting hot gases into opposed exhaust ports. The control mechanism for the system includes a gyroscope having a spin axis disposed for coincidence with the missile axis. A ring in the gyroscope mounts a gimbal shaft that is disposed across the throat and in normal relation to the axis of the missile. A splitter vane is secured to the gimbal shaft in the throat to increase the flow of hot gases through one of the exhaust ports when a disturbing torque has caused the missile axis to be out of coincidence with the gyroscope axis. This increase flow of hot gases through one of the exhaust ports will provide a restoring torque to the missile and restore coincidence of the missile and gyroscope axes. The movement arm of the gases acting on the vane are balanced out or kept small by having it act on the center of gravity of the gyroscope control mechanism to thereby eliminate gyroscope precession.



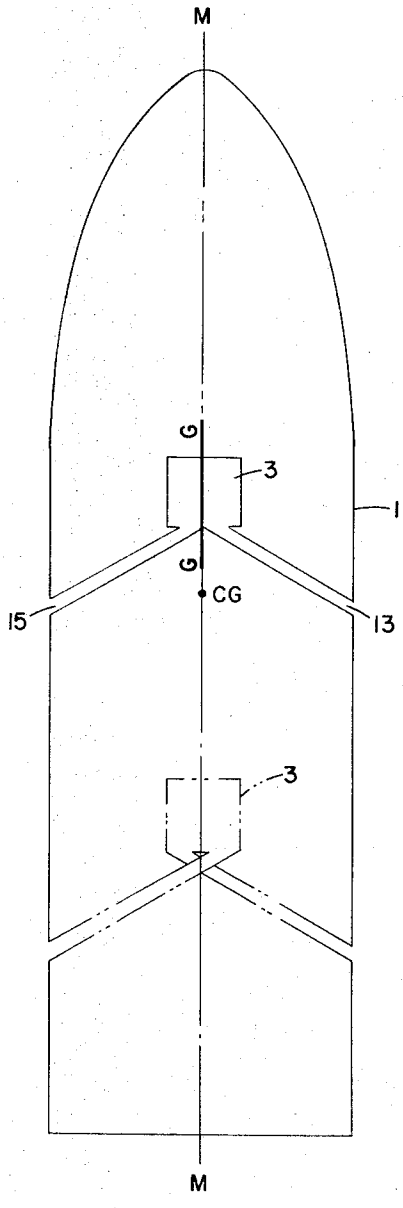


FIG. 1

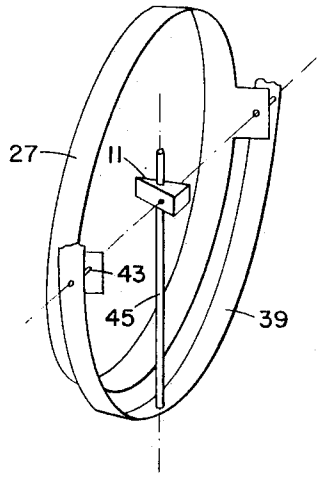


FIG. 5

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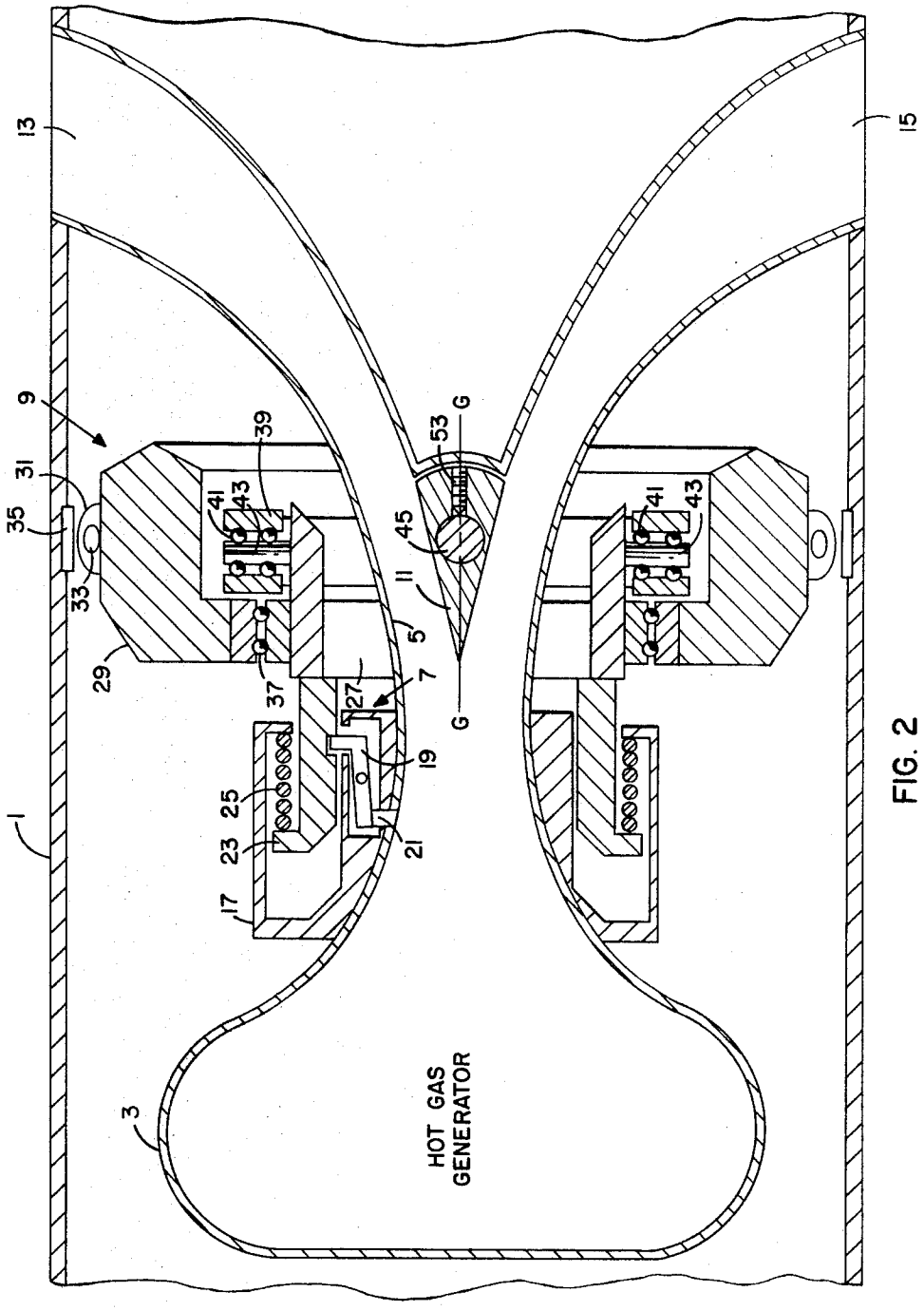


FIG. 2

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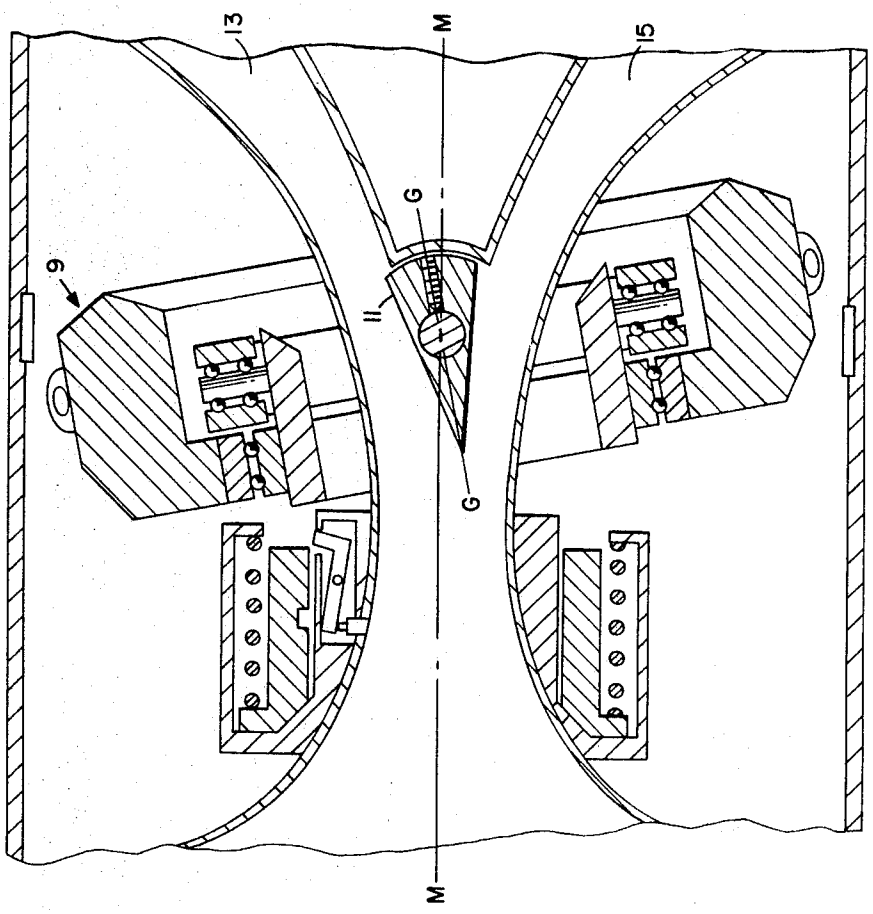


FIG. 3

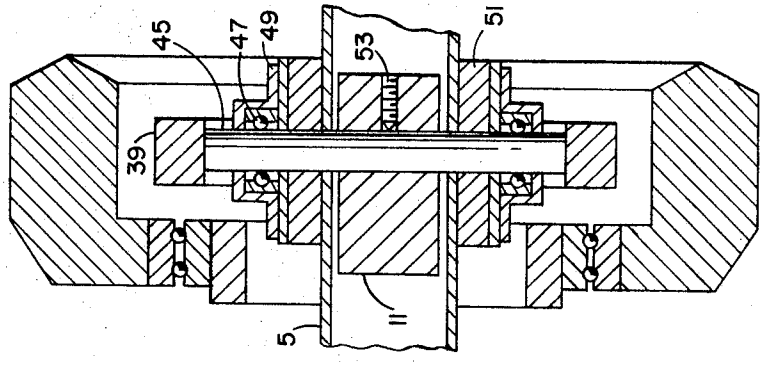


FIG. 4

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GYRO CONTROLLER

BACKGROUND OF THE INVENTION

This invention is related to the field of missiles and more particularly to a gyroscope control mechanism therefor. After launching, a missile is subjected to wind and other disturbing forces normal to its predetermined path causing the missile to pitch or yaw about its center of gravity and to deviate from the desired attitude. The present gyroscope control mechanisms in use have a problem in that the splitter vane in the hot gas throat operates with much longer moment arms that allow small forces to produce greater torques thereby causing the gyroscope to precess. Another problem is that the gyroscope is caged from a stationary pin to the spinning gyroscope rotor. This type of caging makes alignment difficult since it varies as the rotor face turns through 360°.

SUMMARY OF THE INVENTION

The present invention has utilized a single gyroscope to control the balancing torque required to maintain a spinning missile on its predetermined course. At the same time the splitter vane is designed so that the moment arm of any resulting hot gas forces are balanced out or kept small and having it act on the center of the gyroscope system thereby eliminating gyroscope precession. This invention also has provided a caging mechanism that operates from a nonrotating part to a nonrotating part and eliminates relative rotary motion between the caging surfaces and allows simple and accurate uncaging alignment.

This invention may be better understood from the following detailed description taken in conjunction with the accompanying drawings.

FIG. 1 is a diagrammatical view of the missile.

FIG. 2 shows a sectional view of the gyroscope in the caged position.

FIG. 3 shows a sectional view of the gyroscope in the uncaged position.

FIG. 4 shows a sectional view of the splitter vane connected to the gimbal shaft.

FIG. 5 is an isometric view shown partially in section.

PREFERRED EMBODIMENT OF THE INVENTION

As a missile 1 is launched on a predetermined spin path, gases from a hot gas generator 3 are directed toward a throat 5. As pressure builds up in the throat a caging means 7 operates to uncage a gyroscope 9 thereby allowing the gyroscope to maintain directional orientation coincidence with the missile axis. Assuming that no disturbing forces have exerted themselves upon the missile, the hot gases will be evenly divided by a splitter vane 11 and exit opposed exhaust ports 13 and 15. After launching disturbing forces on the missile cause it to move transaxially of the gyroscope axis and the splitter vane will direct more gas through one exhaust port than the other thus providing a restoring torque on the missile and gyroscope axis.

The missile is shown in FIG. 1 with a longitudinal axis M–M, a center of gravity CG and exhaust ports 13 and 15.

Caging means generally indicated by reference numeral 7 is cylindrical and encloses throat 5. A collar 17 of the caging means is secured to the throat and includes a pivoted latch 19 and a latch piston 21 projecting into the throat. A clamping means 23 is spring-biased by a spring 25 and held in this position until released by the latch. While held in this position clamping means 23 cages the gyroscope 9 by clamping against gimbal ring 27. Thus it can be seen that the gyroscope caging is accomplished by a nonrotating part engaging a nonrotating part thereby eliminating relative rotary motion between the caging surfaces. As the gas pressure builds up in the throat to a sufficient pressure it will cause the latch piston to pivot the latch and release the clamping means which moves away from the ring due to the action of spring 25.

The gyroscope includes a rotor 29 that is disposed in rotatable relation to ring 27 and spins about axis G–G. Rotor 29 has a channel 31 containing propellant 33 secured therein for ignition to provide hero turbine method rotation of the rotor responsive to firing of the missile. A fragile covering 35 on the missile skin in blown out and allows gases to escape to atmosphere as the rotor is spun up. The spinning rotor is maintained on a set of spin bearings 37 mounted on thread 5 and disposed to be integral with ring 27.

Gimbal 39 is secured by bearings 41 to posts 43 mounted on ring 27, more clearly shown in FIG. 5, to give second degree of gyro freedom. Gimbal 39 has a shaft 45 disposed across the throat and held in normal relation to the missile axis by bearing 47 and bearing retainers 49. Reference numeral 51 indicates thermal insulation to keep the gimbal bearing from overheating.

Shaft 45 is disposed normal to the missile axis and splitter vane 11 is secured thereto with the sides of the wedge-shaped vane forming continuations of ports 13 and 15 to receive the exhaust gases. The vane has a cylindrical base to house adjustable means such as setscrew 53 for securing the vane to the shaft and for adjusting the flow to be equal through ports 13 and 15 when caged. The shaft is disposed in proximity to the confluence of ports 13 and 15 to provide minimum lever arms to the gas forces impinging on the sides and to minimize precessing torques on the gyroscope. With the exhaust ports located above the missile center of gravity shown in FIG. 1, a disturbing torque A will cause the missile axis and gyroscope axis to be out of coincidence. Vane 11 with instantaneously cause a decrease in the flow of gas through port 13 and increase gas flow through port 15 thereby providing a torque to overcome torque A and restore coincidence of the missile and gyroscope axes. If the exhaust ports are located below the missile center of gravity they will have to be lined up so that the exhaust will exist in a reverse pattern as shown in phantom in FIG. 1.

During assembly the thin edge of the vane is pointed toward the hot gas generated and is adjusted on the shaft until equal amounts of test gas is expelled out each exhaust port.

I claim:

1. A missile system comprising:
   a. a missile with a center of gravity, an axis, a throat for emitting hot gases and exhaust ports disposed in opposed relation;
   b. a gyroscope having a spin axis and a gimbal shaft pivotably disposed in normal relation to the axis of said missile and forward of the center of gravity thereof for normal coincidence of said missile and gyro axes and for rotation of said missile axis from said gyro axis responsive to an external disturbing force applied to said missile; and
   c. a vane secured to said shaft to increase the flow of the hot gases through one of said ports to provide a restoring torque to said missile and restore coincidence of said missile and gyro axes.

2. A missile system as defined in claim 1 with said gyroscope comprising a ring secured to said gimbal shaft and disposed around said throat; a collar secured to said throat and a cylindrical caging means enclosing said throat, said collar including a latch pivoted to retain a clamping means against said ring for caging relation of said ring to substantially normal relation to said missile axis, said clamping means being spring-biased away from said ring and said throat for rotation of said latch responsive to build up of pressure of the hot gases and release of said caging means.

3. A missile system as defined in claim 2 with said vane comprising a wedge with angled sides forming a tip and a cylindrical base end disposed for substantially equal counter balance of opposing forces on said tip and base.

4. A missile system as defined in claim 3 with a rotor disposed in rotatable relation with said ring and a channel formed around said rotor and propellant secured in said channel and disposed for ignition to provide hero turbine method rotation of said rotor responsive to firing of said missile.