Sept. 2, 1958 S. E. SMATHERS 2,849,955

ROCKET CONSTRUCTION

Filed June 30, 1955

FIG. 1

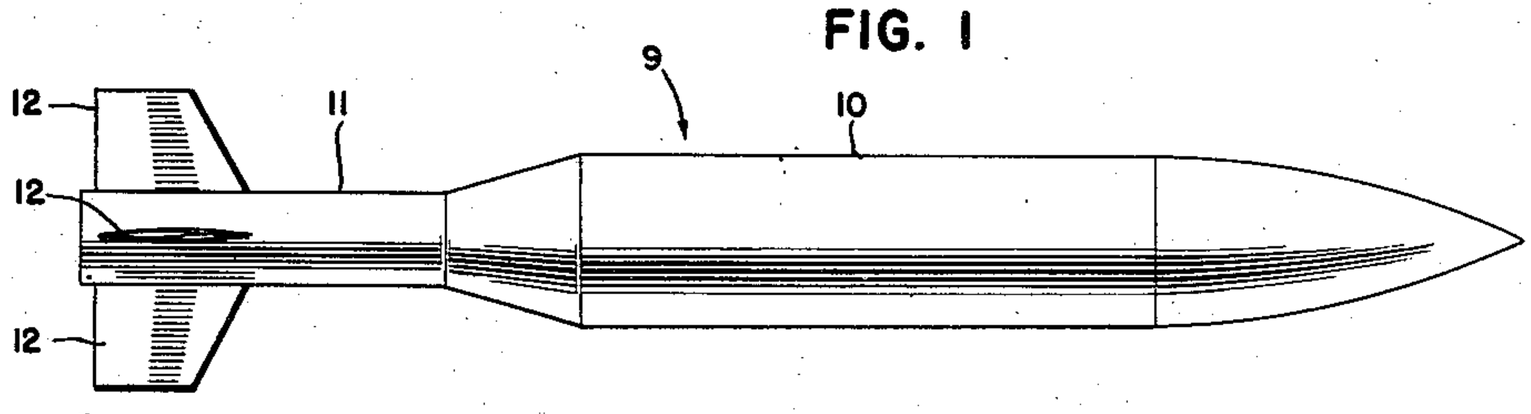


FIG. 2

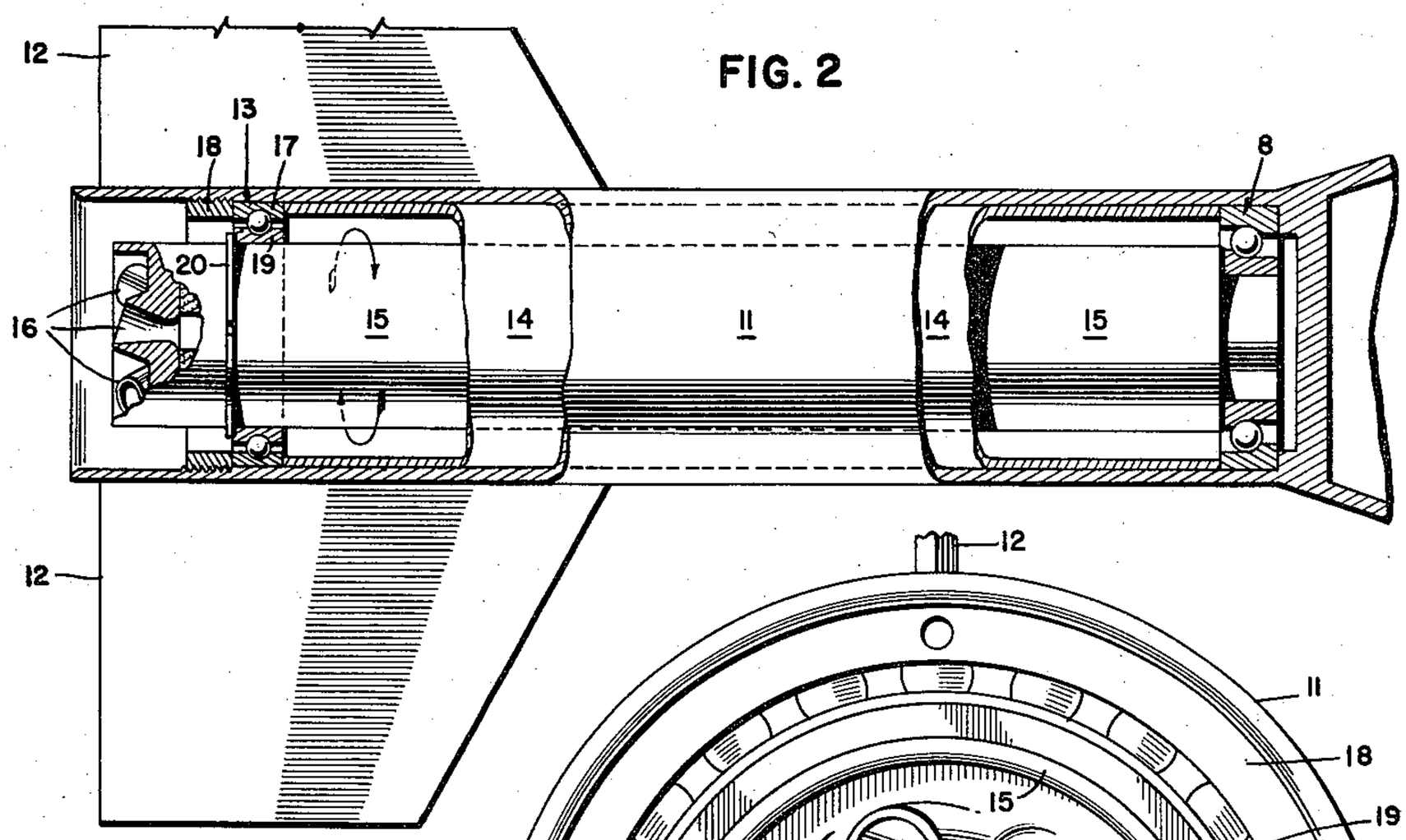
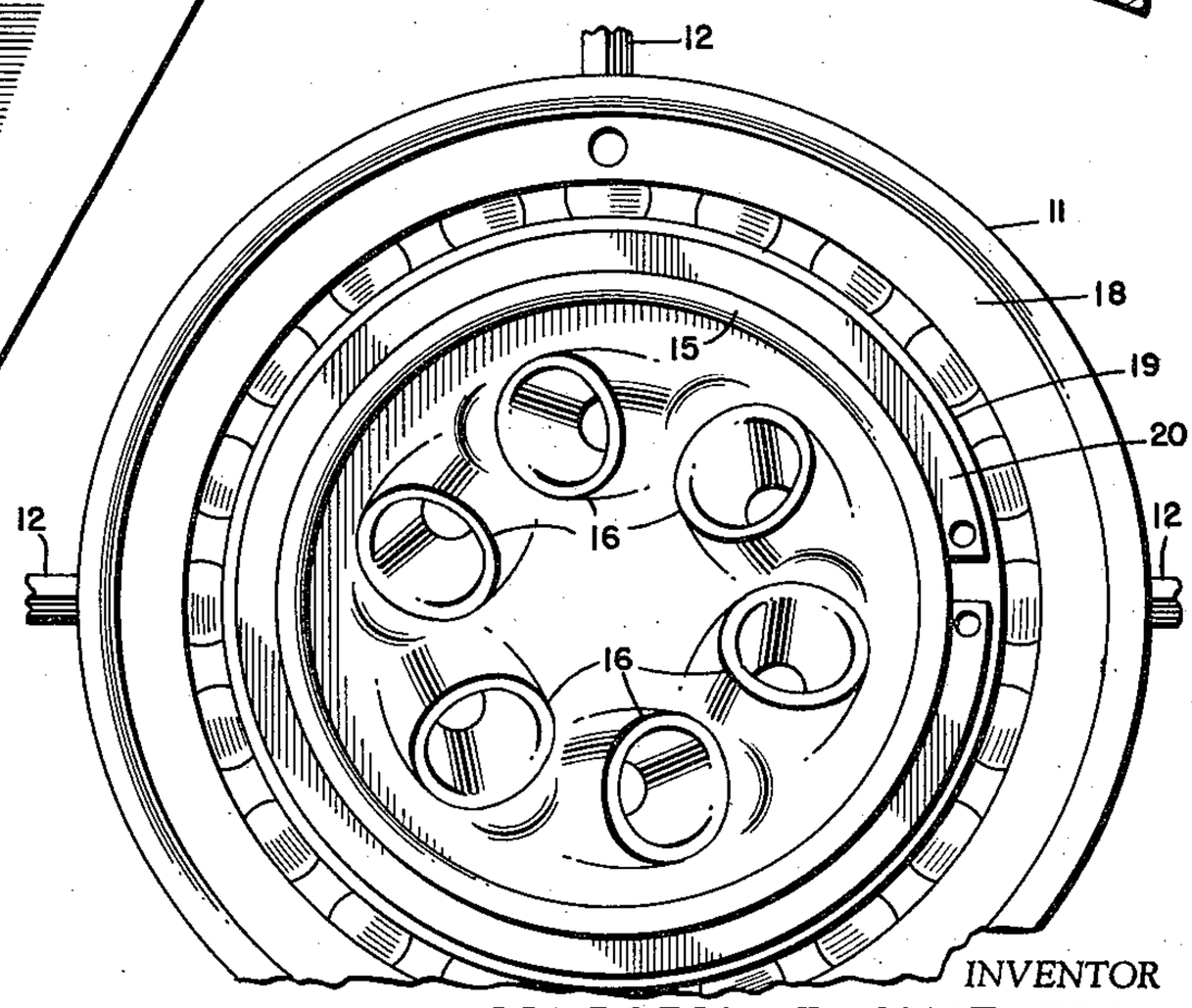


FIG. 3



INVENTOR
SPURGEON E. SMATHERS

BY G. H. O'Brien
R. Baxter Warner
ATTORNEYS

United States Patent Office

2,849,955

Patented Sept. 2, 1958

2,849,955

ROCKET CONSTRUCTION

Spurgeon E. Smathers, Hillcrest Heights, Md.

Application June 30, 1955, Serial No. 519,293

3 Claims. (Cl. 102—50)

(Granted under Title 35, U. S. Code (1952), sec. 266)

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 of any royalties thereon or therefor.

The present invention relates to improvements in rocket projectiles or reaction propelled missiles and more particularly to an arrangement for mounting the power unit of the projectile or missile such that the projectile is properly stabilized with a minimum amount of adverse forces which tend to deflect the missile from its intended trajectory.

It is of course one of the basic principles of rocketry that certain means must be provided to stabilize the rocket such that its path of flight will correspond as close as possible to the intended line of trajectory. Various means of stabilization have been used in the past, the most common method of which is that of rotating the entire rocket through means of canted nozzles or vents. It has been found, however, that these methods have certain outstanding disadvantages. In the manufacture of rockets it has been noted that it is extremely difficult to produce parts which when assembled comprise a projectile whose center of gravity lies in the line of symmetry or the longitudinal center line of the projectile. When the center of gravity of the projectile is not located along the line then the projectile is not perfectly balanced and this unbalanced condition or malalignment will cause the projectile to deviate from the normal intended trajectory.

Experimentation has shown that the variations in range and lateral deflection of the rocket caused by such malalignments can be minimized by rotation of the rocket in flight and prior art devices consequently took advantage of this principle by rotating the entire projectile. It is known that the result of the effect of malalignments decreases as the rate of spin of the projectile is increased and accordingly a smaller variation in range and lateral deflection is present. However, when increasing the spin of the rocket to overcome the effect of malalignments a new problem is created, that of large magnus forces which are the building up of air pressure on one side of the projectile due to the high rate of spin and the slightly unbalanced condition of the projectile. The creation of such large magnus forces is in and of itself a very serious objection to such rocket operation. In attempting to spin the rocket at a rather low rate not only is the effect of malalignments more apparent in the rocket behavior but the relatively low spin rate invites additional problems such as that of resonant instability.

The present invention provides a projectile or rocket structure which obtains the advantages offered by the gyroscopic stability produced by high rate of spin and yet which structure does not present the additional problems of magnus forces or resonant instability. In the invention the rocket or projectile power unit or motor with the attached nozzles is rotatably mounted within the rocket body. In this manner the motor and nozzle

assembly may be rotated at a high spin rate providing excellent stabilization to the rocket. Since the unit is mounted within the rocket body it does not make contact with the outside air and therefore there is less resistance to its spin and consequently a faster spin rate per nozzle thrust. Additionally, since the motor and nozzles are not subjected to the outside air the high spin rate does not create large magnus forces which would deflect the rocket from the desired trajectory. Also in view of the fact that the motor is allowed to spin at an extremely high rate the problem of resonant instability is eliminated.

Accordingly, it is an object of the present invention to provide a rocket or missle assembly which has improved stabilization action.

It is a further object of the present invention to effectively stabilize a rocket without accompanying undesirable large magnus forces and resonant instability factors.

Another object is to obtain internal gyroscopic stabilization action within the rocket body and external stabilization of the rocket body, both stabilization features being provided without the creation of large magnus forces or resonant instability.

A further object of the present invention is that of providing a rocket assembly which has an internal component adapted to rotate at a high spin rate to provide internal gyroscopic action for stabilization of the assembly, said stabilization being established without subjecting the rotating component to the atmosphere through which the projectile travels.

An additional purpose of the present invention is that of providing for rotation of a rocket motor within the rocket body at a high rate of spin, the motor being so mounted that substantially no rotational movement is imparted to the rocket body.

It is also the purpose of the present invention to obtain a greater spin rate from rocket thrust simultaneously eliminating or minimizing the effect of magnus forces such that the result due to malalignment will be constant from projectile to projectile over the entire trajectory.

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 plan view of a self-propelled missile or projectile employing a preferred embodiment of the present invention;

Fig. 2 is an enlarged view of the rear end of the missile of Fig. 1 with portions thereof broken away; and

Fig. 3 is an enlarged end view of the rear section taken in a direction from the left of Fig. 2.

In the embodiment illustrated a reaction propelled missile generally designated by the numeral **9**, is shown in Fig. 1 comprising a head portion **10** connected to a centrally apertured after body extension **11** supporting stabilizing vanes **12**. Mounted within the body extension **11** are forward radial thrust bearing **8** and aft radial bearing **13** which are maintained in longitudinal spaced relationship by spacing sleeve **14**. A propulsion or motor unit **15** having a plurality of rearwardly directed canted nozzles **16** is disposed within the body extension **11** in coaxial relationship thereto, the forward part of the motor **15** being seated against the forward radial thrust bearing **8** and the rear portion being held in spaced relationship from the body by the aft radial bearing **13**. The outer race **17** of the aft bearing **13** and the spacing sleeve **14** are secured within the body extension **11** by the threaded retaining ring **18**, the inner race **19** being secured in place by expansion ring **20**.

It will thus be seen that when the missile is launched

the canted nozzles **16** will provide the desired spin rate to the motor **15** causing an internal gyroscopic action for stabilizing the missile. Since the rotating portion of the rocket, that is, the motor **15** and nozzles **16** are housed entirely within the confines of the body extension **11**, the rotational movement is free from frictional resistance of the outside atmosphere and air stream. Thus, a high rate of spin per thrust is obtained for stabilization purposes without the adverse effect of large magnus forces.

During the high rate of spin of the motor and the nozzles a small amount of rotation may be transferred to the missile body through the slight frictional factors in the bearing members. However, this rotation of the rocket body is very slight and generally is not found to be objectionable. However, if it is desired to substantially eliminate any rotation of the rocket body and head then the vane members **12** may be slightly inclined relative to the longitudinal center line of the rocket member as shown in Figs. 1 and 3. Thereby any rotational movement generated through the bearing members is counteracted or offset.

Thus, the inventive missile provides a projectile which has less dispersion by virtue of a consistent variation in moment arm round for round. In addition this inventive device is more suitable for launching from tube or rail launchers, since there are no outer rotating parts and a smooth bore or rail can be employed.

While in the present application the invention has been disclosed in a form adaptable for rocket projectiles or reaction propelled missiles it is to be understood that the invention is not limited to the specific field of rocketry but may be utilized in other devices or bodies which are of the self-propelling type for free flight and which require the necessary characteristic of self-stabilization for maintaining a true course along a predetermined trajectory.

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 reaction propelled missile comprising a head portion and an after body portion, stabilizing vanes radiating from said body portion, said body portion having an open-ended motor receiving chamber centrally located therein, an internal rotatable stabilizing motor unit supported within said body and rotatable therein and with respect thereto as the missile travels along its trajectory, means disposed within said unit for generating gaseous products of combustion as the generating means is activated, said unit being disposed within the motor chamber in spaced relation with respect to the wall defining said body portion and completely enclosing said generating means, means including a plurality of angularly spaced canted exhaust nozzles forming a part of said motor unit and mounted on one end of said motor unit and within said chamber in spaced relation with respect to the terminal end of said body portion and rotates as the generating means is activated and the gaseous products of combustion pass therethrough and impinge on said canted nozzles for rotating said motor unit, said unit and nozzles being completely confined within the body portion, a first radial thrust bearing positioned at the forward end of the body portion and operatively connected to said motor unit and a second radial thrust bearing positioned at the rearward end of the body portion and operatively connected to the motor unit for rotatably supporting and maintaining the unit in said spaced relation with respect to the body portion.

2. A reaction propelled missile comprising a casing having one end thereof open and an elongated chamber formed therein, an internal rotatable stabilizing housing

disposed within said chamber and in spaced relation with respect to said casing and rotatably supported therein for providing an internal gyroscopic action to stabilize the missile as said housing is rotated within and with respect to said casing, gas generating means disposed within and completely enclosed by said housing for generating gaseous products of combustion as the generating means is activated, means including a plurality of angularly spaced canted exhaust nozzles forming a part of said housing and mounted on one end of said housing and rotated as the generating means is activated and said gaseous products of combustion pass through and impinge on said nozzles for rotating said housing, said housing and nozzles being completely confined within the casing, a first radial thrust bearing disposed within the forward portion of said casing in engagement therewith and with one end of said housing, a second radial thrust bearing disposed within the aft portion of the casing in engagement with the aft portion of said housing and casing, said first and second bearings cooperating to support the housing for rotary movement within the casing and for maintaining the housing in said spaced relation with respect to the casing, and a plurality of external stabilizing vanes on said casing inclined relative to the longitudinal center line thereof in a direction oppositely to the direction of inclination of said canted exhaust nozzles for preventing rotation of the casing which would otherwise be produced in response to the action of frictional forces developed within the bearings during rotation of the housing.

3. A reaction propelled missile comprising an exterior casing having one end thereof open and an elongated chamber formed therein, an internal rotatable stabilizing housing disposed within said chamber and in spaced relation with respect to said casing and rotatably supported therein for providing an internal gyroscopic action to stabilize the missile as said housing is rotated within and with respect to said casing, gas generating means disposed within and completely enclosed by said housing for generating gaseous products of combustion as the generating means is activated, means including a plurality of angularly spaced canted exhaust nozzles forming a part of said housing and mounted on one end of said housing and rotated as the generating means is activated and said gaseous products of combustion pass through and impinge on said nozzles for rotating said housing with respect to said casing whereupon spinning the thrust vector with respect to the exterior casing minimizes the deflection of the missile as it travels along its trajectory thereby increasing the chances of pinpointing a target, said housing and nozzles being completely confined within said casing, a first radial thrust bearing disposed within the forward portion of said casing in engagement therewith and with one end of said housing, a second radial thrust bearing disposed within the aft portion of the casing in engagement with the aft portion of said housing and casing, said first and second bearings cooperating to support the housing for rotary movement within the casing and for maintaining the housing in said spaced relation with respect to the casing, a plurality of external stabilizing vanes on said casing inclined relative to the longitudinal center line thereof in a direction oppositely to the direction of inclination of said canted exhaust nozzles for preventing rotation of the casing which would otherwise be produced in response to the action of frictional forces developed within the bearings during rotation of the housing, a spacer sleeve disposed within said casing in engagement therewith and having one end in engagement with said first named bearing and the other end thereof in engagement with said second named bearing for maintaining the bearings in predetermined spaced relation with respect to each other, and a retaining nut threaded into said casing in engagement with said second named bearing for lock-

ing the bearings and sleeve within the casing and retaining the bearings in said predetermined spaced relation.

References Cited in the file of this patent

UNITED STATES PATENTS

1,307,607	Wilkins	June 24, 1919
2,145,508	Denoix	Jan. 31, 1939
2,398,928	Farr	Apr. 23, 1946
2,661,692	Vegren	Dec. 8, 1953
2,691,495	Chiroky	Oct. 12, 1954

FOREIGN PATENTS

522,506	France	Apr. 1, 1921
375,260	Italy	Sept. 29, 1939